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ENCYCLOPÆDIA BRITANNICA.

[Strength of Materials.]

STRENGTH OF MATERIALS, in mechanics, is a ſubject of ſo much importance, that in a nation ſo eminent as this for invention and ingenuity in all ſpecies of manufactures, and in particular ſo diſtinguiſhed for its improvements in machinery of every kind, it is ſomewhat ſingular that no writer has treated it in the detail which its importance and difficulty demands. The man of ſcience who viſits our great manufactures is delighted with the ingenuity which he obſerves in every part, the innumerable inventions which come even from individual artiſans, and the determined purpoſe of improvement and refinement which he ſees in every workſhop. Every cotton mill appears an academy of mechanical ſcience; and mechanical invention is ſpreading from theſe fountains over the whole kingdom: But the philoſopher is mortified to ſee this ardent ſpirit ſo cramped by ignorance of principle, and many of theſe original and brilliant thoughts obſcured and clogged with needleſs and even hurtful additions, and a complication of machinery which checks improvement even by its appearance of ingenuity. There is nothing in which this want of ſcientific education, this ignorance of principle, is ſo frequently obſerved as in the injudicious proportion of the parts of machines and other mechanical ſtructures; proportions and forms of parts in which the ſtrength and poſition are nowiſe regulated by the ſtrains to which they are expoſed, and where repeated failures have been the only leſſons.

1 [Importance of the ſubject.]

It cannot be otherwiſe. We have no means of inſtruction, except two very ſhort and abſtracted treatiſes of the late Mr Emerſon on the ſtrength of materials. We do not recollect a performance in our language from which our artiſts can get information. Treatiſes written expreſsly on different branches of mechanical arts are totally ſilent on this, which is the baſis and *only principle* of their performances. Who would imagine that PRICE's BRITISH CARPENTER, the work of the firſt reputation in this country, and of which the ſole aim is to teach the carpenter to erect ſolid and durable ſtructures, does not contain one propoſition or one reaſon by which one form of a thing can be ſhown to be ſtronger or weaker than another? We doubt very much if one carpenter in an hundred can give a reaſon to convince his own mind that a joiſt is ſtronger when laid on its edge than when laid on its broad ſide. We ſpeak in this ſtrong manner in hopes of exciting ſome man of ſcience to publiſh a ſyſtem of inſtruction on this ſubject. The limits of our Work will not admit of a detail: but we think it neceſſary to point out the leading principles, and to give the traces of that ſyſtematic connection by which all the knowledge already poſſeſſed of this ſubject may be brought together and properly arranged. This we ſhall now attempt in as brief a manner as we are able.

2 [Strength of materials ariſes from coheſion.]

THE ſtrength of materials ariſes immediately or ultimately from the coheſion of the parts of bodies. Our examination of this property of tangible matter has as yet been very partial and imperfect, and by no means enables us to apply mathematical calculations with preciſion and ſucceſs. The various modifications of coheſion, in its different appearances of perfect ſoftneſs, plaſticity, ductility, elaſticity, hardneſs, have a mighty influence on the ſtrength of bodies, but are hardly ſuſceptible of meaſurement. Their texture alſo, whether uniform like glaſs and ductile metals, cryſtallized or granulated like other metals and freeſtone, or fibrous like timber, is a circumſtance no leſs important; yet even here, although we derive ſome advantage from remarking to which of theſe forms of aggregation a ſubſtance belongs, the aid is but ſmall. All we can do in this want of general principles is to make experiments on every claſs of bodies. Accordingly philoſophers have endeavoured to inſtruct the public in this particular. The Royal Society of London at its very firſt inſtitution made many experiments at their meetings, as may be ſeen in the firſt regiſters of the Society †. Several individuals have added their experiments. The moſt numerous collection in detail is by Muſchenbroek, profeſſor of natural philoſophy at Leyden. Part of it was publiſhed by himſelf in his *Eſſais de Phyſique*, in 2 vols 4to; but the full collection is to be found in his Syſtem of Natural Philoſophy, publiſhed after his death by Lulofs, in 3 vols 4to. This was tranſlated from the Low Dutch into French by Sigaud de la Fond, and publiſhed at Paris in 1760, and is a prodigious collection of phyſical knowledge of all kinds, and may almoſt ſuffice for a library of natural philoſophy. But this collection of experiments on the coheſion of bodies is not of that value which one expects. We preſume that they were carefully made and faithfully narrated; but they were made on ſuch ſmall ſpecimens that the unavoidable natural inequalities of growth or texture produced irregularities in the reſults which bore too great a proportion to the whole quantities obſerved. We may make the ſame remark on the experiments of Couplet, Pitot, De la Hire, Du Hamel, and others of the French academy. In ſhort, if we except the experiments of Buffon on the ſtrength of timber, made at the public expence on a large ſcale, there is nothing to be met with from which we can obtain abſolute meaſures which may be employed with confidence; and there is nothing in the Engliſh language except a ſimple liſt by Emerſon, which is merely a ſet of affirmations, without any narration of circumſtances, to enable us to judge of the validity of his concluſions: but the character of Mr Emerſon, as a man of knowledge and of integrity, gives even to theſe aſſertions a conſiderable value.

3 [Experiments to aſcertain it]

† See Birche's *Hiſtory*, and Hooke's *Mathematical Collections*.

4 [Rendered uſeful by generalization.]

But to make uſe of any experiments, there muſt be employed ſome general principle by which we can generalize their reſults. They will otherwiſe be only narrations of detached facts. We muſt have ſome notion of that intermedium, by the intervention of which an external force applied to one part of a lever, joiſt, or pillar, occaſions a ſtrain on a diſtant part. This can be nothing but the coheſion between the parts.

parts. It is this connecting force which is brought into action, or, as we more ſhortly expreſs it, excited. This action is modified in every part by the laws of mechanics. It is this action which is what we call the *ſtrength* of that part, and its effect is the ſtrain on the adjoining parts; and thus it is the ſame force, differently viewed, that conſtitutes both the ſtrain and the ſtrength. When we conſider it in the light of a reſiſtance to fracture, we call it *ſtrength*.

5
Strength defined.

We call every thing a *force* which we obſerve to be ever accompanied by a change of motion; or, more ſtrictly ſpeaking, we infer the preſence and agency of a force wherever we obſerve the ſtate of things in reſpect of motion different from what we know to be the reſult of the action of all the forces which we know to act on the body. Thus when we obſerve a rope prevent a body from falling, we infer a moving force inherent in the rope with as much confidence as when we obſerve it drag the body along the ground. The *immediate* action of this force is undoubtedly exerted between the immediately adjoining parts of the rope. The immediate effect is the keeping the particles of the rope together. They ought to ſeparate by any external force drawing the ends of the rope contrarywiſe; and we aſcribe their not doing ſo to a mechanical force really oppoſing this external force. When deſired to give it a name, we name it from what we conceive to be its effect, and therefore its characteriſtic, and we call it COHESION. This is merely a name for the fact; but it is the ſame thing in all our denominations. We know nothing of the cauſes but in the effects; and our name for the cauſe is in fact the name of the effect, which is COHESION. We mean nothing elſe by gravitation or magnetiſm. What do we mean when we ſay that Newton underſtood thoroughly the nature of gravitation, of the force of gravitation; or that Franklin underſtood the nature of the electric force? Nothing but this: Newton conſidered with patient ſagacity the general facts of gravitation, and has deſcribed and claſſed them with the utmoſt preciſion. In like manner, we ſhall underſtand the nature of coheſion when we have diſcovered with equal generality the laws of coheſion, or general facts which are obſerved in the appearances, and when we have deſcribed and claſſed them with equal accuracy.

6
Cauſes known only from their effects.

Let us therefore attend to the more ſimple and obvious phenomena of coheſion, and mark with care every circumſtance of reſemblance by which they may be claſſed. Let us receive theſe as the laws of coheſion, characteriſtic of its ſuppoſed cauſe, the force of coheſion. We cannot pretend to enter on this vaſt reſearch. The modifications are innumerable; and it would require the penetration of more than Newton to detect the circumſtance of ſimilarity amidſt millions of diſcriminating circumſtances. Yet this is the only way of diſcovering which are the primary facts characteriſtic of the force, and which are the modifications. The ſtudy is immenſe, but is by no means deſperate; and we entertain great hopes that it will ere long be ſucceſsfully proſecuted: but, in our particular predicament, we muſt content ourſelves with ſelecting ſuch general laws as ſeem to give us the moſt immediate information of the circumſtances that muſt be attended to by the mechanician in his conſtructions, that he may unite ſtrength with ſimplicity, economy, and energy.

7
All bodies elaſtic.

1ſt, Then, it is a matter of fact that all bodies are in a certain degree perfectly elaſtic; that is, when their form or bulk is changed by certain moderate compreſſions or diſtractions, it requires the continuance of the changing force to continue the body in this new ſtate; and when the force is removed, the body recovers its original form. We limit the aſſertion to *certain moderate* changes: For inſtance, take a lead wire of $\frac{1}{12}$th of an inch in diameter and ten feet long; fix one end firmly to the ceiling, and let the wire hang perpendicular; affix to the lower end an index like the hand of a watch; on ſome ſtand immediately below let there be a circle divided into degrees, with its centre correſponding to the lower point of the wire: now turn this index twice round, and thus twiſt the wire. When the index is let go, it will turn backwards again, by the wire's untwiſting itſelf, and make almoſt four revolutions before it ſtops; after which it twiſts and untwiſts many times, the index going backwards and forwards round the circle, diminiſhing however its arch of twiſt each time, till at laſt it ſettles preciſely in its original poſition. This may be repeated for ever. Now, in this motion, every part of the wire partakes equally of the twiſt. The particles are ſtretched, require force to keep them in their ſtate of extenſion, and recover completely their original relative poſitions. Theſe are all the characters of what the mechanician calls *perfect* elaſticity. This is a quality quite familiar in many caſes; as in glaſs, tempered ſteel, &c. but was thought incompetent to lead, which is generally conſidered as having little or no elaſticity. But we make the aſſertion in the moſt general terms, with the limitation to moderate derangement of form. We have made the ſame experiment on a thread of pipe-clay, made by forcing ſoft clay through the ſmall hole of a ſyringe by means of a ſcrew; and we found it more elaſtic than the lead wire: for a thread of $\frac{1}{10}$th of an inch diameter and 7 feet long allowed the index to make two turns, and yet completely recovered its firſt poſition.

2dly, But if we turn the index of the lead wire four times round, and let it go again, it untwiſts again in the ſame manner, but it makes little more than four turns back again; and after many oſcillations it finally ſtops in a poſition almoſt two revolutions removed from its original poſition. It has now acquired a new arrangement of parts, and this new arrangement is permanent like the former; and, what is of particular moment, it is perfectly elaſtic. This change is familiarly known by the denomination of a SET. The wire is ſaid to have TAKEN A SET. When we attend minutely to the procedure of nature in this phenomenon, we find that the particles have as it were ſlid on each other, ſtill cohering, and have taken a new poſition, in which their connecting forces are in equilibrio: and in this change of relative ſituation, it appears that the connecting forces which maintained the particles in their firſt ſituations were not in equilibrio in ſome poſition intermediate between that of the firſt and that of the laſt form. The force required for changing this firſt form augmented with the change, but only to a certain degree; and during this proceſs the connecting forces always tended to the recovery of this firſt form. But after the change of mutual poſition has paſſed a certain magnitude, the union has been partly deſtroyed, and the particles have been brought into new ſituations; ſuch, that the forces which now connect each with its neighbour tend, not to the recovery of the firſt arrangement, but to puſh them farther from it, into a new ſituation, to which they now verge, and require force to prevent them from acquiring. The wire is now in fact again perfectly elaſtic; that is, the forces which now connect the particles with their new neighbours augment to a certain degree as the derangement from this new poſition augments. This is not reaſoning from any theory. It is narrating facts, on which a theory is to be founded. What we have been juſt now ſaying is evidently a deſcription of that ſenſible form of tangible matter which we call *ductility*. It has every gradation of variety, from the ſoftneſs of butter to the firmneſs of gold. All theſe bodies have ſome elaſticity; but we ſay they are not perfectly elaſtic, becauſe they do not completely recover their original form when it has been

8
What is meant by a *ſet*.

9
Ductility

Strength of Materials.

greatly deranged. The whole gradation may be moſt diſtinctly obſerved in a piece of glaſs or hard ſealing wax. In the ordinary form glaſs is perhaps the moſt completely elaſtic body that we know, and may be bent till juſt ready to ſnap, and yet completely recovers its firſt form, and takes no ſet whatever; but when heated to ſuch a degree as juſt to be viſible in the dark, it loſes its brittleneſs, and becomes ſo tough that it cannot be broken by any blow; but it is no longer elaſtic, takes any ſet, and keeps it. When more heated, it becomes as plaſtic as clay; but in this ſtate is re-

10 Viſcidity

markably diſtinguiſhed from clay by a quality which we may call VISCIDITY, which is ſomething like elaſticity, of which clay and other bodies purely plaſtic exhibit no appearance. This is the joint operation of ſtrong adheſion and ſoftneſs. When a rod of perfectly ſoft glaſs is ſuddenly ſtretched a little, it does not at once take the ſhape which it acquires after ſome little time. It is owing to this, that in taking the impreſſion of a ſeal, if we take off the ſeal while the wax is yet very hot, the ſharpneſs of the impreſſion is deſtroyed immediately. Each part drawing its neighbour, and each part yielding, the prominent parts are pulled down and blunted, and the ſharp hollows are pulled upwards and alſo blunted. The ſeal muſt be kept on till all has become not only ſtiff but hard.

11 Obſerved in all homogeneous plaſtic bodies.

This viſcidity is to be obſerved in all plaſtic bodies which are homogeneous. It is not obſerved in clay, becauſe it is not homogeneous, but conſiſts of hard particles of the argillaceous earth ſticking together by their attraction for water. Something like it might be made of finely powdered glaſs and a clammy fluid ſuch as turpentine. Viſcidity has all degrees of ſoftneſs till it degenerates to ropy fluidity like that of olive oil. Perhaps ſomething of it may be found even in the moſt perfect fluid that we are acquainted with, as we obſerved in the experiments for aſcertaining ſpecific gravity.

There is in a late volume of the Philoſophical Tranſactions a narration of experiments, by which it appears that the thread of the ſpider is an exception to our firſt general law, and that it is perfectly ductile. It is there aſſerted, that a long thread of goſſamer, furniſhed with an index, takes any poſition whatever; and that though the index be turned round any number of times (even many hundreds), it has no tendency to recover its firſt form. The thread takes completely any ſet whatever. We have not had an opportunity of repeating this experiment, but we have diſtinctly obſerved a phenomenon totally inconſiſtent with it. If a fibre of goſſamer about an inch long be held by the end horizontally, it bends downward in a curve like a ſlender ſlip of whalebone or a hair. If totally devoid of elaſticity, and perfectly indifferent to any ſet, it would hang down perpendicularly without any curvature.

When ductility and elaſticity are combined in different proportions, an immenſe variety of ſenſible modes of aggregation may be produced. Some degree of both are probably to be obſerved in all bodies of complex conſtitution; that is, which conſiſt of particles made up of many different kinds of atoms. Such a conſtitution of a body muſt afford many ſituations permanent, but eaſily deranged.

In all theſe changes of diſpoſition which take place among the particles of a ductile body, the particles are at ſuch diſtance that they ſtill cohere. The body may be ſtretched a little; and on removing the extending force, the body ſhrinks into its firſt form. It alſo reſiſts moderate compreſſions; and when the compreſſing force is removed, the body ſwells out again. Now the corpuſcular *fact* here is, that the particles are acted on by attractions and repulſions, which balance each other when no external force is acting on the body, and which augment as the particles are made, by any external cauſe, to recede from this ſituation of mutual inactivity; for ſince force is requiſite to produce either the dilatation or the compreſſion, and to maintain it, we are obliged, by the conſtitution of our minds, to infer that it is oppoſed by a force accompanying or inherent in every particle of dilatable or compreſſible matter: and as this neceſſity of employing force to produce a change indicates the agency of theſe corpuſcular forces, and marks their kind, according as the tendencies of the particles appear to be toward each other in dilatation, or from each other in compreſſion; ſo it alſo meaſures the degrees of their intenſity. Should it require three times the force to produce a double compreſſion, we muſt reckon the mutual repulſions triple when the compreſſion is doubled; and ſo in other inſtances.

Strength of Materials.

12 Particles acted on by attractions and repulſions.

We ſee from all this that the phenomena of coheſion indicate ſome relation between the intenſity of the force of coheſion and the diſtance between the centres of the particles. To diſcover this relation is the great problem in corpuſcular mechaniſm, as it was in the Newtonian inveſtigation of the force of gravitation. Could we diſcover this law of action between the corpuſcles with the ſame certainty and diſtinctneſs, we might with equal confidence ſay what will be the reſult of any poſition which we give to the particles of bodies; but this is beyond our hopes. The law of gravitation is ſo ſimple that the diſcovery or detection of it amid the variety of celeſtial phenomena required but one ſtep; and in its own nature its poſſible combinations ſtill do not greatly exceed the powers of human reſearch. One is almoſt diſpoſed to ſay that the Supreme Being has exhibited it to our reaſoning powers as ſufficient to employ with ſucceſs our utmoſt efforts, but not ſo abſtruſe as to diſcourage us from the noble attempt. It ſeems to be otherwiſe with reſpect to coheſion. Mathematics informs us, that if it deviates ſenſibly from the law of gravitation, the ſimpleſt combinations will make the joint action of ſeveral particles an almoſt impenetrable myſtery. We muſt therefore content ourſelves, for a long while to come, with a careful obſervation of the ſimpleſt caſes that we can propoſe, and with the diſcovery of ſecondary laws of action, in which many particles combine their influence. In puſuance of this plan, we obſerve,

13 The great problem in corpuſcular mechaniſm.

14 Particles kept in their places by a balance of forces.

3*dly*, That whatever is the ſituation of the particles of a body with reſpect to each other, when in a quieſcent ſtate, they are kept in theſe ſituations by the balance of oppoſite forces. This cannot be refuſed, nor can we form to ourſelves any other notion of the ſtate of the particles of a body. Whether we ſuppoſe the ultimate particles to be of certain magnitudes and ſhapes, touching each other in ſingle points of coheſion; or whether we (with Boſcovich) conſider them as at a diſtance from each other, and acting on each other by attractions and repulſions—we muſt acknowledge, in the firſt place, that the centres of the particles (by whoſe mutual diſtances we muſt eſtimate the diſtance of the particles) may and do vary their diſtances from each other. What elſe can we ſay when we obſerve a body increaſe in length, in breadth, and in thickneſs, by heating it, or when we ſee it diminiſh in all theſe dimenſions by an external compreſſion? A particle, therefore, ſituated in the midſt of many others, and remaining in that ſituation, muſt be conceived as maintained in it by the mutual balancing of all the forces which connect it with its neighbours. It is like a ball kept in its place by the oppoſite action of two ſprings. This illuſtration merits a more particular application. Suppoſe a number of balls ranged on the table in the angles of equilateral triangles, and that each ball is connected with the ſix which lie around it by means of an elaſtic wire curled like a cork-ſcrew; ſuppoſe ſuch another ſtratum of balls above this, and parallel to it, and ſo placed that

15 Illuſtration of this propoſition

each ball of the upper stratum is perpendicularly over the centre of the equilateral triangle below, and let these be connected with the balls of the under stratum by similar spiral wires. Let there be a third and a fourth, and any number of such strata, all connected in the same manner. It is plain that this may extend to any size and fill any space.—Now let this assemblage of balls be firmly contemplated by the imagination, and be supposed to shrink continually in all its demensions, till the balls, and their distances from each other, and the connecting wires, all vanish from the sight as discrete individual objects. All this is very conceivable. It will now appear like a solid body, having length, breadth, and thickness; it may be compressed, and will again resume its dimensions; it may be stretched, and will again shrink; it will move away when struck; in short, it will not differ in its sensible appearance from a solid elastic body. Now when this body is in a state of compression, for instance, it is evident that any one of the balls is at rest, in consequence of the mutual balancing of the actions of all the spiral wires which connect it with those around it. It will greatly conduce to the full understanding of all that follows to recur to this illustration. The analogy or resemblance between the effects of this constitution of things and the effects of the corpuscular forces is very great; and wherever it obtains, we may safely draw conclusions from what we know would be the condition of the balls in particular circumstances to what will be the condition of a body

16
Example.

of common tangible matter. We shall just give one instructive example, and then have done with this hypothetical body. We can suppose it of a long shape, resting on one point; we can suppose two weights A, B, suspended at the extremities, and the whole in equilibrio. We commonly express this state of things by saying that A and B are in equilibrio. This is very inaccurate. A is in fact in equilibrio with the united action of all the springs which connect the ball to which it is applied with the adjoining balls. These springs are brought into action, and each is in equilibrio with the joint action of all the rest. Thus through the whole extent of the hypothetical body, the springs are brought into action in a way and in a degree which mathematics can easily investigate. We need not do this: it is enough for our purpose that our imagination readily discovers that some springs are stretched, others are compressed, and that a pressure is excited on the middle point of support, and the support exerts a reaction which precisely balances it; and the other weight is, in like manner, in immediate equilibrio with the equivalent of the actions of all the springs which connect the last ball with its neighbours. Now take the analogical or resembling case, an oblong piece of solid matter, resting on a fulcrum, and loaded with two weights in equilibrio. For the actions of the connecting springs substitute the corpuscular forces, and the result will resemble that of the hypothesis.

Now as there is something that is at least analogous to a change of distance of the particles, and a concomitant change of the intensity of the connecting forces, we may express this in the same way that we are accustomed to do in similar cases. Let A and B (fig. 1) represent the centres of two particles of a coherent elastic body in their

Plate
[illegible]

quiescent inactive state, and let us consider only the mechanical condition of B. The body may be stretched. In this case the distance A B of the particles may become A C. In this state there is something which makes it necessary to employ a force to keep the particles at this distance. C has a tendency towards A, or we may say that A attracts C. We may represent the magnitude of this tendency of C *towards* A, or this attraction of A, by a line C *c* perpendicular to A C. Again, the body may be compressed, and the distance A B may become A D. Something obliges us to employ force to continue this compression; and D tends *from* A, or A appears to *repel* D. The intensity of this tendency or repulsion may be represented by another perpendicular D *d*; and, to represent the different directions of these tendencies, or the different nature of these actions, we may set D *d* on the opposite side of A B. It is in this manner that the Abbé Boscovich has represented the actions of corpuscular forces in his celebrated Theory of Natural Philosophy.

17
How Boscovich represents the action of corpuscular forces.

Newton had said, that, as the great movements of the solar system were regulated by forces operating at a distance and varying with the distance, so he strongly suspected (*valde suspicor*) that all the phenomena of cohesion, with all its modifications in the different sensible forms of aggregation, and in the phenomena of chemistry and physiology, resulted from the similar agency of forces varying with the distance of the particles. The learned Jesuit pursued this thought; and has shown, that if we suppose an ultimate atom of matter endowed with powers of attraction and repulsion, varying, both in kind and degree, with the distance, and if this force be the same in every atom, it may be regulated by such a relation to the distance from the neighbouring atom, that a collection of such atoms may have all the sensible appearances of bodies in their different forms of solids, liquids, and vapours, elastic or unelastic, and endowed with all the properties which we perceive, by whose immediate operation the phenomena of motion by impulse, and all the phenomena of chemistry, and of animal and vegetable economy, may be produced. He shows, that notwithstanding a perfect sameness, and even a great simplicity in this atomical constitution, there will result from this union all that unspeakable variety of form and property which diversify and embellish the face of nature. We shall take another opportunity of giving such an account of this celebrated work as it deserves. We mention it only, by the by, as far as a general notion of it will be of some service on the present occasion. For this purpose, we just observe that Boscovich conceives a particle of any individual species of matter to consist of an unknown number of particles of simpler constitution; each of which particles, in their turn, is compounded of particles still more simply constituted, and so on through an unknown number of orders, till we arrive at the simplest possible constitution of a particle of tangible matter, susceptible of length, breadth, and thickness, and necessarily consisting of four atoms of matter. And he shows that the more complex we suppose the constitution of a particle, the more must the sensible qualities of the aggregate resemble the observed qualities of tangible bodies. In particular, he shows how a particle may be so constituted, that although it act on one other particle of the same kind through a considerable interval, the interposition of a third particle of the same kind may render it totally, or almost totally, inactive; and therefore an assemblage of such particles would form such a fluid as air. All these curious inferences are made with uncontrovertible evidence; and the greatest encouragement is thus given to the mathematical philosopher to hope, that by cautious and patient proceeding in this way, we may gradually approach to a knowledge of the laws of cohesion, that will not shun a comparison even with the *Principia* of Newton. No step can be made in this investigation, but by observing with care, and generalizing with judgment, the phenomena, which are abundantly numerous, and much more at our command than those of the great and sensible motions of bodies. Following this plan, we observe,

18
Every body compressible and dilatable.

4thly, It is matter of fact, that every body has some degree of compressibility and dilatability; and when the changes of dimension are so moderate that the body completely recovers its

of its original dimenſions on the ceſſation of the changing force, the extenſions or compreſſions are ſenſibly proportional to the extending or compreſſing forces; and therefore *the connecting forces are proportional to the diſtances of the particles from their quieſcent, neutral, or inactive poſitions.* This ſeems to have been firſt viewed as a law of nature by the penetrating eye of Dr Robert Hooke, one of the moſt eminent philoſophers of the laſt century. He publiſhed a cipher, which he ſaid contained the theory of ſpringineſs and of the motions of bodies by the action of ſprings. It was this, *c e i i i n o s s s t t u u.*—When explained in his diſſertation, publiſhed ſome years after, it was *ut tenſio ſic vis.* This is preciſely the propoſition juſt now aſſerted as a general fact, a law of nature. This diſſertation is full of curious obſervations of facts in ſupport of his aſſertion. In his application to the motion of bodies he gives his noble diſcovery of the balance-ſpring of a watch, which is founded on this law. The ſpring, as it is more and more coiled up, or unwound, by the motion of the balance, acts on it with a force proportional to the diſtance of the balance from its quieſcent poſition. The balance therefore is acted on by an accelerating force, which varies in the ſame manner as the force of gravity acting on a pendulum ſwinging in a cycloid. Its vibrations therefore muſt be performed in equal time, whether they are wide or narrow. In the ſame diſſertation Hooke mentions all the facts which John Bernoulli afterwards adduced in ſupport of Leibnitz's whimſical doctrine of the force of bodies in motion, or the doctrine of the *vires vivæ;* a doctrine which Hooke might juſtly have claimed as his own, had he not ſeen its futility.

19 Law of nature diſcovered by Hooke.

20 Experiments made ſince the time of Hooke ſhow that this law is ſtrictly true in the extent to which we have limited it, viz. in all the changes of form which will be completely undone by the elaſticity of the body. It is nearly true to a much greater extent. James Bernoulli, in his diſſertation on the elaſtic curve, relates ſome experiments of his own, which ſeem to deviate conſiderably from it; but on cloſe examination they do not. The fineſt experiments are thoſe of Coulomb, publiſhed in ſome late volumes of the memoirs of the Academy of Paris. He ſuſpended balls by wires, and obſerved their motions of oſcillation, which he found accurately correſponding with this law.

This we ſhall find to be a very important fact in the doctrine of the ſtrength of bodies, and we deſire the reader to make it familiar to his mind. If we apply to this our manner of expreſſing theſe forces by perpendicular ordinates C*c*, D*d* (fig. 1.), we muſt take other ſituations E, F, of the particle B, and draw E*e*, F*f*: and we muſt have D*d* : F*f* = BD : BF, or C*c* : E*e* = BC : BE. In ſuch a ſuppoſition F*d*B*ce* muſt be a ſtraight line. But we ſhall have abundant evidence by and by that this cannot be ſtrictly true, and that the line B*ce* which limits the ordinates expreſſing the attractive forces becomes concave towards the line ABE, and that the part B*df* is convex towards it. All that can be ſafely concluded from the experiments hitherto made is, that *to a certain extent* the forces, both attractive and repulſive, are *ſenſibly* proportional to the dilatations and compreſſions. For,

21 *5thly*, It is univerſally obſerved, that when the dilatations have proceeded a certain length, a leſs addition of force is ſufficient to increaſe the dilatation in the ſame degree. This is always obſerved when the body has been ſo far ſtretched that it takes a ſet, and does not completely recover its form. The like may be generally obſerved in compreſſions. Moſt perſons will recollect, that in violently ſtretching an elaſtic cord, it becomes ſuddenly weaker, or more eaſily ſtretched. But theſe phenomena do not poſitively prove a diminution of the corpuſcular force acting on one particle; It more probably ariſes from the diſunion of ſome particles, whoſe action contributed to the whole or ſenſible effect. And in compreſſions we may ſuppoſe ſomething of the ſame kind; for when we compreſs a body in one direction, it commonly bulges out in another; and in caſes of very violent action ſome particles may be diſunited, whoſe tranſverſe action had formerly balanced *part* of the compreſſing force. For the reader will ſee on reflection, that ſince the compreſſion in one direction cauſes the body to bulge out in the tranſverſe direction; and ſince this bulging out is in oppoſition to the tranſverſe forces of attraction, it muſt employ ſome part of the compreſſing force. And the common appearances are in perfect uniformity with this conception of things. When we preſs a bit of dryiſh clay, it ſwells out and cracks tranſverſely. When a pillar of wood is overloaded, it ſwells out, and ſmall crevices appear in the direction of the fibres. After this it will not bear half of the load. This the carpenters call CRIPPLING; and a knowledge of the circumſtances which modify it is of great importance, and enables us to underſtand ſome very paradoxical appearances, as will be ſhown by and by.

This partial diſuniting of particles formerly cohering is, we imagine, the chief reaſon why the totality of the forces which really oppoſe an external ſtrain does not increaſe in the proportion of the extenſions and compreſſions. But ſufficient evidence will alſo be given that the forces which would connect one particle with one other particle do not augment in the accurate proportion of the change of diſtance; that in extenſions they increaſe more ſlowly, and in compreſſions more rapidly.

But there is another cauſe of this deviation perhaps equally effectual with the former. Moſt bodies manifeſt ſome degree of ductility. Now what is this? The fact is, that the parts have taken a new arrangement, in which they again cohere. Therefore, in the paſſage to this new arrangement, the ſenſible forces, which are the joint reſult of many corpuſcular forces, begin to reſpect this new arrangement inſtead of the former. This muſt change the ſimple law of corpuſcular force, characteriſtic of the particular ſpecies of matter under examination. It does not require much reflection to convince us that the poſſible arrangements which the particles of a body may acquire, without appearing to change their nature, muſt be more numerous according as the particles are of a more complex conſtitution; and it is reaſonable to ſuppoſe that the conſtitution even of the moſt ſimple kind of matter that we are acquainted with is exceedingly complex. Our microſcopes ſhow us animals ſo minute, that a heap of them muſt appear to the naked eye an uniform maſs with a grain finer than that of the fineſt marble or razor hone; and yet each of theſe has not only limbs, but bones, muſcular fibres, blood-veſſels, fibres, and a blood conſiſting, in all probability, of globules organiſed and complex like our own. The imagination is here loſt in wonder; and nothing is left us but to adore inconceivable art and wiſdom, and to exult in the thought that we are the only ſpectators of this beautiful ſcene who can derive pleaſure from the view. What is trodden under foot with indifference, even by the half-reaſoning elephant, may be made by us the ſource of the pureſt and moſt unmixed pleaſure. But let us proceed to obſerve,

22 Ductility another cauſe of deviation.

6thly, That the forces which connect the particles of tangible bodies change by a change of diſtance, not only in degree, but alſo in kind. The particle B (fig. 1.) is attracted by A when in the ſituation C or E. It is repelled by it when at D or F. It is not affected by it when in the ſituation B. The reader is requeſted carefully to remark, that this is not an inference founded on the authority of our mathematical figure. The figure is an expreſſion (to aſſiſt the imagination) of facts in nature. It requires no force to keep the particles of a body in their

23 The forces which connect the particles of tangible bodies change by a change of diſtance.

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their quieſcent ſituations: but if they are ſeparated by ſtretching the body, they endeavour (pardon the figurative expreſſion) to come together again. If they are brought nearer by compreſſion, they endeavour to recede. This endeavour is manifeſted by the neceſſity of employing force to maintain the extenſion or condenſation; and we repreſent this by the different poſition of our lines. But this is not all: the particle B, which is repelled by A when in the ſituation F or D, is neutral when at B, and is attracted when at C or E, may be placed at ſuch a diſtance A G from A greater than AB that it ſhall be again repelled, or at ſuch a diſtance AH that it ſhall again be attracted; and theſe alterations may be repeated again and again. This is curious and important, and requires ſomething more than a bare aſſertion for its proof.

24
Light alternately attracted and repelled.

In the article OPTICS we mentioned the moſt curious and valuable obſervations of Sir Iſaac Newton, by which it appears that light is thus alternately attracted and repelled by bodies. The rings of colour which appear between the object glaſſes of long teleſcopes ſhowed, that in the ſmall interval of [illegible]th of an inch, there are at leaſt an hundred ſuch changes obſervable, and that it is highly probable that theſe alternations extend to a much greater diſtance. At one of theſe diſtances the light actually converges towards the ſolid matter of the glaſs, which we expreſs ſhortly, by ſaying that it is attracted by it, and that at the next diſtance it declines from the glaſs, or is repelled by it. The ſame thing is more ſimply inferred from the phenomena of light paſſing by the edges of knives and other opaque bodies. We refer the reader to the experiments themſelves, the detail being too long for this place; and we requeſt the reader to conſider them minutely and attentively, and to form diſtinct notions of the inferences drawn from them. And we deſire it to be remarked, that although Sir Iſaac, in his diſcuſſion, always conſiders light as a ſet of corpuſcles moving in free ſpace, and obeying the actions of external forces like any other matter, the particular concluſion in which we are juſt now intereſted does not at all depend on this notion of the nature of light. Should we, with Des Cartes or Huygens, ſuppoſe light to be the undulation of an elaſtic medium, the concluſion will be the ſame. The undulations at certain diſtances are diſturbed by forces directed towards the body, and at a greater diſtance, the diſturbing forces tend *from* the body.

25
The ſame alternations of attraction and repulſion obſervable in the particles of other bodies, as glaſs.

But the ſame alternations of attraction and repulſion may be obſerved between the particles of common matter. If we take a piece of very flat and well poliſhed glaſs, ſuch as are made for the horizon glaſſes of a good Hadley's quadrant, and if we wrap round it a fibre of ſilk as it comes from the cocoon, taking care that the fibre nowhere croſs another, and then preſs this pretty hard on ſuch another piece of glaſs, it will lift it up and keep it ſuſpended. The particles therefore of the one do moſt certainly attract thoſe of the other, and this at a diſtance equal to the thickneſs of the ſilk fibre. This is nearly the limit; and it ſometimes requires a conſiderable preſſure to produce the effect. The preſſure is effectual only by compreſſing the ſilk fibre, and thus diminiſhing the diſtance between the glaſs plates. This adheſion cannot be attributed to the preſſure of the atmoſphere, becauſe there is nothing to hinder the air from inſinuating itſelf between the plates, ſince they are ſeparated by the ſilk. Beſides, the experiment ſucceeds equally well under the receiver of an air-pump. This moſt valuable experiment was firſt made by Huygens, who reported it to the Royal Society. It is narrated in the Philoſophical Tranſactions, n° 86.

Here then is an attraction acting, like gravity, at a diſtance. But take away the ſilk fibre, and try to make the glaſſes touch each other, and we ſhall find a very great force neceſſary. By Newton's experiments it appears, that unleſs the priſmatic colours begin to appear between the glaſſes, they are at leaſt $\frac{1}{89000}$th of an inch aſunder or more. Now we know that a very conſiderable force is neceſſary for producing theſe colours, and that the more we preſs the glaſſes together the more rings of colours appear. It alſo appears from Newton's meaſures, that the difference of diſtance between the glaſſes where each of theſe colours appear is about the 89,000th part of an inch. We know farther, that when we have produced the laſt appearance of a greaſy or pearly colour, and then augment the preſſure, making it about a thouſand pounds on the ſquare inch, all colours vaniſh, and the two pieces of glaſs ſeem to make one tranſparent undiſtinguiſhable maſs. They appear now to have no air between them, or to be in mathematical contact. But another fact ſhows this concluſion to be premature. The ſame circles of colours appear in the top of a ſoap bubble; and as it grows thinner at top, there appears an unreflecting ſpot in the middle. We have the greateſt probability therefore that the perfect tranſparency in the middle of the two glaſſes does not ariſe from their being in contact, but becauſe the thickneſs of air between them is too ſmall in that place for the reflection of light. Nay, Newton expreſsly found no reflection where the thickneſs was $\frac{3}{5}$ths or more of the $\frac{1}{89000}$th part of an inch.

All this while the glaſſes are ſtrongly repelling each other, for great preſſure is neceſſary for continuing the appearance of thoſe colours, and they vaniſh in ſucceſion as the preſſure is diminiſhed. This vaniſhing of the colours is a proof that the glaſſes are moving off from each other, or repelling each other. But we can put an end to this repulſion by very ſtrong preſſure, and at the ſame time ſliding the glaſſes on each other. We do not pretend to account for this effect of the ſliding motion; but the fact is, that by ſo doing, the glaſſes will cohere with very great force, ſo that we ſhall break them by any attempt to pull them aſunder. It commonly happens (at leaſt it did ſo with us), that in this ſliding compreſſion of two ſmooth flat plates of glaſs they ſcratch and mutually deſtroy each other's ſurface. It is alſo worth remarking, that different kinds of glaſs exhibit different properties in this reſpect. Flint glaſs will attract even though a ſilk fibre lies double between them, and they much more readily cohere by this ſliding preſſure.

Here then are two diſtances at which the plates of glaſs attract each other; namely, when the ſilk fibre is interpoſed, and when they are forced together with this ſliding motion. And in any intermediate ſituation they repel each other. 26
We ſee the ſame thing in other ſolid bodies. Two pieces of lead made perfectly clean, may be made to cohere by grinding them together in the ſame manner. It is in this way that pretty ornaments of ſilver are united to iron. The piece is ſcraped clean, and a ſmall bit of ſilver like a fiſh ſcale is laid on. The die which is to ſtrike it into a flower or other ornament is then ſet on it, and we give it a ſmart blow, which forces the metals into contact as firm as if they were ſoldered together. It ſometimes happens that the die adheres to the coin ſo that they cannot be ſeparated: and it is found that this frequently happens, when the engraving is ſuch, that the raiſed figure is not completely ſurrounded with a ſmooth flat ground. 27
The probable cauſe of this is curious. When the coin has a flat ſurface all around, this is produced by the moſt prominent part of the die. This applies to the metal, and completely confines the air which filled the hollow of the die. As the preſſure goes on, the metal is ſqueezed up into the hollow of the die; but there is ſtill air compreſſed between them, which cannot eſcape by any paſſage. It is therefore prodigiouſly condenſed,

Lead and iron.

Probable cauſe why the die adheres to the coin.

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condensed, and exerts an elasticity proportioned to the condensation. This serves to separate the die from the metal when the stroke is over. The hollow part of the die has not touched the metal all the while, and we may say that the impression was made by air. If this air escape by any engraving reaching through the border, they cohere inseparably.

We have admitted that the glass plates are in contact when they cohere thus firmly. But we are not certain of this: for if we take these cohering glasses, and touch them with water, it quickly insinuates itself between them. Yet they still cohere, but can now be pretty easily separated.

28 Repulsion the cause why some bodies swim in a specifically heavier than themselves.

It is owing to this repulsion, exerted through its proper sphere, that certain powders swim on the surface of water, and are wetted with great difficulty. Certain insects can run about on the surface of water. They have brushy feet, which occupy a considerable surface; and if their steps are viewed with a magnifying glass, the surface of the water is seen depressed all around, resembling the footsteps of a man walking on feather-beds. This is owing to a repulsion between the brush and the water. A common fly cannot walk in this manner on water. Its feet are wetted, because they attract the water instead of repelling it. A steel needle, wiped very clean, will lie on the surface of water, making an impression as a great bar would make on a feather bed; and its weight is less than that of the displaced water. A dew drop lies on the leaves of plants without touching them mathematically, as is plain from the extreme brilliancy of the reflection at the posterior surface; nay, it may be sometimes observed that the drops of rain lie on the surface of water, and roll about on it like balls on a table. Yet all these substances can be wetted; that is, water can be applied to them at such distances that they attract it.

What we said a little ago of water insinuating itself between the glass plates without altogether destroying their cohesion, shows that this cohesion is not the same that obtains between the particles of one of the plates; that is, the two plates are not in the state of one continued mass. It is highly probable, therefore, that between these two states there is an intermediate state of repulsion, nay, perhaps many such, alternated with attractive states.

A piece of ice is elastic, for it rebounds and it rings. Its particles, therefore, when compressed, resile; and when stretched, contract again. The particles are therefore in the state represented by B in figure 1. acted on by repulsive forces, if brought nearer; and by attractive forces, if drawn further asunder. Ice expands, like all other bodies, by heat. It absorbs a vast quantity of fire; which, by combining its attractions and repulsions with those of the particles of ice, changes completely the law of action, without making any sensible change in the distance of the particles, and the ice becomes water. In this new state the particles are again in limits between attractive and repulsive forces; for water has been shown, by the experiments of Canton and Zimmerman, to be elastic or compressible. It again expands by heat. It again absorbs a prodigious quantity of heat, and becomes elastic vapour; its particles repelling each other at all distances yet observed. The distance between the particles of one plate of glass and those of another which lies on it, and is carried by it, is a distance of repulsion; for the force which supports the upper piece is acting in opposition to its weight. This distance is less than that at which it would *suspend* it below it with a silk fibre interposed; for no prismatic colours appear between them when the silk fibre is interposed. But the distance at which glass attracts water is much less than this, for no colours appear when glass is wetted with water. This distance is less, and not greater, than the other; for when the glasses have water interposed between them instead of air, it is found, that when any particular colour appears, the thickness of the plate of water is to that of the plate of air which would produce the same colour nearly as 3 to 4. Now, if a piece of glass be wetted, and exhibit no colour, and another piece of glass be simply laid on it, no colour will appear; but if they are strongly pressed, the colours appear in the same manner as if the glasses had air between. Also, when glass is simply wetted, and the film of water is allowed to evaporate, when it is thus reduced to a proper thinness, the colours show themselves in great beauty.

29 Particles of matter connected by forces acting at a distance.

These are a few of many thousand facts, by which it is unquestionably proved that the particles of tangible matter are connected by forces acting at a distance, varying with the distance, and alternately attractive and repulsive. If we represent these forces as we have already done in fig. 1. by the ordinates C c, D d, E e, F f, &c. of a curve, it is evident that this curve must cross the axis at all those distances where the forces change from attractive to repulsive, and the curve must have branches alternately above and below the axis.

All these alternations of attraction and repulsion take place at small and insensible distances. At all sensible distances the particles are influenced by the attraction of gravitation; and therefore this part of the curve must be a hyperbola whose equation is $y = \frac{a^3}{x^2}$. What is the form of the curve corresponding to the smallest distance of the particles? that is, what is the mutual action between the particles just before their coming into absolute contact? Analogy should lead us to suppose it to be repulsion: for solidity is the last and simplest form of bodies with which we are acquainted.—Fluids are more compounded, containing fire as an essential ingredient. We should conclude that this ultimate repulsion is insuperable, for the hardest bodies are the most elastic. We are fully entitled to say, that this repelling force exceeds all that we have ever yet applied to overcome it; nay, there are good reasons for saying that this ultimate repulsion, by which the particles are kept from mathematical contact, is really insuperable in its own nature, and that it is impossible to produce mathematical contact.

30 Mathematical contact impossible.

We shall just mention one of these, which we consider as unanswerable. Suppose two atoms, or ultimate particles of matter A and B. Let A be at rest, and B move up to it with the velocity 2; and let us suppose that it comes into mathematical contact, and impels it (according to the common acceptation of the word). Both move with the velocity 1. This is granted by all to be the final result of the collision. Now the instant of time in which this communication happens is no part either of the duration of the solitary motion of A, nor of the joint motion of A and B: It is the separation or boundary between them. It is at once the end of the first, and the beginning of the second, belonging equally to both. A was moving with the velocity 2. The distinguishing circumstance therefore of its mechanical state is, that it has a determination (however incomprehensible) by which it would move for ever with the velocity 2, if nothing changed it. This it has during the whole of its solitary motion, and therefore in the last instant of this motion. In like manner, during the whole of the joint motion, and therefore in the first instant of this motion, the atom A has a determination by which it would move for ever with the velocity 1. In one and the same instant, therefore, the atom A has two incompatible determinations. Whatever notion we can form of this state, which

which we call velocity, as a diſtinction of condition, the ſame impoſſibility of conception or the ſame abſurdity occurs. Nor can it be avoided in any other way than by ſaying, that this change of A's motion is brought about by inſenſible gradations; that is, that A and B influence each other preciſely as they would do it a ſlender ſpring were interpoſed. The reader is deſired to look at what we have ſaid in the article Physics, § 82.

The two magnets there ſpoken of are good repreſentatives of two atoms endowed with mutual powers of repulſion; and the communication of motion is accompliſhed in both caſes in preciſely the ſame manner.

If, therefore, we ſhall ever be ſo fortunate as to diſcover the law of variation of that force which connects one ATOM of matter with another atom, and which is therefore characteriſtic of matter, and the ultimate ſource of all its ſenſible qualities, the curve whoſe ordinates repreſent the kind and the intenſity of this atomical force will be ſomething like that ſketched in fig. 2. The firſt branch $a\,n$ B will have AK (perpendicular to the axis AH) for its aſſymptote, and the laſt branch $l\,m\,o$ will be to all ſenſe a hyperbola, having AO for its aſſymptote; and the ordinates lL, mM, &c. will be proportional to $\frac{1}{\overline{AL}^2}$, $\frac{1}{\overline{AM}^2}$, &c. expreſſing the univerſal gravitation of matter. It will have many branches B b C, D d E, F f G, &c. expreſſing attractions, and alternate repulſive branches C c D, E e F, G g H, &c. All theſe will be contained within a diſtance A H, which does not exceed a very minute fraction of an inch.

31 The ſimpleſt extended particle conſiſts of four atoms.

The ſimpleſt particle which can be a conſtituent of a body having length, breadth, and thickneſs, muſt conſiſt of four ſuch atoms, all of which combine their influence on each atom of another ſuch particle. It is evident that the curve which expreſſes the forces that connect two ſuch particles muſt be totally different from this original curve, this hylarchic principle. Suppoſing the laſt known, our mathematical knowledge is quite able to diſcover the firſt; but when we proceed to compoſe a body of particles, each of which conſiſts of four ſuch particles, we may venture to ſay, that the compound force which connects them is almoſt beyond our ſearch, and that the diſcovery of the primary force from an *accurate* knowledge of the corpuſcular forces of *this* particular matter is abſolutely out of our power.

All that we can learn is, the poſſibility, nay the certainty, of an innumerable variety of external ſenſible forms and qualities, by which different kinds of matter will be diſtinguiſhed, ariſing from the number, the order of compoſition, and the arrangement of the ſubordinate particles of which a particle of this or that kind of matter is compoſed. All theſe varieties will take place at thoſe ſmall and inſenſible diſtances which are between A and H, and may produce all that variety which we obſerve in the tangible or mechanical forms of bodies, ſuch as elaſticity, ductility, hardneſs, ſoftneſs, fluidity, vapour, and all thoſe unſeen motions or actions which we obſerve in fuſion and congelation, evaporation and condenſation, ſolution and precipitation, cryſtallization, vegetable and animal aſſimilation and ſecretion, &c. &c. &c. while all bodies muſt be, in a certain degree, elaſtic, all muſt gravitate, and all muſt be impenetrable.

This general and ſatisfactory reſemblance between the appearances of tangible matter and the legitimate conſequence of this general hypothetical property of an atom of matter, affords a conſiderable probability that ſuch is the origin of all the phenomena. We earneſtly recommend to our readers a *careful* peruſal of Boſcovich's celebrated treatiſe. A careful peruſal is neceſſary for ſeeing its value; and nothing will be got by a haſty look at it. The reader will be particularly pleaſed with the facility and evidence with which the ingenious author has deduced all the ordinary principles of mechanics, and with the explanation which he has given of fluidity, and his deduction from thence of the laws of hydroſtatics. No part of the treatiſe is more valuable than the doctrine of the propagation of preſſure through ſolid bodies. This, however, is but juſt touched on in the courſe of the inveſtigation of the principles of mechanics. We ſhall borrow as much as will ſuffice for our preſent inquiry into the ſtrength of materials; and we truſt that our readers are not diſpleaſed with this general ſketch of the doctrine (if it may be ſo called) of the cohesion of bodies. It is curious and important in itſelf, and is the foundation of all the knowledge we can acquire of the preſent article. We are ſorry to ſay that it is as yet a new ſubject of ſtudy; but it is a very promiſing one, and we by no means deſpair of ſeeing the whole of chemiſtry brought by its means within the pale of mechanical ſcience. The great and diſtinguiſhing agent in chemiſtry is heat, or fire the cauſe of heat; and one of its moſt ſingular effects is the converſion of bodies into elaſtic vapour. We have the cleareſt evidence that this is brought about by mechanical forces: for it can be oppoſed or prevented by external preſſure, a very familiar mechanical force. We may perhaps find another mechanical force which will prevent fuſion.

32 The doctrine of coheſion yet a new ſubject.

Having now made our readers familiar with the mode of action in which coheſion operates in giving ſtrength to ſolid bodies, we proceed to conſider the ſtrains to which this ſtrength is oppoſed.

A piece of ſolid matter is expoſed to four kinds of ſtrain, pretty different in the manner of their operation.

33 Strains to which ſtrength is oppoſed.

1. It may be torn aſunder, as in the caſe of ropes, ſtretchers, king-poſts, tye-beams, &c.

2. It may be cruſhed, as in the caſe of pillars, poſts, and truſs-beams.

3. It may be broken acroſs, as happens to a joiſt or lever of any kind.

4. It may be wrenched or twiſted, as in the caſe of the axle of a wheel, the nail of a preſs, &c.

I. It may be pulled asunder.

34 Matter may be pulled aſunder.

This is the ſimpleſt of all ſtrains, and the others are indeed modifications of it. To this the force of coheſion is *directly* oppoſed, with very little modification of its action by any particular circumſtances.

When a long cylindrical or priſmatic body, ſuch as a rod of wood or metal, or a rope, is drawn by one end, it muſt be reſiſted at the other, in order to bring its coheſion into action. When it is faſtened at one end, we cannot conceive it any other way than as equally ſtretched in all its parts; for all our obſervations and experiments on natural bodies concur in ſhowing us that the forces which connect their particles, in any way whatever, are equal and oppoſite. This is called the *third law of motion*; and we admit its univerſality, while we affirm that it is purely experimental (ſee Physics). Yet we have met with diſſertations by perſons of eminent knowledge, where propoſitions are maintained inconſiſtent with this. During the diſpute about the communication of motion, ſome of the ableſt writers have ſaid, that a ſpring compreſſed or ſtretched at the two ends was gradually leſs and leſs compreſſed or ſtretched from the extremities towards the middle: but the ſame writers acknowledged the univerſal equality of action and reaction, which is quite incompatible with this ſtate of the ſpring. No ſuch inequality of compreſſion or dilatation has ever been obſerved;

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ved ; and a little reflection will ſhow it to be impoſſible, in conſiſtency with the equality of action and reaction.

Since all parts are thus equally ſtretched, it follows, that the ſtrain in any tranſverſe ſection is the ſame, as alſo in every point of that ſection. If therefore the body be ſuppoſed of a homogeneous texture, the coheſion of the parts is equable ; and ſince every part is equally ſtretched, the particles are drawn to equal diſtances from their quieſcent poſitions, and the forces which are thus excited, and now exerted in oppoſition to the ſtraining force, are equal. This external force may be increaſed by degrees, which will gradually ſeparate the part of the body more and more from each other, and the connecting forces increaſe with this increaſe of diſtance, till at laſt the coheſion of ſome particles is overcome. This muſt be immediately followed by a rupture, becauſe the remaining forces are now weaker than before.

It is the united force of coheſion, immediately before the diſunion of the firſt particles, that we call the STRENGTH of the ſection. It may alſo be properly called its ABSOLUTE STRENGTH, being exerted in the ſimpleſt form, and not modified by any relation to other circumſtances.

35 A circumſtance to be attended to in every conſtruction requiring ſtrength.

If the external force has not produced any permanent change on the body, and it therefore recovers its former dimenſions when the force is withdrawn, it is plain that this ſtrain may be repeated as often as we pleaſe, and the body which withſtands it once will always withſtand it. It is evident that this ſhould be attended to in all conſtructions, and that in all our inveſtigations on this ſubject this ſhould be kept ſtrictly in view. When we treat a piece of ſoft clay in this manner, and with this precaution, the force employed muſt be very ſmall. If we exceed this, we produce a permanent change. The rod of clay is not indeed torn aſunder ; but it has become ſomewhat more ſlender : the number of particles in a croſs ſection is now ſmaller ; and therefore, although it will again, in this new form, ſuffer, or allow an endleſs repetition of a *certain* ſtrain without any farther permanent change, this ſtrain is ſmaller than the former.

Something of the ſame kind happens in all bodies which receive a SETT by the ſtrain to which they are expoſed. All ductile bodies are of this kind. But there are many bodies which are not ductile. Such bodies break completely whenever they are ſtretched beyond the limit of their perfect elaſticity. Bodies of a fibrous ſtructure exhibit very great varieties in their coheſion. In ſome the fibres have no lateral coheſion, as in the caſe of a rope. The only way in which all the fibres can be made to unite their ſtrength is, to twiſt them together. This cauſes them to bind each other ſo faſt, that any one of them will break before it can be drawn out of the bundle. In other fibrous bodies, ſuch as timber, the fibres are held together by ſome cement or gluten. This is ſeldom as ſtrong as the fibre. Accordingly timber is much eaſier pulled aſunder in a direction tranſverſe to the fibres. There is, however, every poſſible variety in this particular.

36 Great variety in coheſion, but

In ſtretching and breaking fibrous bodies, the viſible extenſion is frequently very conſiderable. This is not ſolely the increaſing of the diſtance of the particles of the cohering fibre : the greateſt part chiefly ariſes from drawing the crooked fibre ſtraight. In this, too, there is great diverſity ; and it is accompanied with important differences in their power of withſtanding a ſtrain. In ſome woods, ſuch as fir, the fibres on which the ſtrength moſt depends are very ſtraight. Such woods are commonly very elaſtic, do not take a ſett, and break abruptly when overſtrained : others, ſuch as oak and birch, have their reſiſting fibres very undulating and crooked, and ſtretch very ſenſibly by a ſtrain. They are very liable to take a ſet, and they do not break ſo ſuddenly, but give warning by *complaining*, as the carpenters call it ; that is, by giving viſible ſigns of a derangement of texture. Hard bodies of an uniform glaſſy ſtructure, or granulated like ſtones, are elaſtic through the whole extent of their coheſion, and take no ſett, but break at once when overloaded.

Notwithſtanding the immenſe variety which nature exhibits in the ſtructure and coheſion of bodies, there are certain general facts of which we may now avail ourſelves with advantage. In particular,

37 The abſolute coheſion or ſtrength proportional to the area of the ſection perpendicular to the extending force.

The abſolute coheſion is proportional to the area of the ſection. This muſt be the caſe where the texture is perfectly uniform, as we have reaſon to think it is in glaſs and the ductile metals. The coheſion of each particle being alike, the whole coheſion muſt be proportional to their number, that is, to the area of the ſection. The ſame muſt be admitted with reſpect to bodies of a granulated texture, where the granulation is regular and uniform. The ſame muſt be admitted of fibrous bodies, if we ſuppoſe their fibres equally ſtrong, equally denſe, and ſimilarly diſpoſed through the whole ſection ; and this we muſt either ſuppoſe, or muſt ſtate the diverſity, and meaſure the coheſion accordingly.

We may therefore aſſert, as a general propoſition on this ſubject, that the abſolute ſtrength in any part of a body by which it reſiſts being pulled aſunder, or the force which muſt be employed to tear it aſunder *in that part*, is proportional to the area of the ſection perpendicular to the extending force.

Therefore all cylindrical or priſmatical rods are equally ſtrong in every part, and will break alike in any part ; and bodies which have unequal ſections will always break in the ſlendereſt part. The length of the cylinder or priſm has no effect on the ſtrength ; and the vulgar notion, that it is eaſier to break a very long rope than a ſhort one, is a very great miſtake. Alſo the abſolute ſtrengths of bodies which have ſimilar ſections are proportional to the ſquares of their diameters or homologous ſides of the ſection.

The weight of the body itſelf may be employed to ſtrain it and to break it. It is evident, that a rope may be ſo long as to break by its own weight. When the rope is hanging perpendicularly, although it is equally ſtrong in every part, it will break towards the upper end, becauſe the ſtrain on any part is the weight of all that is below it. Its RELATIVE STRENGTH in any part, or power of withſtanding the ſtrain which is actually laid on it, is inverſely as the quantity below that part.

38 Relative ſtrength.

When the rope is ſtretched horizontally, as in towing a ſhip, the ſtrain ariſing from its weight often bears a very ſenſible proportion to its whole ſtrength.

Let AEB (fig. 3.) be any portion of ſuch a rope, and AC, BC be tangents to the curve into which its gravity bends it. Complete the parallelogram ACBD. It is well known that the curve is a catenaria, and that DC is perpendicular to the horizon ; and that DC is to AC as the weight of the rope AEB to the ſtrain at A.

In order that a ſuſpended heavy body may be equally able in every part to carry its own weight, the ſection in that part muſt be proportional to the ſolid contents of all that is below it. Suppoſe it a conoidal ſpindle, formed by the revolution of the curve A a e (fig. 4.) round the axis CE. We muſt have $AC^2 : ac^2 =$ AEB ſol. : aEb ſol. This condition requires the logarithmic curve for A a e, of which Cc is the axis.

Theſe are the chief general rules which can be ſafely deduced from our cleareſt notions of the coheſion of bodies. In order to make any practical uſe of them, it is proper to have ſome meaſures of the coheſion of ſuch bodies as are com-

Strength of Materials. commonly employed in our mechanics, and other structures where they are exposed to this kind of strain. These must be deduced solely from experiment. Therefore they must be considered as no more than general values, or as the averages of many particular trials. The irregularities are very great, because none of the substances are constant in their texture and firmness. Metals differ by a thousand circumstances unknown to us, according to their purity, to the heat with which they were melted, to the moulds in which they were cast, and the treatment they have afterwards received, by forging, wire-drawing, tempering, &c.

39 [illegible]

It is a very curious and inexplicable fact, that by forging a metal, or by frequently drawing it through a smooth hole in a steel plate, its cohesion is greatly increased. This operation undoubtedly deranges the natural situation of the particles. They are squeezed closer together in one direction; but it is not in the direction in which they resist the fracture. In this direction they are rather separated to a greater distance. The general density, however, is augmented in all of them except lead, which grows rather rarer by wire-drawing: but its cohesion may be more than tripled by this operation. Gold, silver, and brass, have their cohesion nearly tripled; copper and iron have it more than doubled. In this operation they also grow much harder. It is proper to heat them to redness after drawing a little. This is called *nealing* or *annealing*. It softens the metal again, and renders it susceptible of another drawing without the risk of cracking in the operation.

We do not pretend to give any explanation of this remarkable and very important fact, which has something resembling it in woods and other fibrous bodies, as will be mentioned afterwards.

The varieties in the cohesion of stones and other minerals, and of vegetable and animal substances, are hardly susceptible of any description or classification.

40 Table of the cohesion and strength of different metals.

We shall take for the measure of cohesion the number of pounds avoirdupois which are just sufficient to tear asunder a rod or bundle of one inch square. From this it will be easy to compute the strength corresponding to any other dimension.

1*st*, METALS.

		lbs.
Gold, cast	-	20,000
		24,000
Silver, cast	- -	40,000
		43,000
Copper, cast	Japan - -	19,500
	Barbary - -	22,000
	Hungary - -	31,000
	America - -	34,000
	Sweden - -	37,000
Iron, cast	- -	42,000
		59,000
Iron, bar	Ordinary - -	68,000
	Stirian - -	75,000
	Best Swedish and Russian	84,000
	Horse-nails -	71,000 (A)
Steel, bar	Soft - -	120,000
	Razor temper -	150,000
Tin, cast	Malacca - -	3,100
	Banca - -	3,600
	Block - -	3,800
	English block -	5,200
	——— grain -	6,500

	lbs.
Lead, cast - - -	860
Regulus of antimony - -	1,000
Zinc - - -	2,600
Bismuth - - -	2,900

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41 Tenacity of metals increased by mixture.

It is very remarkable that almost all the mixtures of metals are more tenacious than the metals themselves. The change of tenacity depends much on the proportion of the ingredients, and the proportion which produces the most tenacious mixture is different in the different metals. We have selected the following from the experiments of Muschenbroek. The proportion of ingredients here selected is that which produces the greatest strength.

Two parts of gold with one of silver -	28,000
Five parts of gold with one of copper -	50,000
Five parts of silver with one of copper -	48,500
Four parts of silver with one of tin -	41,000
Six parts of copper with one of tin -	41,000
Five parts of Japan copper with one of Banca tin - - -	57,000
Six parts of Chili copper with one of Malacca tin - - -	60,000
Six parts of Swedish copper with one of Malacca tin - - -	64,000
Brass consists of copper and zinc in an unknown proportion; its strength is -	51,000
Three parts of block-tin with one part of lead	10,200
Eight parts of block-tin with one part of zinc	10,000
Four parts of Malacca tin with one part of regulus of antimony - -	12,000
Eight parts of lead with one of zinc -	4,500
Four parts of tin with one of lead and one of zinc - - -	13,000

These numbers are of considerable use in the arts. The mixtures of copper and tin are particularly interesting in the fabric of great guns. We see that, by mixing copper whose greatest strength does not exceed 37,000 with tin which does not exceed 6,000, we produce a metal whose tenacity is almost double, at the same time that it is harder and more easily wrought. It is, however, more fusible, which is a great inconvenience. We also see that a very small addition of zinc almost doubles the tenacity of tin, and increases the tenacity of lead five times; and a small addition of lead doubles the tenacity of tin. These are economical mixtures. This is a very valuable information to the plumbers for augmenting the strength of water-pipes.

By having recourse to these tables, the engineer can proportion the thickness of his pipes (of whatever metal) to the pressures to which they are exposed.

2*d*, WOODS.

WE may premise to this part of the table the following general observations:

42 Tenacity and strength of wood.

1. The wood immediately surrounding the pith or heart of the tree is the weakest, and its inferiority is so much more remarkable as the tree is older. In this assertion, however, we speak with some hesitation. Muschenbroek's *detail* of experiments is decidedly in the affirmative. Mr Buffon, on the other hand, says, that his experience has taught him that the heart of a sound tree is the strongest; but he gives no instances. We are certain, from many observations

(A) This was an experiment by Muschenbroek, to examine the vulgar notion that iron forged from old horse-nails was stronger than all others, and shows its falsity.

ength of materials. servations of our own on *very large* oaks and firs, that the heart is much weaker than the exterior parts.

2. The wood next the bark, commonly called the *white* or *blea*, is also weaker than the rest; and the wood gradually increases in strength as we recede from the centre to the blea.

3. The wood is stronger in the middle of the trunk than at the springing of the branches or at the root; and the wood of the branches is weaker than that of the trunk.

4. The wood of the north side of all trees which grow in our European climates is the weakest, and that of the south-east side is the strongest; and the difference is most remarkable in hedge row trees, and such as grow singly. The heart of a tree is never in its centre, but always nearer to the north side, and the annual coats of wood are thinner on that side. In conformity with this, it is a general opinion of carpenters that timber is stronger whose annual plates are thicker. The trachea or air-vessels are weaker than the simple ligneous fibres. These air-vessels are the same in diameter and number of rows in trees of the same species, and they make the visible separation between the annual plates. Therefore when these are thicker, they contain a greater proportion of the simple ligneous fibres.

5. All woods are more tenacious while green, and lose very considerably by drying after the trees are felled.

The only author who has put it in our power to judge of the propriety of his experiments is Muschenbroek. He has described his method of trial minutely, and it seems unexceptionable. The woods were all formed into slips fit for his apparatus, and part of the slip was cut away to a parallelopiped of $\frac{1}{5}$th of an inch square, and therefore $\frac{1}{25}$th of a square inch in section. The absolute strengths of a square inch were as follow:

43 [Ab]solute [stre]ngth of [diff]erent [kin]ds of [wo]od,

	lib.		lib.
Locust treee	20,100	Pomegranate	9,750
Jujeb -	18,500	Lemon	9,250
Beech, oak	17,300	Tamarind	8,750
Orange -	15,500	Fir -	8,330
Alder -	13,900	Walnut	8,130
Elm -	13,200	Pitch pine	7,650
Mulberry	12,500	Quince -	6,750
Willow -	12,500	Cypress	6,000
Ash -	12,000	Poplar -	5,500
Plum -	11,800	Cedar -	4,880
Elder -	10,000		

Mr Muschenbroek has given a very minute detail of the experiments on the ash and the walnut, stating the weights which were required to tear asunder slips taken from the four sides of the tree, and on each side in a regular progression from the centre to the circumference. The numbers of this table corresponding to these two timbers may therefore be considered as the average of more than 50 trials made of each; and he says that all the others were made with the same care. We cannot therefore see any reason for not confiding in the results; yet they are considerably higher than those given by some other writers. Mr Pitot says, on the authority of his own experiments, and of those of Mr Parent, that 60 pounds will just tear asunder a square line of sound oak, and that it will bear 50 with safety. This gives 8640 for the utmost strength of a square inch, which is much inferior to Muschenbroek's valuation.

We may add to these,

44 [Strength of o]ther sub[sta]nces.

Ivory - - - -	16,270
Bone - - -	5,250
Horn - - -	8,750
Whalebone - - -	7,500
Tooth of sea-calf - -	4,075

The reader will surely observe, that these numbers express something more than the utmost cohesion; for the weights are such as will very quickly, that is, in a minute or two, tear the rods asunder. It may be said in general, that two-thirds of these weights will sensibly impair the strength after a considerable while, and that one half is the utmost that can remain suspended at them without risk for ever; and it is this last allotment that the engineer should reckon upon in his constructions. There is, however, considerable difference in this respect. Woods of a very straight fibre, such as fir, will be less impaired by any load which is not sufficient to break them immediately.

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45 No substance to be strained in architecture above one half its strength.

According to Mr Emerson, the load which may be safely suspended to an inch square is as follows:

Iron - - -	76,400
Brass - - -	35,600
Hempen rope - -	19,600
Ivory - - -	15,700
Oak, box, yew, plum-tree - -	7,850
Elm, ash, beech - -	6,070
Walnut, plum - -	5,360
Red fir, holly, elder, plane, crab -	5,000
Cherry, hazle - -	4,760
Alder, asp, birch, willow - -	4,290
Lead - - -	430
Freestone - - -	914

He gives us a practical rule, that a cylinder whose diameter is *d* inches, loaded to one-fourth of its absolute strength, will carry as follows:

Iron -	135	Cwt.
Good rope -	22	
Oak -	14	
Fir -	9	

The rank which the different woods hold in this list of Mr Emerson's is very different from what we find in Muschenbroek's. But precise measures must not be expected in this matter. It is wonderful that in a matter of such unquestionable importance the public has not enabled some persons of judgment to make proper trials. They are beyond the abilities of private persons.

II. Bodies may be crushed.

46 It is of importance to know what will crush bodies.

It is of equal, perhaps greater, importance to know the strain which may be laid on solid bodies without danger of crushing them. Pillars and posts of all kinds are exposed to this strain in its simplest form; and there are cases where the strain is enormous, viz. where it arises from the oblique position of the parts; as in the struts, braces, and trusses, which occur very frequently in our great works.

It is therefore most desirable to have some general knowledge of the principle which determines the strength of bodies in opposition to this kind of strain. But unfortunately we are much more at a loss in this than in the last case. The mechanism of nature is much more complicated in the present case. It must be in some circuitous way that compression can have any tendency to tear asunder the parts of a solid body, and it is very difficult to trace the steps.

If we suppose the particles insuperably hard and in contact, and disposed in lines which are in the direction of the external pressures, it does not appear how any pressure can disunite the particles; but this is a gratuitous supposition. There are infinite odds against this precise arrangement of the lines of particles; and the compressibility of all kinds of matter in some degree shows that the particles are in a situation equivalent to distance. This being the case, and the particles, with their intervals, or what is equivalent to intervals,

Strength of Materials. tervals, being in ſituations that are oblique with reſpect to the preſſures, it muſt follow, that by ſqueezing them together in one direction, they are made to bulge out or ſeparate in other directions. This may proceed ſo far that ſome may be thus puſhed laterally beyond their limits of cohesion. The moment that this happens the reſiſtance to compreſſion is diminiſhed, and the body will now be cruſhed together. We may form ſome notion of this by ſuppoſing a number of ſpherules, like ſmall ſhot, ſticking together by means of a cement. Compreſſing this in ſome particular direction cauſes the ſpherules to act among each other like ſo many wedges, each tending to penetrate through between the three which lie below it: and this is the ſimpleſt, and perhaps the only diſtinct, notion we can have of the matter. We have reaſon to think that the conſtitution of very homogeneous bodies, ſuch as glaſs, is not very different from this. The particles are certainly arranged ſymmetrically in the manner of ſome regular ſolids. It is only ſuch an arrangement that is conſiſtent with tranſparency, and with the free paſſage of light in *every* direction.

47 If this be the conſtitution of bodies, it appears probable that the ſtrength, or the reſiſtance which they are capable of making to an attempt to cruſh them to pieces, is proportional to the area of the ſection whoſe plane is perpendicular to the external force; for each particle being ſimilarly and equally acted on and reſiſted, the whole reſiſtance muſt be as their number; that is, as the extent of the ſection.

Accordingly this principle is aſſumed by the few writers who have conſidered this ſubject; but we confeſs that it appears to us very doubtful. Suppoſe a number of brittle or friable balls lying on a table uniformly arranged, but not cohering nor in contact, and that a board is laid over them and loaded with a weight; we have no heſitation in ſaying, that the weight neceſſary to cruſh the whole collection is proportional to their number or to the area of the ſection. But when they are in contact (and ſtill more if they cohere), we imagine that the caſe is materially altered. Any individual ball is cruſhed only in conſequence of its being bulged outwards in the direction perpendicular to the preſſure employed. If this could be prevented by a hoop put round the ball like an equator, we cannot ſee how any force can cruſh it. Any thing therefore which makes this bulging outwards more difficult, makes a greater force neceſſary. Now this effect will be produced by the mere contact of the balls before the preſſure is applied; for the central ball cannot ſwell outward laterally without puſhing away the balls on all ſides of it. This is prevented by the friction on the table and upper board, which is at leaſt equal to one third of the preſſure. Thus any interior ball becomes ſtronger by the mere vicinity of the others; and if we farther ſuppoſe them to cohere laterally, we think that its ſtrength will be ſtill more increaſed.

The analogy between theſe balls and the cohering particles of a friable body is very perfect. We ſhould therefore expect that the ſtrength by which it reſiſts being cruſhed will increaſe in a greater ratio than that of the ſection, or the ſquare of the diameter of ſimilar ſections; and that a ſquare inch of any matter will bear a greater weight in proportion as it makes a part of a greater ſection. Accordingly this appears in many experiments, as will be noticed afterwards. Muſchenbroek, Euler, and ſome others, have ſuppoſed the ſtrength of columns to be as the biquadrates of their diameters. But Euler deduced this from formulæ which occurred to him in the courſe of his algebraic analyſis; and he boldly adopts it as a principle, without looking for its foundation in the phyſical aſſumptions which he had made in the beginning of his inveſtigation. But ſome of his original aſſumptions were as paradoxical, or at leaſt as gratuitous, as theſe reſults: and thoſe, in particular, from which this proportion of the ſtrength of columns was deduced, were almoſt foreign to the caſe; and therefore the inference was of no value. Yet it was received as a principle by Muſchenbroek and by the academicians of St Peterſburgh. We make theſe very few obſervations, becauſe the ſubject is of great practical importance; and it is a great obſtacle to improvements when deference to a great name, joined to incapacity or indolence, cauſes authors to adopt his careleſs reveries as principles from which they are afterwards to draw important conſequences. It muſt be acknowledged that we have not as yet eſtabliſhed the relation between the dimenſions and the ſtrength of a pillar on ſolid mechanical principles. Experience plainly contradicts the general opinion, that the ſtrength is proportional to the area of the ſection; but it is ſtill more inconſiſtent with the opinion, that it is in the quadruplicate ratio of the diameters of ſimilar ſections. It would ſeem that the ratio depends much on the internal ſtructure of the body; and experiment ſeems the only method for aſcertaining its general laws. 48

If we ſuppoſe the body to be of a fibrous texture, having the fibres ſituated in the direction of the preſſure, and ſlightly adhering to each other by ſome kind of cement, ſuch a body will fail only by the bending of the fibres, by which they will break the cement and be detached from each other. Something like this may be ſuppoſed in wooden pillars. In ſuch caſes, too, it would appear that the reſiſtance muſt be as the number of equally reſiſting fibres, and as their mutual ſupport, jointly; and, therefore, as ſome function of the area of the ſection. The ſame thing muſt happen if the fibres are naturally crooked or undulated, as is obſerved in many woods, &c. provided we ſuppoſe ſome ſimilarity in their form. Similarity of ſome kind muſt always be ſuppoſed, otherwiſe we need never aim at any general inferences.

In all caſes therefore we can hardly refuſe admitting that the ſtrength in oppoſition to compreſſion is proportional to a function of the area of the ſection.

As the whole length of a cylinder or priſm is equally preſſed, it does not appear that the ſtrength of a pillar is at all affected by its length. If indeed it be ſuppoſed to bend under the preſſure, the caſe is greatly changed, becauſe it is then expoſed to a tranſverſe ſtrain; and this increaſes with the length of the pillar. But this will be conſidered with due attention under the next claſs of ſtrains.

Few experiments have been made on this ſpecies of ſtrength and ſtrain. Mr Petit ſays, that his experiments, and thoſe of Mr Parent, ſhow that the force neceſſary for cruſhing a body is nearly equal to that which will tear it aſunder. He ſays that it requires ſomething more than 60 pounds on every ſquare line to cruſh a piece of ſound oak. But the rule is by no means general: Glaſs, for inſtance, will carry a hundred times as much as oak in this way, that is, reſting on it; but will not *ſuſpend* above four or five times as much. Oak will ſuſpend a great deal more than fir; but fir will carry twice as much as a pillar. Woods of a ſoft texture, although conſiſting of very tenacious fibres, are more eaſily cruſhed by their load. This ſoftneſs of texture is chiefly owing to their fibres not being ſtraight but undulated, and there being conſiderable vacuities between them, ſo that they are eaſily bent laterally and cruſhed. When a poſt is overſtrained by its load, it is obſerved to ſwell ſenſibly in diameter. Increaſing the load cauſes longitudinal cracks or ſhivers to appear, and it preſently after gives way. This is called *crippling*.

In all caſes where the fibres lie oblique to the ſtrain the ſtrength is greatly diminiſhed, becauſe the parts can then be made

made to ſlide on each other, when the coheſion of the cementing matter is overcome.

Mutchenbroek has given ſome experiments on this ſubject; but they are caſes of long pillars, and therefore do not belong to this place. They will be conſidered afterwards.

The only experiments of which we have ſeen any detail (and it is uſeleſs to inſert mere aſſertions) are thoſe of Mr Gauthey, in the 4th volume of Rozier's *Journal de Phyſique*. This engineer expoſed to great preſſures ſmall rectangular parallelopipeds, cut from a great variety of ſtones, and noted the weights which cruſhed them. The following table exhibits the medium reſults of many trials on two very uniform kinds of freeſtone, one of them among the hardeſt and the other among the ſofteſt uſed in building.

49 Column 1ſt expreſſes the length AB of the ſection in French lines or 12ths of an inch; column 2d expreſſes the breadth BC; column 3d is the area of the ſection in ſquare lines; column 4th is the number of ounces required to cruſh the piece; column 5th is the weight which was then borne by each ſquare line of the ſection; and column 6th is the round numbers to which Mr Gauthey imagines that theſe in column 5th approximate.

Hard Stone.

	AB	BC	AB × BC	Weight	Force	
1	8	8	64	736	11,5	12
2	8	12	96	2625	27,3	24
3	8	16	128	4496	35,1	36

Soft Stone.

4	9	16	144	560	3,9	4
5	9	18	162	848	5,3	4,5
6	18	18	324	2928	9	9
7	18	24	432	5296	12,2	12

Little can be deduced from theſe experiments: The 1ſt and 3d, compared with the 5th and 6th, ſhould furniſh ſimilar reſults; for the 1ſt and 5th are reſpectively half of the 3d and 6th: but the 3d is three times ſtronger (that is, a line of the 3d) than the firſt, whereas the 6th is only twice as ſtrong as the 5th.

It is evident, however, that the ſtrength increaſes much faſter than the area of the ſection, and that a ſquare line can carry more and more weight, according as it makes a part of a larger and larger ſection. In the ſeries of experiments on the ſoft ſtone, the individual ſtrength of a ſquare line ſeems to increaſe nearly in the proportion of the ſection of which it makes a part.

Mr Gauthey deduces, from the whole of his numerous experiments, that a pillar of hard ſtone of Givry, whoſe ſection is a ſquare foot, will bear with perfect ſafety 664,000 pounds, and that its extreme ſtrength is 871,000, and the ſmalleſt ſtrength obſerved in any of his experiments was 460,000. The ſoft bed of Givry ſtone had for its ſmalleſt ſtrength 187,000, for its greateſt 311,000, and for its ſafe load 249,000. Good brick will carry with ſafety 320,000; chalk will carry only 9000. The boldeſt piece of architecture in this reſpect which he has ſeen is a pillar in the church of All-Saints at Angers. It is 24 feet long and 11 inches ſquare, and is loaded with 60,000, which is not ¼th of what is neceſſary for cruſhing it.

We may obſerve here by the way, that Mr Gauthey's meaſure of the ſuſpending ſtrength of ſtone is vaſtly ſmall in proportion to its power of ſupporting a load laid above it. He finds that a priſm of the hard bed of Givry, of a foot ſection, is torn aſunder by 4600 pounds; and if it be firmly fixed horizontally in a wall, it will be broken by a

50 weight of 56,000 ſuſpended a foot from the wall. If it reſt on two props at a foot diſtance, it will be broken by 206,000 laid on its middle. Theſe experiments agree ſo ill with each other, that little uſe can be made of them. The ſubject is of great importance, and well deſerves the attention of the patriotic philoſopher. Strength of Materials.

A ſet of good experiments would be very valuable, becauſe it is againſt this kind of ſtrain that we muſt guard by judicious conſtruction in the moſt delicate and difficult problems which come through the hands of the civil and military engineer. The conſtruction of ſtone arches, and the conſtruction of great wooden bridges, and particularly the conſtruction of the frames of carpentry called *centres* in the erection of ſtone bridges, are the moſt difficult jobs that occur. In the centres on which the arches of the bridge of Orleans were built ſome of the pieces of oak were carrying upwards of two tons on every ſquare inch of their ſcantling. All who ſaw it ſaid that it was not able to carry the fourth part of the intended load. But the engineer underſtood the principles of his art, and ran the riſk: and the reſult completely juſtified his confidence; for the centre did not complain in any part, only it was found too ſupple; ſo that it went out of ſhape while the haunches only of the arch were laid on it. The engineer corrected this by loading it at the crown, and thus kept it completely in ſhape during the progreſs of the work. 51 Good experiments much wanted.

In the Memoirs (old) of the Academy of Peterſburgh for 1778, there is a diſſertation by Euler on this ſubject, but particularly limited to the ſtrain on columns, in which the bending is taken into the account. Mr Fuſs has treated the ſame ſubject with relation to carpentry in a ſubſequent volume. But there is little in theſe papers beſides a dry mathematical diſquiſition, proceeding on aſſumptions which (to ſpeak favourably) are extremely gratuitous. The moſt important conſequence of the compreſſion is wholly overlooked, as we ſhall preſently ſee. Our knowledge of the mechaniſm of coheſion is as yet far too imperfect to entitle us to a confident application of mathematics. Experiments ſhould be multiplied.

The only way we can hope to make theſe experiments uſeful is to pay a careful attention to the *manner* in which the fracture is produced. By diſcovering the general reſemblances in this particular, we advance a ſtep in our power of introducing mathematical meaſurement. Thus, when a cubical piece of chalk is ſlowly cruſhed between the chaps of a vice, we ſee it uniformly ſplit in a ſurface oblique to the preſſure, and the two parts then ſlide along the ſurface of fracture. This ſhould lead us to examine mathematically what relation there is between this ſurface of fracture and the neceſſary force; then we ſhould endeavour to determine experimentally the poſition of this ſurface. Having diſcovered ſome general law or reſemblance in this circumſtance, we ſhould try what mathematical hypotheſis will agree with this. Having found one, we may then apply our ſimpleſt notions of coheſion, and compare the reſult of our computations with experiment. We are authoriſed to ſay, that a ſeries of experiments have been made in this way, and that their reſults have been very uniform, and therefore ſatisfactory, and that they will ſoon be laid before the public as the foundations of ſucceſsful practice in the conſtruction of arches. 52 How they are to be made uſeful.

III. A Body may be broken across.

The moſt uſual, and the greateſt ſtrain, to which materials are expoſed, is that which tends to break them tranſverſely. It is ſeldom, however, that this is done in a manner perfectly ſimple; for when a beam projects horizontally from a wall, and a weight is ſuſpended from its extremity, the beam is commonly broken near the wall, and the intermediate part has performed the functions of a lever. It ſometimes, though rarely, happens that the pin in the joint of a pair of pincers or ſciſſars is cut through by the ſtrain, 53 It is of importance to know what ſtrain will break a body tranſverſely.

ſtrain; and this is almoſt the only caſe of a ſimple tranſverſe fracture. Being ſo rare, we may content ourſelves with ſaying, that in this caſe the ſtrength of the piece is proportional to the area of the ſection.

54
Experiments made to aſcertain it.

Experiments were made for diſcovering the reſiſtances made by bodies to this kind of ſtrain in the following manner: Two iron bars were diſpoſed horizontally at an inch diſtance; a third hung perpendicularly between them, being ſupported by a pin made of the ſubſtance to be examined. This pin was made of a priſmatic form, ſo as to fit exactly the holes in the three bars, which were made very exact, and of the ſame ſize and ſhape. A ſcale was ſuſpended at the lower end of the perpendicular bar, and loaded till it tore out that part of the pin which filled the middle hole. This weight was evidently the meaſure of the lateral coheſion of two ſections. The ſide bars were made to graſp the middle bar pretty ſtrongly between them, that there might be no diſtance impoſed between the oppoſite preſſures. This would have combined the energy of a lever with the purely tranſverſe preſſure. For the ſame reaſon it was neceſſary that the internal parts of the holes ſhould be no ſmaller than the edges. Great irregularities occurred in our firſt experiments from this cauſe, becauſe the pins were ſomewhat tighter within than at the edges; but when this was corrected they were extremely regular. We employed three ſets of holes, viz. a circle, a ſquare (which was occaſionally made a rectangle whoſe length was twice its breadth), and an equilateral triangle. We found in all our experiments the ſtrength exactly proportional to the area of the ſection, and quite independent of its figure or poſition, and we found it conſiderably above the direct coheſion; that is, it took conſiderably more than twice the force to tear out this middle piece than to tear the pin aſunder by a direct pull. A piece of fine freeſtone required 205 pounds to pull it directly aſunder, and 575 to break it in this way. The difference was

55
Their reſult.

very conſtant in any one ſubſtance, but varied from $\frac{1}{3}$ds to $\frac{2}{3}$ds in different kinds of matter, being ſmalleſt in bodies of a fibrous texture. But indeed we could not make the trial on any bodies of conſiderable coheſion, becauſe they required ſuch forces as our apparatus could not ſupport. Chalk, clay baked in the ſun, baked ſugar, brick, and freeſtone, were the ſtrongeſt that we could examine.

But the more common caſe, where the energy of a lever intervenes, demands a minute examination.

56
The ſtrength of a lever

Let DABC (fig. 5. n° 1.) be a vertical ſection of a priſmatic ſolid (that is, of eqnal ſize throughout), projecting horizontally from a wall in which it is firmly fixed; and let a weight P be hung on it at B, or let any power P act at B in a direction perpendicular to AB. Suppoſe the body of inſuperable ſtrength in every part except in the vertical ſection DA, perpendicular to its length. It muſt break in this ſection only. Let the coheſion be uniform over the whole of this ſection; that is, let each of the adjoining particles of the two parts cohere with an equal force f.

There are two ways in which it may break. The part ABCD may ſimply ſlide down along the ſurface of fracture, provided that the power acting at B is equal to the accumulated force which is exerted by every particle of the ſection in the direction AD.

But ſuppoſe this effectually prevented by ſomething that ſupports the point A. The action at P tends to make the body turn round A (or round a horizontal line paſſing thro' A at right angles to AB) as round a joint. This it cannot do without ſeparating at the line DA. In this caſe the adjoining particles at D or at E will be ſeparated horizontally. But their coheſion reſiſts this ſeparation. In order, therefore, that the fracture may happen, the energy or momentum of the power P, acting by means of the lever AB, muſt be ſuperior to the accumulated energies of the particles. The energy of each depends not only on its coheſive force, but alſo on its ſituation; for the ſuppoſed inſuperable firmneſs of the reſt of the body makes it a lever turning round the fulcrum A, and the coheſion of each particle, ſuch as D or E, acts by means of the arm DA or EA. The energy of each particle will therefore be had by multiplying the force exerted by it in the inſtant of fracture by the arm of the lever by which it acts.

Let us therefore firſt ſuppoſe, that in the inſtant of fracture every particle is exerting an equal force f. The energy of D will be $f \times DA$, and that of E will be $f \times EA$, and that of the whole will be the ſum of all theſe products. Let the depth DA of the ſection be called d, and let any undetermined part of it EA be called x, and then the ſpace occupied by any particle will be $\dot{x}$. The coheſion of this ſpace may be repreſented by $f\dot{x}$, and that of the whole by fd. The energy by which each element $\dot{x}$ of the line DA, or d, reſiſts the fracture, will be $f\dot{x}x$, and the whole accumulated energies will be $f \times \int x\dot{x}$. This we know to be $f \times \frac{1}{2} d^2$, or $fd \times \frac{1}{2} d$. It is the ſame therefore as if the coheſion fd of the whole ſection had been acting at the point G, which is in the middle of DA.

The reader who is not familiarly acquainted with this fluxionary calculus may arrive at the ſame concluſion in another way. Suppoſe the beam, inſtead of projecting horizontally from a wall, to be hanging from the ceiling, in which it is firmly fixed. Let us conſider how the equal coheſion of every part operates in hindering the lower part from ſeparating from the upper by opening round the joint A. The equal coheſion operates juſt as equal gravity would do, but in the oppoſite direction. Now we know, by the moſt elementary mechanics, that the effect of this will be the ſame as if the whole weight were concentrated in the centre of gravity G of the line DA, and that this point G is in the middle of DA. Now the number of fibres being as the length d of the line, and the coheſion of each fibre being $= f$, the coheſion of the whole line is $f \times d$ or fd.

The accumulated energy therefore of the coheſion in the inſtant of fracture is $fd \times \frac{1}{2} d$. Now this muſt be equal or juſt inferior to the energy of the power employed to break it. Let the length AB be called l; then $P \times l$ is the correſponding energy of the power. This gives us $fd\,\frac{1}{2}\,d = pl$ for the equation of equilibrium correſponding to the vertical ſection ADCB.

Suppoſe now that the fracture is not permitted at DA, but at another ſection $\delta\,\alpha$ more remote from B. The body being priſmatic, all the vertical ſections are equal; and therefore $fd\,\frac{1}{2}\,d$ is the ſame as before. But the energy of the power is by this means increaſed, being now $= P \times B\alpha$, inſtead of $P \times BA$: Hence we ſee that when the priſmatic body is not inſuperably ſtrong in all its parts, but equally ſtrong throughout, it muſt break cloſe at the wall, where the ſtrain or energy of the power is greateſt. We ſee, too, that a power which is juſt able to break it at the wall is unable to break it anywhere elſe; alſo an abſolute coheſion fd, which can withſtand the power p in the ſection DA, will not withſtand it in the ſection $\delta\,\alpha$, and will withſtand more in the ſection $d'\,a'$.

This teaches us to diſtinguiſh between abſolute and relative ſtrength. The relative ſtrength of a ſection has a reference to the ſtrain actually exerted on that ſection. This relative ſtrength is properly meaſured by the power which is juſt able to balance or overcome it, when applied at its

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proper place. Now ſince we had $f d \frac{1}{2} d = p l$, we have $p = \frac{f d \frac{1}{2} d}{l}$ for the meaſure of the ſtrength of the ſection DA, in relation to the power applied at B.

If the ſolid is a rectangular beam, whoſe breadth is b, it is plain that all the vertical ſections are equal, and that AG or $\frac{1}{2} d$ is the ſame in all. Therefore the equation expreſſing the equilibrium between the momentum of the external force and the accumulated momenta of coheſion will be $p l = f d b \times \frac{1}{2} d$.

The product $d b$ evidently expreſſes the area of the ſection of fracture, which we may call s, and we may expreſs the equilibrium thus, $p l = f s \frac{1}{2} d$, and $2 l : d = f s : p$.

Now $f s$ is a proper expreſſion of the abſolute coheſion of the ſection of fracture, and p is a proper meaſure of its ſtrength in relation to a power applied at B. We may therefore ſay, that *twice the length of a rectangular beam is to the depth as the abſolute coheſion to the relative ſtrength.*

Since the action of equable coheſion is ſimilar to the action of equal gravity, it follows, that whatever is the figure of the ſection, the relative ſtrength will be the ſame as if the abſolute coheſion of all the fibres were acting at the centre of gravity of the ſection. Let g be the diſtance between the centre of gravity of the ſection and the axis of fracture, we ſhall have $p l = f s g$, and $l : g = f s : p$. It will be very uſeful to recollect this analogy in words: "*The length of a priſmatic beam of any ſhape is to the height of the centre of gravity above the lower ſide, as the abſolute coheſion to the ſtrength relative to this length.*"

Becauſe the relative ſtrength of a rectangular beam is $\frac{f b d \frac{1}{2} d}{l}$ or $\frac{f b d^2}{2 l}$, it follows, that the relative ſtrengths of different beams are proportional to the abſolute coheſion of the particles, to the breadth, and to the ſquare of the depth directly, and to the length inverſely; alſo in priſms whoſe ſections are ſimilar, the ſtrengths are as the cubes of the diameters.

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Such are the more general reſults of the mechaniſm of this tranſverſe ſtrain, in the hypotheſis that all the particles are exerting equal forces in the inſtant of fracture. We are indebted for this doctrine to the celebrated Galileo; and it was one of the firſt ſpecimens of the application of mathematics to the ſcience of nature.

We have not included in the preceding inveſtigation that action of the external force by which the ſolid is drawn ſidewiſe, or tends to ſlide along the ſurface of fracture. We have ſuppoſed a particle E to be pulled only in the direction $E e$, perpendicular to the ſection of fracture, by the action of the crooked lever BAE. But it is alſo pulled in the direction EA; and its reaction is in ſome direction εE, compounded of εf, by which it reſiſts being pulled outwards; and εe, by which it reſiſts being pulled downwards. We are but imperfectly acquainted with the force εe, and only know that their accumulated ſum is equal to the force p: but in all important caſes which occur in practice, it is unneceſſary to attend to this force; becauſe it is ſo ſmall in compariſon of the forces in the direction $E e$, as we eaſily conclude from the uſual ſmallneſs of AD in compariſon of AB.

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The hypotheſis of equal coheſion, exerted by all the particles in the inſtant of fracture, is not conformable to nature: for we know, that when a force is applied tranſverſely at B, the beam is bent downwards, becoming convex on the upper ſide; that ſide is therefore on the ſtretch. The particles at D are farther removed from each other than thoſe at E, and are therefore *actually exerting* greater coheſive forces. We cannot ſay with certainty and preciſion in what proportion each fibre is extended. It ſeems moſt probable that the extenſions are proportional to the diſtances from A. We ſhall ſuppoſe this to be really the caſe. Now recollect the general law which we formerly ſaid was *obſerved* in all moderate extenſions, *viz.* that the attractive forces exerted by the dilated particles were proportional to their dilatations. Suppoſe now that the beam is ſo much bent that the particles at D are exerting their utmoſt force, and that this fibre is juſt ready to break or actually breaks. It is plain that a total fracture muſt immediately enſue; becauſe the force which was ſuperior to the full coheſion of the particle at D, and a certain portion of the coheſion of all the reſt, will be more than ſuperior to the full coheſion of the particle next within D, and a ſmaller portion of the coheſion of the remainder.

Strength of Materials.

Now let F repreſent, as before, the full force of the exterior fibre D, which is exerted by it in the inſtant of its breaking, and then the force exerted at the ſame inſtant by the fibre E will be had by this analogy AD : AE, or $d : x = f : \frac{f x}{d}$, and the force really exerted by the fibre E is $f \times \frac{x}{d}$.

The force exerted by a fibre whoſe thickneſs is $\dot{x}$ is therefore $\frac{f x \dot{x}}{d}$; but this force reſiſts the ſtrain by acting by means of the lever EA or x. Its energy or momentum is therefore $\frac{f x^2 \dot{x}}{d}$, and the accumulated momenta of all the fibres in the line AE will be $f \times$ ſum of $\frac{x^2 \dot{x}}{d}$. This, when x is taken equal to d, will expreſs the momentum of the whole fibres in the line AD. This, therefore, is $f \frac{\frac{1}{3} d^3}{d}$, or $f \frac{1}{3} d^2$, or $f d \times \frac{1}{3} d$. Now $f d$ expreſſes the abſolute coheſion of the whole line AD. The accumulated momentum is therefore the ſame as if the abſolute coheſion of the whole line were exerted at $\frac{1}{3}$d of AD from A.

59 The ſtrength aſcertained on other principles.

From theſe premiſes it follows that the equation expreſſing the equilibrium of the ſtrain and coheſion is $p l = f d \times \frac{1}{3} d$; and hence we deduce the analogy, "*As thrice the length is to the depth, ſo is the abſolute coheſion to the relative ſtrength.*"

This equation and this proportion will equally apply to rectangular beams whoſe breadth is b; for we ſhall then have $p l = f b d \times \frac{1}{3} d$.

We alſo ſee that the relative ſtrength is proportional to the abſolute coheſion of the particles, to the breadth, and to the ſquare of the depth directly, and to the length inverſely: for p is the meaſure of the force with which it is reſiſted, and $p = \frac{f b d \frac{1}{3} d}{l}, = \frac{f b d^2}{3 l}$. In this reſpect therefore this hypotheſis agrees with the Galilean; but it aſſigns to every beam a ſmaller proportion of the abſolute coheſion of the ſection of fracture, in the proportion of 3 to 2. In the Galilean hypotheſis this ſection has a momentum equal to $\frac{1}{2}$ of its abſolute ſtrength, but in the other hypotheſis it is only $\frac{1}{3}$d. In beams of a different form the proportion may be different.

As this is a moſt important propoſition, and the foundation of many practical maxims, we are anxious to have it clearly comprehended, and its evidence perceived by all. Our better informed readers will therefore indulge us while we endeavour to preſent it in another point of view, where it will be better ſeen by thoſe who are not familiarly acquainted with the fluxionary calculus.

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6.
The same properties exhibited in another point of view.

Fig. 5. n° 2. A is a perspective view of a three sided beam projecting horizontally from a wall, and loaded with a weight at B just sufficient to break it. D ABC is a vertical plane through its highest point D, in the direction of its length. a D a is another vertical section perpendicular to AB. The piece being supposed of infuperable strength everywhere except in the section a D a, and the cohesion being also supposed infuperable along the line a A a, it can break nowhere but in this section, and by turning round a A a as round a hinge. Make D d equal to AD, and let D d represent the absolute cohesion of the fibre at D, which absolute cohesion we expressed by the symbol f. Let a plane $a\,d\,a$ be made to pass through $a\,a$ and d, and let $d\,a'\,a$ be another cross section. It is plain that the prismatic solid contained between the two sections a D a and $a\,d\,a'$ will represent the full cohesion of the whole section of fracture; for we may conceive this prism as made up of lines such as F f, equal and parallel to D d, representing the absolute cohesion of each particle such as F. The pyramidal solid d D $a\,a$, cut off by the plane $d\,a\,a$, will represent the cohesions *actually exerted* by the different fibres in the instant of fracture. For take any point E in the surface of fracture, and draw E e parallel to AB, meeting the plane $a\,d\,a$ in e, and let e A E be a vertical plane. It is evident that D d is to E e as AD to AE; and therefore (since the forces exerted by the different fibres are as their extension, and their extension as their distances from the axis of fracture) E e will represent the force actually exerted by the fibre in E, while D is exerting its full force D d. In like manner, the plane F F $f\,f$ expresses the cohesion exerted by all the fibres in the line F F, and so on through the whole surface. Therefore the pyramid $d\,a\,a$ D expresses the accumulated exertion of the whole surface of fracture.

Farther, suppose the beam to be held perpendicular to the horizon with the end B uppermost, and that the weight of the prism contained between the two sections a D a and $a\,d\,a'$ (now horizontal) is just able to overcome the full cohesion of the section of fracture. The weight of the pyramid d D $a\,a$ will also be just able to overcome the cohesions *actually exerted* by the different fibres in the instant of fracture, because the weight of each fibre, such as E e, is just superior to the cohesion actually exerted at E.

Let o be the centre of gravity of the pyramidal solid, and draw o O perpendicular to the plane a D a. The whole weight of the solid d D $a\,a$ may be conceived as accumulated in the point o, and as acting on the point O, and it will have the same tendency to separate the two cohering surfaces as when each fibre is hanging by its respective point. For this reason the point O may be called the *centre of actual effort* of the unequal forces of cohesion. The momentum therefore, or energy by which the cohering surfaces are separated, will be properly measured by the weight of the solid d D $a\,a$ multiplied by OA; and this product is equal to the product of the weight p multiplied by BA, or by l. Thus suppose that the cohesion along the line AD only is considered. The whole cohesion will be represented by a triangle A D d. D d represents f, and AD is d, and AD is x. Therefore A D d is $\frac{1}{2} f d$. The centre of gravity o of the triangle A D d is in the intersection of a line drawn from A to the middle of D d with a line drawn from d to the middle of AD; and therefore the line o O will make AO $= \frac{2}{3}$ of A D. Therefore the actual momentum of cohesion $= f \times \frac{1}{2} d \times \frac{2}{3} d, = f \times d \times \frac{1}{3} d, = f d \times \frac{1}{3} d$, or equal to the absolute cohesion acting by means of the lever $\frac{d}{3}$. If the section of fracture is a rectangle, as in a common joist, whose breadth $a\,a$ is $= b$, it is plain that all the vertical lines will be equal to AD, and their cohesions will be represented by triangles like A D d; and the whole actual cohesion will be represented by a wedge whose bases are vertical planes, and which is equal to half of the parallelopiped AD $\times$ D $d \times a\,a$, and will therefore be $= \frac{1}{2} f b d$; and the distance A O of its centre of gravity from the horizontal line A A' will be $\frac{2}{3}$ of A D. The momentum of cohesion of a joist will therefore be $\frac{1}{2} f b d \times \frac{2}{3} d$, or $f b d \frac{1}{3} d$, as we have determined in the other way.

The beam represented in the figure is a triangular prism. The pyramid D $a\,a\,d$ is $\frac{1}{3}$ of the prism $a\,a$ D $d\,a'\,a'$. If we make s represent the surface of the triangle a D a, the pyramid is $\frac{1}{3}$ of $f s$. The distance AO of its centre of gravity from the horizontal line A A' is $\frac{1}{2}$ of A D, or $\frac{1}{2} d$. Therefore the momentum of actual cohesion is $\frac{1}{3} f s \times \frac{1}{2} d, = f s \frac{1}{6} d$; that is, it is the same as if the full cohesion of all the fibres were accumulated at a point I whose distance from A is $\frac{1}{6}$th of AD or d; or (that we may see its value in every point of view) it is $\frac{1}{6}$th of the momentum of the full cohesion of all the fibres when accumulated at the point D, or acting at the distance $d =$ A D.

This is a very convenient way of conceiving the momentum of actual cohesion, by comparing it with the momentum of absolute cohesion applied at the distance AD from the axis of fracture. The momentum of the absolute cohesion applied at D is to the momentum of actual cohesion in the instant of fracture as AD to AI. Therefore the length of AI, or its proportion to AD, is a sort of index of the strength of the beam. We shall call it the INDEX, and express it by the symbol i.

Its value is easily obtained. The product of the absolute cohesion by AI must be equal to that of the actual cohesion by AO. Therefore say, "as the prismatic solid $a\,a$ D $d\,a'\,a'$ is to the pyramidal solid $a\,a$ D d, so is AO to A I." We are assisted in this determination by a very convenient circumstance. In this hypothesis of the actual cohesions being as the distances of the fibres from A, the point O is the centre of oscillation or percussion of the surface D $a\,a$ turning round the axis $a\,a$: for the momentum of cohesion of the line F F is F F $\times$ F $f \times$ E A $=$ F F $\times$ E A^2, because F f is equal to E A. Now A O, by the nature of the centre of gravity, is equal to the sum of all these momenta divided by the pyramid $a\,a$ D d; that is, by the sum of all the F F $\times$ F f: that is, by the sum of all the F F $\times$ E A.

Therefore A O $= \frac{\text{sum of F F} \times \text{E A}^2}{\text{sum of F F} \times \text{E A}}$, which is just the value of the distance of the centre of percussion of the triangle $a\,a$ D from A: (See ROTATION). Moreover, if G be the centre of gravity of the triangle a D a, we shall have D A to G A as the absolute cohesion to the sum of the cohesions actually exerted in the instant of fracture; for, by the nature of this centre of gravity, A G is equal to $\frac{\text{sum of F F} \times \text{E A}}{\text{sum of F F}}$, and the sum of F F $\times$ A G is equal to the sum of F F $\times$ E A. But the sum of all the lines F F is the triangle a D a, and the sum of all the F F $\times$ E A is the sum of all the rectangles F F $f\,f$; that is, the pyramid d D $a\,a$. Therefore a prism whose base is the triangle a D a, and whose height is AG, is equal to the pyramid, or will express the sum of the actual cohesions; and a prism, whose base is the same triangle, and whose height is D d or D a, expresses the absolute cohesion. Therefore D A is to G A as the absolute cohesion to the sum of the actual cohesions.

Therefore we have D A : G A $=$ O A : I A.

Therefore, whatever be the form of the beam, that is, whatever be the figure of its section, find the centre of oscillation O, and the centre of gravity G of this section.

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Call their distances from the axis of fracture o and g. Then A I or $i = \frac{og}{d}$, and the momentum of cohesion is $fs \times \frac{og}{d}$, where s is the area of fracture.

This index is easily determined in all the cases which generally occur in practice. In a rectangular beam A I is $\frac{1}{3}$d of AD; in a cylinder (circular or elliptic) AI is $\frac{5}{16}$ths of AD, &c. &c.

In this hypothesis, that the cohesion actually exerted by each fibre is as its extension, and that the extensions of the fibres are as their distances from A (fig. 5. nº 1.), it is plain that the forces exerted by the fibres D, E, &c. will be represented by the ordinates D d, E e, &c. to a straight line A d. And we learn from the principles of ROTATION that the centre of percussion O is in the ordinate which passes through the centre of gravity of the triangle A D d, or (if we consider the whole section having breadth as well as depth) through the centre of gravity of the solid bounded by the planes DA, dA; and we found that this point O was the centre of effort of the cohesions *actually* exerted in the instant of fracture, and that I was the centre of an *equal* momentum, which would be produced if all the fibres were accumulated there and exerted their *full* cohesion.

This consideration enables us to determine, with equal facility and neatness, the strength of a beam in any hypothesis of forces. The above hypothesis was introduced with a cautious limitation to moderate strains, which produced no permanent change of form, or no sett as the artists call it: and this suffices for all purposes of practice, seeing that it would be imprudent to expose materials to more violent strains. But when we compare this theory with experiments in which the pieces are really broken, considerable deviations may be expected, because it is very probable that in the vicinity of rupture the forces are no longer proportional to the extensions. 61

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That no doubt may remain as to the justness and completeness of the theory, we must show how the relative strength may be determined in any other hypothesis. Therefore suppose that it has been established by experiment on any kind of solid matter, that the forces actually exerted in the instant of fracture by the fibres at D, E, &c. are as the ordinates D d', E e', &c. of any curve line A e' d'. We are supposed to know the form of this curve, and that of the solid which is bounded by the vertical plane through AD, and by the surface which passes through this curve A e' d' perpendicularly to the length of the beam. We know the place of the centre of gravity of this curve surface or solid, and can draw a line through it parallel to A B, and cutting the surface of fracture in some point O. This point is also the centre of effort of all the cohesions actually exerted; and the product of A O and of the solid which expresses the actual cohesions will give the momentum of cohesion equivalent to the former $fs \frac{og}{d}$. Or we may find an index A I, by making A I a fourth proportional to the full cohesion of the surface of fracture, to the accumulated actual cohesions, and to A O; and then $fs \times i$ (= A I) will be the momentum of cohesion; and we shall still have I for the point in which all the fibres may be supposed to exert their full cohesion f, and to produce a momentum of cohesion equal to the real momentum of the cohesions actually exerted, and the relative strength of the beam will still be $p = \frac{fsi}{l}$ or $\frac{fsgo}{dl}$. Thus, if the forces be as the squares of the extensions (still supposed to be as the distances from A), the curve A e' d' will be a common parabola, having AB for its axis and AD for the tangent at its vertex. The area A D d' will be $\frac{1}{3}$d A D × D d; and in the case of a rectangular beam, AO will be $\frac{3}{4}$ths AD, and AI will be $\frac{1}{4}$th of A D.

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We may observe here in general, that if the forces actually exerted in the instant of fracture be as any power q of the distance from A, the index A I will be $= \frac{AD}{q+2}$ for a rectangular beam, and the momentum of cohesion will always be (*cæteris paribus*) as the breadth and as the square of the depth; nay, this will be the case whenever the action of the fibres D and E is expressed by any *similar functions* of d and x. This is evident to every reader acquainted with the fluxionary calculus.

As far as we can judge from experience, no simple algebraic power of the distance will express the actual cohesions of the fibres. No curve which has either AD or AB for its tangent will suit. The observations which we made in the beginning show, that although the curve of fig. 2. must be sensibly straight in the vicinity of the points of intersection with the axis, in order to agree with our observations which show the moderate extensions to be as the extending forces, the curve *must* be concave towards the axis in all its attractive branches, because it cuts it again. Therefore the curve A e' d' of fig. 5. (nº 1.) must make a finite angle with AD or AB, and it must, in all probability, be also concave towards AD in the neighbourhood of d'. It may however be convex in some part of the intermediate arch. We have made experiments on the extensions of different bodies, and find great diversities in this respect: But in all, the moderate extensions were as the forces, and this with great accuracy till the body took a sett, and remained longer than formerly when the extending force was removed.

We must now remark, that this correction of the Galilean hypothesis of equal forces was suggested by the bending which is observed in all bodies which are strained transversely. Because they are bent, the fibres on the convex side have been extended. We cannot say in what proportion this obtains in the different fibres. Our most distinct notions of the internal equilibrium between the particles render it highly probable that their extension is proportional to their distance from that fibre which retains its former dimensions. But by whatever law this is regulated, we see plainly that the actions of the stretched fibres must follow the proportions of some function of this distance, and that therefore the relative strength of a beam is in all cases susceptible of mathematical determination. 62

We also see an intimate connection between the strain and the curvature. This suggested to the celebrated James Bernoulli the problem of the ELASTIC CURVE, *i. e.* the curve into which an extensible rigid body will be bent by a transverse strain. His solution in the *Acta Lipsiæ* 1694 and 1695 is a very beautiful specimen of mathematical discussion; and we recommend it to the perusal of the curious reader. He will find it very perspicuously treated in the first volume of his works, published after his death, where the wide steps which he had taken in his investigation are explained so as to be easily comprehended. His nephew Dan. Bernoulli has given an elegant abridgment in the Petersburg Memoirs for 1729. The problem is too intricate to be fully discussed in a work like ours; but it is also too intimately connected with our present subject to be entirely omitted. We must content ourselves with showing the leading mechanical property of this curve, from which the mathematician may deduce all its geometrical properties.

Bernoulli's problem of the elastic curve.

When a bar of uniform depth and breadth, and of a given length, is bent into an arch of a circle, the extension of the outer

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outer fibres is proportional to the curvature; for, because the curves formed by the inner and outer sides of the beam are similar, the circumferences are as the radii, and the radius of the inner circle is to the difference of the radii as the length of the inner circumference is to the difference of the circumferences. The difference of the radii is the depth of the beam, the difference of the circumferences is the extension of the outer fibres, and the inner circumference is supposed to be the primitive length of the beam. Now the second and third quantities of the above analogy, viz. the depth and length of the beam, are constant quantities, as is also their product. Therefore the product of the inner radius and the extension of the outer fibre is also a constant quantity, and the whole extension of the outer fibre is inversely as the radius of curvature, or directly as the curvature of the beam.

63 [illegible] described.

The mathematical reader will readily see, that into whatever curve the elastic bar is bent, the whole extension of the outer fibre is equal to the length of a similar curve, having the same proportion to the thickness of the beam that the length of the beam has to the radius of curvature.

Now let ADCB (Fig. 5. n° 2.) be such a rod, of uniform breadth and thickness, firmly fixed in a vertical position, and bent into a curve AEFB by a weight W suspended at B, and of such magnitude that the extremity B has its tangent perpendicular to the action of the weight, or parallel to the horizon. Suppose too that the extensions are proportional to the extending forces. From any two points E and F draw the horizontal ordinates EG, FH. It is evident that the exterior fibres of the sections E *e* and F *f* are stretched by forces which are in the proportion of EG to FH (these being the long arms of the levers, and the equal thicknesses E *e*, F *f* being the short arms). Therefore (by the hypothesis) their extensions are in the same proportion. Therefore, since the extensions are proportional to some similar functions of the distance from the axes of fracture E and F, the extension of any fibre in the section E *e* is to the contemporaneous extension of the similarly situated fibre in the section F *f*, as the extension of the exterior fibre in the section E *e* is to the extension of the exterior fibre in the section F *f*: therefore the whole extension of E *e* is to the whole extension of F *f* as EG to FH, and EG is to FH as the curvature in E to the curvature in F.

Here let it be remarked, that this proportionality of the curvature to the extension of the fibres is not limited to the hypothesis of the proportionality of the extensions to the extending forces. It follows from the extension in the different sections being as some similar function of the distance from the axis of fracture; an assumption which cannot be refused.

This then is the fundamental property of the elastic curve, from which its equation, or relation between the abscissa and ordinate, may be deduced in the usual forms, and all its other geometrical properties. These are foreign to our purpose; and we shall notice only such properties as have an immediate relation to the strain and strength of the different parts of a flexible body, and which in particular serve to explain some difficulties in the valuable experiments of Mr Buffon on the Strength of Beams.

64 It is not a circle.

We observe, in the first place, that the elastic curve cannot be a circle, but is gradually more incurvated as it recedes from the point of application B of the straining forces. At B it has no curvature; and if the bar were extended beyond B there would be no curvature there. In like manner, when a beam is supported at the ends and loaded in the middle, the curvature is greatest in the middle; but at the props, or beyond them, if the beam extend farther, there is no curvature. Therefore when a beam projecting 20 feet from a wall is bent to a certain curvature at the wall by a weight suspended at the end, and a beam of the same size projecting 20 feet is bent to the very same curvature at the wall by a greater weight at 10 feet distance, the figure and the mechanical state of the beam in the vicinity of the wall is different in these two cases, though the curvature at the very wall is the same in both. In the first case every part of the beam is incurvated; in the second, all beyond the 10 feet is without curvature. In the first experiment the curvature at the distance of five feet from the wall is $\frac{3}{4}$ths of the curvature at the wall; in the second, the curvature at the same place is but $\frac{1}{2}$ of that at the wall. This must weaken the long beam in this whole interval of five feet, because the greater curvature is the result of a greater extension of the fibres.

65 Every beam has a certain determinate curvature.

In the next place, we may remark, that there is a certain determinate curvature for every beam which cannot be exceeded without breaking it; for there is a certain separation of two adjoining particles that puts an end to their cohesion. A fibre can therefore be extended only a certain proportion of its length. The ultimate extension of the outer fibres must bear a certain determinate proportion to its length, and this proportion is the same with that of the thickness (or what we have hitherto called the depth) to the radius of ultimate curvature, which is therefore determinate.

66 And when of uniform breadth and depth is most incurvated where the strain is greatest.

A beam of uniform breadth and depth is therefore most incurvated where the strain is greatest, and will break in the most incurvated part. But by changing its form, so as to make the strength of its different sections in the ratio of the strain, it is evident that the curvature may be the same throughout, or may be made to vary according to any law. This is a remark worthy of the attention of the watchmaker. The most delicate problem in practical mechanics is so to taper the balance-spring of a watch that its wide and narrow vibrations may be isochronous. Hooke's principle *ut tensio sic vis* is not sufficient when we take the *inertia* and motion of the spring itself into the account. The figure into which it bends and unbends has also an influence. Our readers will take notice that the artist aims at an accuracy which will not admit an error of $\frac{1}{86400}$th, and that Harrison and Arnold have actually attained it in several instances. The taper of a spring is at present a nostrum in the hands of each artist, and he is careful not to impart his secret.

Again, since the depth of the beam is thus proportional to the radius of ultimate curvature, this ultimate or breaking curvature is inversely as the depth. It may be expressed by $\frac{1}{d}$.

67 To what the curvature is proportional.

When a weight is hung on the end of a prismatic beam, the curvature is nearly as the weight and the length directly, and as the breadth and the cube of the depth inversely; for the strength is $= f\frac{b\,d^2}{3\,l}$. Let us suppose that this produces the ultimate curvature $\frac{1}{d}$. Now let the beam be loaded with a smaller weight w, and let the curvature produced be C, we have this analogy $f\frac{b\,d^2}{3\,l} : w = \frac{1}{d} : \text{C}$, and C $= \frac{3\,l\,w}{f\,b\,d^3}$. It is evident that this is also true of a beam supported at the ends and loaded between the props; and we see how to determine the curvature in its different parts, whether arising from the load, or from its own weight, or from both.

When a beam is thus loaded at the end or middle, the loaded

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68 lection.

loaded point is pulled down, and the ſpace through which it is drawn may be called the DEFLECTION. This may be conſidered as the ſub-tenſe of the angle of contact, or as the verſed ſine of the arch into which the beam is bent, and is therefore as the curvature when the length of the arches is given (the flexure being moderate), and as the ſquare of the length of the arch when the curvature is given. The deflection therefore is as the curvature and as the ſquare of the length of the arch jointly; that is, as $\frac{3\,l\,w}{f\,b\,d^3} \times l^2$, or as $\frac{3\,l^3\,w}{f\,b\,d^3}$. The deflection from the primitive ſhape is therefore as the bending weight and the cube of the length directly, and as the breadth and cube of the depth inverſely.

69 e theo- s reſult- from ſubject rd the ſt me- ds of ex- ining laws of puſcular on.

In beams juſt ready to break, the curvature is as the depth inverſely, and the deflection is as the ſquare of the length divided by the depth; for the ultimate curvature at the breaking part is the ſame whatever is the length; and in this caſe the deflection is as the ſquare of the length.

We have been the more particular in our conſideration of this ſubject, becauſe the reſulting theorems afford us the fineſt methods of examining the laws of corpuſcular action, that is, for diſcovering the variation of the force of coheſion by a change of diſtance. It is true it is not the atomical law, or HYLARCHIC PRINCIPLE as it may juſtly be called, which is thus made acceſſible, but the ſpecific law of the particles of the ſubſtance or kind of matter under examination. But even this is a very great point; and coincidences in this reſpect among the different kinds of matter are of great moment. We may thus learn the nature of the corpuſcular action of different ſubſtances, and perhaps approach to a diſcovery of the *mechaniſm* of chemical affinities. For that chemical actions are inſenſible caſes of local motion is undeniable, and local motion is the province of mechanical diſcuſſion; nay, we ſee that theſe hidden changes are produced by mechanical forces in many important caſes, for we ſee them promoted or prevented by means purely mechanical. The converſion of bodies into elaſtic vapour by heat can at all times be prevented by a *ſufficient* external preſſure. A ſtrong ſolution of Glauber's ſalt will congeal in an inſtant by agitation, giving out its latent heat; and it will remain fluid for ever, and return its latent heat in a cloſe veſſel which it completely fills. Even water will by ſuch treatment freeze in an inſtant by agitation, or remain fluid for ever by confinement. We know that heat is produced or extricated by friction, that certain compounds of gold or ſilver with ſaline matters explode with irreſiſtible violence by the ſmalleſt preſſure or agitation. Such facts ſhould rouſe the mathematical philoſopher, and excite him to follow out the conjectures of the illuſtrious Newton, encouraged by the ingenious attempts of Boſcovich; and the proper beginning of this ſtudy is to attend to the laws of attraction and repulſion exerted by the particles of cohering bodies, diſcoverable by experiments made on their actual extenſions and compreſſions. The experiments of ſimple extenſions and compreſſions are quite inſufficient, becauſe the total ſtretching of a wire is ſo ſmall a quantity, that the miſtake of the 100th part of an inch occaſions an irregularity which deranges any progreſſion ſo as to make it uſeleſs. But by the bending of bodies, a diſtenſion of $\frac{1}{100}$th of an inch may be eaſily magnified in the deflection of the ſpring ten thouſand times. We know that the inveſtigation is intricate and difficult, but not beyond the reach of our preſent mathematical attainments; and it will give very fine opportunities of employing all the addreſs of analyſis. In the laſt century and the beginning of the preſent this was a ſufficient excitement to the firſt geniuſes of Europe. The cycloid, the catenaria, the elaſtic curve, the velaria, the cauſtics, were reckoned an abundant recompenſe for much ſtudy; and James Bernoulli requeſted, as an honourable monument, that the logarithmic ſpiral might be inſcribed on his tombſtone. The reward for the ſtudy to which we now preſume to incite the mathematicians is the almoſt unlimited extenſion of natural ſcience, important in every particular branch. To go no further than our preſent ſubject, a great deal of important practical knowledge reſpecting the ſtrength of bodies is derived from the ſingle obſervation, that in the moderate extenſions which happen before the parts are overſtrained the forces are nearly in the proportion of the extenſions or ſeparations of the particles. To return to our ſubject.

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70 Bernoulli calls in queſtion this law,

James Bernoulli in his ſecound diſſertation on the elaſtic curve, calls in queſtion this law, and accommodates his inveſtigation to any hypotheſis concerning the relation of the forces and extenſions. He relates ſome experiments of lute ſtrings where the relation was conſiderably different. Strings of three feet long,

Stretched by	2, 4, 6, 8, 10 pds.
Were lengthened	9, 17, 23, 27, 30 lines.

But this is a moſt exceptionable form of the experiment. The ſtrings were twiſted, and the mechaniſm of the extenſions is here exceedingly complicated, combined with compreſſions and with tranſverſe twiſts, &c. We made experiments on fine ſlips of the gum caoutchouc, and on the juice of the berries of the white bryony, of which a ſingle grain will draw to a thread of two feet long, and again return into a perfectly round ſphere. We meaſured the diameter of the thread by a microſcope with a micrometer, and thus could tell in every ſtate of extenſion the proportional number of particles in the ſections. We found, that though the whole range in which the diſtance of the particles was changed in the proportion of 13 to 1, the extenſions did not *ſenſibly* deviate from the proportion of the forces. The ſame thing was obſerved in the caoutchouc as long as it perfectly recovered its firſt dimenſions. And it is on the authority of theſe experiments that we preſume to announce this as a law of nature.

71 Which was firſt aſſumed by Dr Hooke.

Dr Robert Hooke was undoubtedly the firſt who attended to this ſubject, and aſſumed this as a law of nature. Mariottè indeed was the firſt who expreſsly uſed it for determining the ſtrength of beams: this he did about the 1679, correcting the ſimple theory of Galileo. Leibnitz indeed, in his diſſertation in the *Acta Eruditorum* 1684 *de Reſiſtentia Solidorum*, introduces this conſideration, and wiſhes to be conſidered as the diſcoverer; and he is always acknowledged as ſuch by the Bernoullis and others who adhered to his peculiar doctrines. But Marriottè had publiſhed the doctrine in the moſt expreſs terms long before; and Bulfinger, in the *Comment. Petropol.* 1729, completely vindicates his claim. But Hooke was unqueſtionably the diſcoverer of this law. It made the foundation of his theory of ſprings, announced to the Royal Society about the year 1661, and read in 1666. On this occaſion he mentions many things on the ſtrength of bodies as quite familiar to his thoughts, which are immediate deductions from this principle; and among theſe *all* the facts which John Bernoulli ſo vauntingly adduces in ſupport of Leibnitz's finical dogmas about the force of bodies in motion; a doctrine which Hooke might have claimed as his own, had he not perceived its frivolous inanity.

72 Though corrected by Marriotte it does not properly explain the mechaniſm of tranſverſe ſtrain,

But even with this firſt correction of Marriottè, the mechaniſm of tranſverſe ſtrain is not fully nor juſtly explained. The force acting in the direction BP (fig. 5. n° 1.), and bending the body ABCD, not only ſtretches the fibres on the ſide oppoſite to the axis of fracture, but compreſſes the ſide AB, which becomes concave by the ſtrain. Indeed it cannot do the one without doing the other: For in order to

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to stretch the fibres at D, there must be some fulcrum, some support, on which the virtual lever BAD may press, that it may tear asunder the stretched fibres. This fulcrum must sustain both the pressure arising from the cohesion of the distended fibres, and also the action of the external force, which immediately tends to cause the prominent part of the beam to slide along the section DA. Let BAD (fig. 5. n° 1.) be considered as a crooked lever, of which A is the fulcrum. Let an external force be applied at B in the direction BP, and let a force equal to the accumulated cohesion of AD be applied at O in the direction opposite to AB, that is, perpendicular to AO; and let these two forces be supposed to balance each other by the intervention of the lever. In the first place, the force at O must be to the force at B as AB to AO: Therefore, if we make AK equal and opposite to AO, and AL equal and opposite to AB, the common principles of mechanics inform us that the fulcrum A is affected in the same manner as if the two forces AK and AL were immediately applied to it, the force AK being equal to the weight P, and AL equal to the accumulated cohesion actually exerted in the instant of fracture. The fulcrum is therefore really pressed in the direction AM, the diagonal of the parallelogram, and it must resist in the direction and with the force MA; and this power of resistance, this support, must be furnished by the repulsive forces exerted by *those particles only* which are in a state of actual compression. The force AK, which is equal to the external force P, must be resisted in the direction KA by the lateral cohesion of the whole particles between D and A (the particle D is not only drawn forward but downward). This prevents the part CDAB from sliding down along the section DA.

73 As is fully verified by experiment.

This is fully verified by experiment. If we attempt to break a long slip of cork, or any such very compressible body, we always observe it to bulge out on the concave side before it cracks on the other side. If it is a body of fibrous or foliated texture, it seldom fails splintering off on the concave side; and in many cases this splintering is very deep, even reaching half way through the piece. In hard and granulated bodies, such as a piece of freestone, chalk, dry clay, sugar, and the like, we generally see a considerable splinter or shiver fly off from the hollow side. If the fracture be slowly made by a force at B gradually augmented, the formation of the splinter is very distinctly seen. It forms a triangular piece like *a* I *b*, which generally breaks in the middle. We doubt not but that attentive observation would show that the direction of the crack on each side of I is not very different from the direction AM and its correspondent on the other side. This is by no means a circumstance of idle curiosity, but intimately connected with the mechanism of cohesion.

74 Consequences resulting from the state of the case.

Let us see what consequences result from this state of the case respecting the strength of bodies. Let DΔKC (fig. 6.) represent a vertical section of a prism of compressible materials, such as a piece of timber. Suppose it loaded with a weight P hung at its extremity. Suppose it of such a constitution that all the fibres in AD are in a state of dilatation, while those in AΔ are in a state of compression. In the instant of fracture the particles at D and E are with-held by forces D*d*, E*e*, and the particles at Δ and E repel, resist, or support, with forces Δδ, Eε.

Some line, such as *de*Aεδ, will limit all these ordinates, which represent the forces actually exerted in the instant of fracture. If the forces are as the extensions and compressions, as we have great reason to believe, *de*A and Aεδ will be two straight lines. They will form *one* straight line *d*Aδ, if the forces which resist a certain dilatation are equal to the forces which resist an equal compression. But this is quite accidental, and is not strictly true in any body. In most bodies which have any considerable firmness, the compressions made by any external force are not so great as the dilatations which the same force would produce; that is, the repulsions which are excited by any supposed degree of compression are greater than the attractions excited by the same degree of dilatation. Hence it will generally follow, that the angle *d*AD is less than the angle δAΔ, and the ordinates D*d*, E*e*, &c. are less than the corresponding ordinates Δδ, Eε, &c.

But whatever be the nature of the line *d*Aδ, we are certain of this, that the whole area AD*d* is equal to the whole area AΔδ: for as the force at B is gradually increased, and the parts between A and D are more extended, and greater cohesive forces are excited, there is always such a degree of repulsive forces excited in the particles between A and Δ that the one set precisely balances the other. The force at B, acting perpendicularly to AB, has no tendency to push the whole piece closer on the part next the wall or to pull it away. The sum of the attractive and repulsive forces actually excited must therefore be equal. These sums are represented by the two triangular areas, which are therefore equal.

The greater we suppose the repulsive forces corresponding to any degree of compression, in comparison with the attractive forces corresponding to the same degree of extension, the smaller will AΔ be in comparison of AD. In a piece of cork or sponge, AΔ may chance to be equal to AD, or even to exceed it; but in a piece of marble, AΔ will perhaps be very small in comparison of AD.

Now it is evident that the repulsive forces excited between A and Δ have no share in preventing the fracture. They rather contribute to it, by furnishing a fulcrum to the lever, by whose energy the cohesion of the particles in AD is overcome. Hence we see an important consequence of the compressibility of the body. Its power of resisting this transverse strain is diminished by it, and so much the more diminished as the stuff is more compressible. 75 An important consequence of the compressibility of bodies fully proved.

This is fully verified by some very curious experiments made by Du Hamel. He took 16 bars of willow 2 feet long and ½ an inch square, and supporting them by props under the ends, he broke them by weights hung on the middle. He broke 4 of them by weights of 40, 41, 47, and 52 pounds: the mean is 45. He then cut 4 of them ⅓d through on the upper side, and filled up the cut with a thin piece of harder wood stuck in pretty tight. These were broken by 48, 54, 50, and 52 pounds; the mean of which is 51. He cut other four ½ through, and they were broken by 47, 49, 50, 46; the mean of which is 48. The remaining four were cut ⅔ds; and their mean strength was 42.

Another set of his experiments is still more remarkable.

Six battens of willow 36 inches long and 1½ square were broken by 525 pounds at a medium.

Six bars were cut ⅓d through, and the cut filled with a wedge of hard wood stuck in with a little force: these broke with 551.

Six bars were cut half through, and the cut was filled in the same manner: they broke with 542.

Six bars were cut ¾ths through: these broke with 530.

A batten cut ¾ths through, and loaded till nearly broken, was unloaded, and the wedge taken out of the cut. A thicker wedge was put in tight, so as to make the batten straight again by filling up the space left by the compression of the wood: this batten broke with 577 pounds.

From this it is plain that more than ⅔ds of the thickness (perhaps nearly ¾ths) contributed nothing to the strength.

The point A is the centre of fracture in this case; and in order to estimate the strength of the piece, we may suppose

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poſe that the crooked lever virtually concerned in the ſtrain is DAB. We muſt find the point I, which is the centre of effort of all the attractive forces, or that point where the full coheſion of AD muſt be applied, ſo as to have a momentum equal to the accumulated momenta of all the variable forces. We muſt in like manner find the centre of effort i of the repulſive or ſupporting forces exerted by the fibres lying between A and Δ.

It is plain, and the remark is important, that this laſt centre of effort is the real fulcrum of the lever, although A is the point where there is neither extenſion nor contraction; for the lever is ſupported in the ſame manner as if the repulſions of the whole line AΔ were exerted at that point. Therefore let S repreſent the ſurface of fracture from A to D, and f repreſent the abſolute coheſion of a fibre at D in the inſtant of fracture. We ſhall have $f S \times \overline{I + i} = p\,l$, or $l : I + i = f S : p$; that is, the length AB is to the diſtance between the two centres of effort I and i, as the abſolute coheſion of the ſection between A and D is to the relative ſtrength of the ſection.

It would be perhaps more accurate to make AI and Ai equal to the diſtances of A from the horizontal lines paſſing through the centres of gravity of the triangles dAD and δAΔ. It is only in this conſtruction that the points I and i are the centres of real effort of the accumulated attractions and repulſions. But I and i, determined as we have done, are the points where the full, equal, actions may be all applied, ſo as to produce the ſame momenta. The final reſults are the ſame in both caſes. The attentive and duly informed reader will ſee that Mr Bulfinger, in a very elaborate diſſertation on the ſtrength of beams in the *Comment. Petropolitan.* 1720, has committed ſeveral miſtakes in his eſtimation of the actions of the fibres. We mention this becauſe his reaſonings are quoted and appealed to as authorities by Muſchenbroek and other authors of note. The ſubject has been conſidered by many authors on the continent. We recommend to the reader's peruſal the very minute diſcuſſions in the Memoirs of the Academy of Paris for 1702 by Varignon, the Memoirs for 1708 by Parent, and particularly that of Coulomb in the *Mem. par les ſçavans Etrangers*, tom. vii.

It is evident, from what has been ſaid above, that if S and s repreſent the ſurfaces of the ſections above and below A, and if G and g are the diſtances of their centres of gravity from A, and O and o the diſtances of their centres of oſcillation, and D and d their whole depths, the momentum of coheſion will be $\frac{f S \cdot G \cdot O}{D} + \frac{f s \cdot g \cdot o}{d} = p\,l$.

If (as is moſt likely) the forces are proportional to the extenſions and compreſſions, the diſtances AI and Ai, which are reſpectively $= \frac{G \cdot O}{D}$ and $\frac{g \cdot o}{d}$, are reſpectively $= \frac{1}{3}$ DA, and $\frac{1}{3}\,\Delta$A; and when taken together are $= \frac{1}{3}$ DΔ. If, moreover, the extenſions are equal to the compreſſions in the inſtant of fracture, and the body is a rectangular priſm like a common joiſt or beam, then DA and ΔA are alſo equal; and therefore the momentum of coheſion is $f b \times \frac{1}{2} d \times \frac{1}{3} d, = \frac{f b d^2}{6}, = f b d \times \frac{1}{6} d = p\,l$. Hence we obtain this analogy, "Six times the length is to the depth as the abſolute coheſion of the ſection is to its relative ſtrength."

Thus we ſee that the compreſſibility of bodies has a very great influence on their power of withſtanding a tranſverſe ſtrain. We ſee that in this moſt favourable ſuppoſition of equal dilatations and compreſſions, the ſtrength is reduced to one half of the value of what it would have been had the body been incompreſſible. This is by no means obvious; for it does not readily appear how compreſſibility, which does not diminiſh the coheſion of a ſingle fibre, ſhould impair the ſtrength of the whole. The reaſon, however, is ſufficiently convincing when pointed out. In the inſtant of fracture a ſmaller portion of the ſection is actually exerting coheſive forces, while a part of it is only ſerving as a fulcrum to the lever, by whoſe means the ſtrain on the ſection is produced. We ſee too that this diminution of ſtrength does not ſo much depend on the ſenſible compreſſibility, as on its proportion to the dilatability by equal forces. When this proportion is ſmall, AΔ is ſmall in compariſon of AD, and a greater portion of the whole fibre is exerting attractive forces. The experiments already mentioned of Du Hamel de Monceau on battens of willow ſhow that its compreſſibility is nearly equal to its dilatability. But the caſe is not very different in tempered ſteel. The famous Harriſon, in the delicate experiments which he made while occupied in making his longitude watch, diſcovered that a rod of tempered ſteel was nearly as much diminiſhed in its length as it was augmented by the ſame external force. But it is not by any means certain that this is the proportion of dilatation and compreſſion which obtains in the very inſtant of fracture. We rather imagine that it is not. The forces are nearly as the dilatations till very near breaking; but we think that they diminiſh when the body is juſt going to break. But it ſeems certain that the forces which reſiſt compreſſion increaſe faſter than the compreſſions, even before fracture. We know inconteſtably that the ultimate reſiſtances to compreſſion are inſuperable by any force which we can employ. The repulſive forces therefore (in their whole extent) increaſe faſter than the compreſſions, and are expreſſed by an aſſymptotic branch of the Boſcovician curve formerly explained. It is therefore probable, eſpecially in the more ſimple ſubſtances, that they increaſe faſter, even in ſuch compreſſions as frequently obtain in the breaking of hard bodies. We are diſpoſed to think that this is always the caſe in ſuch bodies as do not fly off in ſplinters on the concave ſide; but this muſt be underſtood with the exception of the permanent changes which may be made by compreſſion, when the bodies are crippled by it. This always increaſes the compreſſion itſelf, and cauſes the neutral point to ſhift ſtill more towards D. The effect of this is ſometimes very great and fatal.

Experiment alone can help us to diſcover the proportion between the dilatability and compreſſibility of bodies. The ſtrain now under conſideration ſeems the beſt calculated for this reſearch. Thus if we find that a piece of wood an inch ſquare requires 12,000 pounds to tear it aſunder by a direct pull, and that 200 pounds will break it tranſverſely by acting 10 inches from the ſection of fracture, we muſt conclude that the neutral point A is in the middle of the depth, and that the attractive and repulſive forces are equal. Any notions that we can form of the conſtitution of ſuch fibrous bodies as timber, make us imagine that the ſenſible compreſſions, including what ariſes from the bending up of the compreſſed fibres, is much greater than the real corpuſcular extenſions. One may get a general conviction of this unexpected propoſition by reflecting on what muſt happen during the fracture. An undulated fibre can only be drawn ſtraight, and then the corpuſcular extenſion begins; but it may be bent up by compreſſion to any degree, the corpuſcular compreſſion being little affected all the while. This obſervation is very important; and though the forces of corpuſcular repulſion may be almoſt inſuperable by any compreſſion that we can employ, a ſenſible compreſſion may be produced by forces not enormous, ſufficient to cripple the beam. Of this we ſhall ſee very important inſtances afterwards.

It

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77 The proportional strengths of pieces follow the same ratio.

It deserves to be noticed, that although the relative strength of a prismatic solid is extremely different in the three hypotheses now considered, yet the proportional strengths of different pieces follow the same ratio; namely, the direct ratio of the breadth, the direct ratio of the square of the depth, and the inverse ratio of the length. In the first hypothesis (of equal forces) the strength of a rectangular beam was $\frac{f b d^2}{2 l}$; in the second (of attractive forces proportional to the extensions) it was $\frac{f b d^2}{3 l}$; and in the third (equal attractions and repulsions proportional to the extensions and compressions) it was $\frac{f b d^2}{6 l}$, or more generally $\frac{f b d^2}{m l}$, where m expresses the unknown proportion between the attractions and repulsions corresponding to an equal extension and compression.

78 The strength of a piece depends chiefly on its depth,

Hence we derive a piece of useful information, which is confirmed by unexcepted experience, that the strength of a piece depends chiefly on its depth, that is, on that dimension which is in the direction of the strain. A bar of timber of one inch in breadth and two inches in depth is four times as strong as a bar of only one inch deep, and it is twice as strong as a bar two inches broad and one deep; that is, a joist or lever is always strongest when laid on its edge.

79 And therefore a choice in the manner in which the cohesion is opposed to the strain.

There is therefore a choice in the manner in which the cohesion is opposed to the strain. The general aim must be to put the centre of effort I as far from the fulcrum or the neutral point A as possible, so as to give the greatest energy or momentum to the cohesion. Thus if a triangular bar projecting from a wall is loaded with a weight at its extremity, it will bear thrice as much when one of the sides is uppermost as when it is undermost. The bar of fig. 5. nº 2. would be three times as strong if the side AB were uppermost and the edge DC undermost.

80 The strongest joist has not the greatest quantity of timber.

Hence it follows that the strongest joist that can be cut out of a round tree is not the one which has the greatest quantity of timber in it, but such that the product of its breadth by the square of its depth shall be the greatest possible. Let ABCD (fig. 7.) be the section of this joist inscribed in the circle, AB being the breadth and AD the depth. Since it is a rectangular section, the diagonal BD is a diameter of the circle, and BAD is a right angled triangle. Let BD be called a, and BA be called x; then AD is $= \sqrt{a^2 - x^2}$. Now we must have $AB \times AD^2$, or $x \times a^2 - x^2$, or $a^2 x - x^3$, a maximum. Its fluxion $a^2 \dot{x} - 3x^2 \dot{x}$ must be made $= 0$, or $a^2 = 3x^2$, or $x^2 = \frac{a^2}{3}$. If therefore we make $DE = \frac{1}{3}$ DB, and draw EC perpendicular to BD, it will cut the circumference in the point C, which determines the depth BC and the breadth CD.

Because $BD : BC = CD : CE$, we have the area of the section $BC \cdot CD = BD \cdot CE$. Therefore the different sections having the same diagonal BD are proportional to their heights CE. Therefore the section BCDA is less than the section BcDa, whose four sides are equal. The joist so shaped, therefore, is both stronger, lighter, and cheaper.

81 A hollow tube stronger than a hollow one containing the same quantity of matter,

The strength of ABCD is to that of aBcD as 10,000 to 9186, and the weight and expence as 10,000 to 10,607; so that ABCD is preferable to aBcD in the proportion of 10,607 to 9186, or nearly 115 to 100.

From the same principles it follows that a hollow tube is stronger than a solid rod containing the same quantity of matter. Let fig. 8. represent the section of a cylindric tube, of which AF and EL are the exterior and interior diameters and C the centre. Draw BD perpendicular to FC, and join DC. Then, because $BD^2 = CD^2 - CB^2$, BD is the radius of a circle containing the same quantity of matter with the ring. If we estimate the strength by the first hypothesis, it is evident that the strength of the tube will be to that of the solid cylinder, whose radius is BD, as $BD^2 \times AC$ to $BD^2 \times BD$; that is, as AC to BD: for BD^2 expresses the cohesion of the ring or the circle, and AC and BD are equal to the distances of the centres of effort (the same with the centres of gravity) of the ring and circle from the axis of fracture.

The proportion of these strengths will be different in the other hypotheses, and is not easily expressed by a general formula; but in both it is still more in favour of the ring or hollow tube.

The following very simple solution will be readily understood by the intelligent reader. Let O be the centre of oscillation of the exterior circle, o the centre of oscillation of the inner circle, and ϖ the centre of oscillation of the ring included between them. Let M be the quantity of surface of the exterior circle, m that of the inner circle, and μ that of the ring.

We have $F\varpi = \frac{M \cdot FO - m \cdot Fo}{\mu}, = \frac{5\,FC^2 + EC^2}{4\,FC}$, and the strength of the ring $= \frac{f\mu \times F\varpi}{2}$, and the strength of the same quantity of matter in the form of a solid cylinder is $f\mu \times \frac{5}{8}$ BD; so that the strength of the ring is to that of the solid rod of equal weight as $F\varpi$ to $\frac{5}{8}$ BD, or nearly as FC to BD. This will easily appear by recollecting that FO is $= \frac{\text{sum of } p \cdot r^2}{m \cdot FC}$ (see Rotation), and that the momentum of cohesion is $\frac{fm \cdot FC \cdot Fo}{2\,FC} = \frac{fm \cdot Fo}{2}$ for the inner circle, &c.

Emerson has given a very inaccurate approximation to this value in his *Mechanics*, 4to.

82 And more stiff.

This property of hollow tubes is accompanied also with greater stiffness; and the superiority in strength and stiffness is so much the greater as the surrounding shell is thinner in proportion to its diameter.

83 Hence the wisdom of God in forming bones hollow.

Here we see the admirable wisdom of the Author of nature in forming the bones of animal limbs hollow. The bones of the arms and legs have to perform the office of levers, and are thus opposed to very great transverse strains. By this form they become incomparably stronger and stiffer, and give more room for the insertion of muscles, while they are lighter and therefore more agile; and the same Wisdom has made use of this hollow for other valuable purposes of the animal economy. In like manner the quills in the wings of birds acquire by their thinness the very great strength which is necessary, while they are so light as to give sufficient buoyancy to the animal in the rare medium in which it must live and fly about. The stalks of many plants, such as all the grasses, and many reeds, are in like manner hollow, and thus possess an extraordinary strength. Our best engineers now begin to imitate nature by making many parts of their machines hollow, such as their axles of cast iron, &c.; and the ingenious Mr Ramsden now makes the axes and framings of his great astronomical instruments in the same manner.

In the supposition of homogeneous texture, it is plain that the fracture happens as soon as the particles at D are separated beyond their utmost limit of cohesion. This is a determined quantity, and the piece bends till this degree of extension is produced in the outermost fibre. It follows, that the smaller we suppose the distance between A and D, the

the greater will be the curvature which the beam will acquire before it breaks. Greater depth therefore makes a beam not only stronger but also stiffer. But if the parallel fibres can slide on each other, both the strength and the stiffness will be diminished. Therefore if, instead of one beam D ∆ KC, we suppose two, DAEC and A ∆ KB, not cohering, each of them will bend, and the extension of the fibres AB of the under beam will not hinder the compression of the adjoining fibres AB of the upper beam. The two together therefore will not be more than twice as strong as one of them (supposing DA = A ∆) instead of being four times as strong; and they will bend as much as either of them alone would bend by half the load. This may be prevented, if it were possible to unite the two beams all along the seam AB, so that the one shall not slide on the other. This may be done in small works, by gluing them together with a cement as strong as the natural lateral cohesion of the fibres. If this cannot be done (as it cannot in large works), the sliding is prevented by JOGGLING the beams together; that is, by cutting down several rectangular notches in the upper side of the lower beam, and making similar notches in the under side of the upper beam, and filling up the square spaces with pieces of very hard wood firmly driven in, as represented in fig. 9. Some employ iron bolts by way of joggles. But when the joggle is much harder than the wood into which it is driven, it is very apt to work loose, by widening the hole into which it is lodged. The same thing is sometimes done by scarfing the one upon the other, as represented in fig. 9. (n° 2.); but this wastes more timber, and is not so strong, because the mutual hooks which this method forms on each beam are very apt to tear each other up. By one or other of these methods, or something similar, may a compound beam be formed, of any depth, which will be almost as stiff and strong as an entire piece.

On the other hand, we may combine strength with pliableness, by composing our beam of several thin planks laid on each other, till they make a proper depth, and leaving them at full liberty to slide on each other. It is in this manner that coach-springs are formed, as is represented in fig. 10. In this assemblage there must be no joggles nor bolts of any kind put through the planks or plates: for this would hinder their mutual sliding. They must be kept together by straps which surround them, or by something equivalent.

The preceding observations show the propriety of some maxims of construction, which the artists have derived from long experience.

Thus, if a mortise is to be cut out of a piece which is exposed to a cross strain, it should be cut out from that side which becomes concave by the strain, as in fig. 11. but by no means as in fig. 12.

If a piece is to be strengthened by the addition of another, the added piece must be joined to the side which grows convex by the strain, as in fig. 13. and 14.

Before we go any farther, it will be convenient to recal the reader's attention to the analogy between the strain on a beam projecting from a wall and loaded at the extremity, and a beam supported at both ends and loaded in some intermediate point. It is sufficient on this occasion to read attentively what is delivered in the article ROOF, n° 19.— We learn there that the strain on the middle point C (fig. 14. of the present article) of a rectangular beam AB, supported on props at A and B, is the same as if the part CA projected from a wall, and were loaded with the half of the weight W suspended at A. The momentum of the strain is therefore $\frac{1}{2}W \times \frac{1}{2}AB, = W \times \frac{1}{4}AB = p\frac{1}{4}l$, or $\frac{pl}{4}$. The momentum of cohesion must be equal to this in every hypothesis. Strength of Materials.

Having now considered in sufficient detail the circumstances which affect the strength of any section of a solid body that is strained transversely, it is necessary to take notice of some of the chief modifications of the strain itself. We shall consider only those that occur most frequently in our constructions.

The strain depends on the external force, and also on the lever by which it acts.

87 The strain depends on the external force,

It is evidently of importance, that since the strain is exerted in any section by means of the cohesion of the parts intervening between the section under consideration and the point of application of the external force, the body must be able in all these intervening parts to propagate or excite the strain in the remote section. In every part it must be able to resist the strain excited in that part. It should therefore be equally strong; and it is useless to have any part stronger, because the piece will nevertheless break where it is not stronger throughout; and it is useless to make it stronger (relatively to its strain) in any part, for it will nevertheless equally fail in the part that is too weak.

Suppose then, in the first place, that the strain arises from a weight suspended at one extremity, while the other end is firmly fixed in a wall. Supposing also the cross sections to be all rectangular, there are several ways of shaping the beam so that it shall be equally strong throughout. Thus it may be equally deep in every part, the upper and under surfaces being horizontal planes. The condition will be fulfilled by making all the horizontal sections triangles, as in fig. 15. The two sides are vertical planes meeting in an edge at the extremity L. For the equation expressing the balance of strain and strength is $pl = fbd^2$. Therefore since d^2 is the same throughout, and also f, we must have $fb = l$, and b (the breadth AD of any section ABCD) must be proportional to l (or AL), which it evidently is.

Or, if the beam be of uniform breadth, we must have d^2 everywhere proportional to l. This will be obtained by making the depths the ordinates of a common parabola, of which L is the vertex and the length is the axis. The upper or under side may be a straight line, as in fig. 16. or the middle line may be straight, and then both upper and under surfaces will be curved. It is almost indifferent what is the shape of the upper and under surfaces, provided the distances between them in every part be as the ordinates of a common parabola.

Or, if the sections are all similar, such as circles, squares, or any other similar polygons, we must have d^3 or b^3 proportional to l, and the depths or breadths must be as the ordinates of a cubical parabola.

88 And on the arm of the lever by which it acts.

It is evident that these are also the proper forms for a lever moveable round a fulcrum, and acted on by a force at the extremity. The force comes in the place of the weight suspended in the cases already considered; and as such levers always are connected with another arm, we readily see that both arms should be fashioned in the same manner. Thus in fig. 15. the piece of timber may be considered a kind of steelyard, moveable round a horizontal axis OP, in the front of the wall, and having the two weights P and π in equilibrio. The strain occasioned by each at the section in which the axis OP is placed must be the same, and each arm OL and Oλ must be equally strong in all its parts. The longitudinal sections of each arm must be a triangle, a common parabola, or a cubic parabola, according to the conditions previously given.

And, moreover, all these forms are equally strong: For any one of them is equally strong in all its parts, and they are all supposed to have the same section at the front of the wall

Strength of Materials. wall or at the fulcrum. They are not, however, equally stiff. The first, represented in fig. 15. will bend least upon the whole, and the one formed by the cubic parabola will bend most. But their curvature at the very fulcrum will be the same in all.

It is also plain, that if the lever is of the second or third kind, that is, having the fulcrum at one extremity, it must still be of the same shape; for in abstract mechanics it is indifferent which of the three points is considered as the axis of motion. In every lever the two forces at the extremities act in one direction, and the force in the middle acts in the opposite direction, and the great strain is always at that point. Therefore a lever such as fig. 15. moveable round an axis passing horizontally through P, and acting against an obstacle at OP, is equally able in all its parts to resist the strains excited in those parts.

The same principles and the same construction will apply to beams, such as joists, supported at the ends L and ʌ (fig. 15.), and loaded at some intermediate part OP. This will appear evident by merely inverting the directions of the forces at these three points, or by recurring to the article Roofs, n° 19.

89 The external straining force may be distributed over the beam. Hitherto we have supposed the external straining force as acting only in one point of the beam. But it may be uniformly distributed all over the beam. To make a beam in such circumstances equally strong in all its parts, the shape must be considerably different from the former.

Thus suppose the beam to project from a wall.

90 To make a beam strong which projects from a wall. If it be of equal breadth throughout, its sides being vertical planes parallel to each other and to the length, the vertical section in the direction of its length must be a triangle instead of a common parabola; for the weight uniformly distributed over the part lying beyond any section, is as the length beyond that section: and since it may all be conceived as collected at its centre of gravity, which is the middle of that length, the lever by which this load acts or strains the section is also proportional to the same length. The strain on the section (or momentum of the load) is as the square of that length. The section must have strength in the same proportion. Its strength being as the breadth and the square of the depth, and the breadth being constant, the square of the depth of any section must be as the square of its distance from the end, and the depth must be as that distance; and therefore the longitudinal vertical section must be a triangle.

But if all the transverse sections are circles, squares, or any other similar figures, the strength of every section, or the cube of the diameter, must be as the square of the lengths beyond that section, or the square of its distance from the end; and the sides of the beam must be a semicubical parabola.

If the upper and under surfaces are horizontal planes, it is evident that the breadth must be as the square of the distance from the end, and the horizontal sections may be formed by arches of the common parabola, having the length for their tangent at the vertex.

By recurring to the analogy so often quoted between a projecting beam and a joist, we may determine the proper form of joists which are uniformly loaded through their whole length.

91 The strain upon a beam supported at both ends. This is a frequent and important case, being the office of joists, rafters, &c. and there are some circumstances which must be particularly noticed, because they are not so obvious, and have been misunderstood. When a beam AB (fig. 17.) is supported at the ends, and a weight is laid on any point P, a strain is excited in every part of the beam. The load on P causes the beam to press on A and B, and the props react with forces equal and opposite to these pressures. The load at P is to the pressures at A and B as AB to PB and PA, and the pressures at A is to that at B as PB to PA; the beam therefore is in the same state, with respect to strain in every part of it, as if it were resting on a prop at P, and were loaded at the ends with weights equal to the two pressures on the props: and observe, these pressures are such as will balance each other, being inversely as their distances from P. Let P represent the weight or load at P. The pressure on the prop P must be $P \times \frac{PA}{AB}$. This is therefore the reaction of the prop B, and is the weight which we may suppose suspended at B, when we conceive the beam resting on a prop at P, and carrying the balancing weights at A and B.

The strain occasioned at any other point C, by the load P at P, is the same with the strain at C, by the weight $P \times \frac{PA}{AB}$ hanging at B, when the beam rests on P, in the manner now supposed; and it is the same if the beam, instead of being balanced on a prop at P, had its part AP fixed in a wall. This is evident. Now we have shown at length that the strain at C, by the weight $P \times \frac{PA}{AB}$ hanging at B, is $P \times \frac{PA}{AB} \times BC$. We desire it to be particularly remarked that the pressure at A has no influence on the strain at C, arising from the action of any load between A and C; for it is indifferent how the part AP of the projecting beam PB is supported. The weight at A just performs the same office with the wall in which we suppose the beam to be fixed. We are thus particular, because we have seen even persons not unaccustomed to discussions of this kind puzzled in their conceptions of this strain.

Now let the load P be laid on some point p between C and B. The same reasoning shows us that the point is (with respect to strain) in the same state as if the beam were fixed in a wall, embracing the part pB, and a weight $= P \times \frac{pB}{AB}$ were hung on at A, and the strain at C is $P \times \frac{pB}{AB} \times AC$.

92 A general proposition. In general, therefore, the strain on any point C, arising from a load P laid on another point P, is proportional to the rectangle of the distances of P and C from the ends nearest to each. It is $P \times \frac{PA \times CB}{AB}$, or $P \times \frac{pB \times CA}{AB}$, according as the load lies between C and A or between C and B.

Cor. 1. The strains which a load on any point P occasions on the points C, c, lying on the same side of P, are as the distances of these points from the end B. In like manner the strains on E and e are as EA and e A.

Cor. 2. The strain which a load occasions in the part on which it rests is as the rectangle of the parts on each side. Thus the strain occasioned at C by a load is to that at D by the same load as $AC \times CB$ to $AD \times DB$. It is therefore greatest in the middle.

93 The strain arising from a load distributed along the beam. Let us now consider the strain on any point C arising from a load uniformly distributed along the beam. Let AP be represented by x, and Pp by $\dot{x}$, and the whole weight on the beam by a. Then

The weight on Pp is $= a\,\frac{\dot{x}}{AB}$,

Pressure on B by the weight on Pp $= a\,\frac{\dot{x}}{AB} \times \frac{x}{AB}$.

Or

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Or $= a\frac{x\dot{x}}{AB^2}$.

Pref. on B by the whole wt. on AC $= a\frac{\frac{1}{2}AC^2}{AB^2} = a\frac{AC^2}{2\,AB^2}$.

Strain at C by the weight on AC $= a\frac{AC^2 \times BC}{2\,AB^2}$.

Strain at C by the weight on BC $= a\frac{BC^2 \times AC}{2\,AB^2}$.

Do. by the whole weight on AB $= a\frac{AC^2 \times BC + BC^2 \times AC}{2\,AB^2}$,

$= a\frac{AC \times BC \times \overline{AC + CB}}{2\,AB^2}, = a\frac{AC \times BC}{2\,AB}$.

Thus we fee that the ftrain is proportional to the rectangle of the parts, in the fame manner as if the load a had been laid directly on the point C, and is indeed equal to one-half of the ftrain which would be produced at C by the load a laid on there.

94
Miftakes in this fubject committed by authors of reputation.

It was neceffary to be thus particular, becaufe we fee in fome elementary treatifes of mechanics, publifhed by authors of reputation, miftakes which are very plaufible, and miflead the learner. It is there faid, that the preffure at B from a weight uniformly diffufed along AB is the fame as if it were collected at its centre of gravity, which would be the middle of AB; and then the ftrain at C is faid to be this preffure at B multiplied by BC. But furely it is not difficult to fee the difference of thefe ftrains. It is plain that the preffure of gravity downwards on any point between the end A and the point C has no tendency to diminifh the ftrain at C, arifing from the upward reaction of the prop B; whereas the preffure of gravity between C and B is almoft in direct oppofition to it, and muft diminifh it. We may however avoid the fluxionary calculus with fafety by the confideration of the centre of gravity, by fuppofing the weights of AC and BC to be collected at their refpective centres of gravity; and the refult of this computation will be the fame as above: and we may ufe either method, although the weight is not uniformly diftributed, provided only that we know in what manner it is diftributed.

This inveftigation is evidently of importance in the practice of the engineer and architect, informing them what fupport is neceffary in the different parts of their conftructions. We confidered fome cafes of this kind in the article Roofs.

95
To form a joift which may have the fame relative ftrength in all its parts.

It is now eafy to form a joift, fo that it fhall have the fame relative ftrength in all its parts.

I. To make it equally able in all its parts to carry a given weight laid on any point C taken at random, or uniformly diffufed over the whole length, the ftrength of the fection at the point C muft be as AC × CB. Therefore

1. If the fides are parallel vertical planes, the fquare of the depth (which is the only variable dimenfion) or CD^2, muft be as AC × CB, and the depths muft be ordinates of an ellipfe.

2. If the tranfverfe fections are fimilar, we muft make CD^3 as AC × CB.

3. If the upper and under furfaces are parallel, the breadth muft be as AC × CB.

II. If the beam is neceffarily loaded at fome given point C, and we would have the beam equally able in all its parts to refift the ftrain arifing from the weight at C, we muft make the ftrength of every tranfverfe fection between C and either end as its diftance from that end. Therefore

1. If the fides are parallel vertical planes, we muft make $CD^2 : EF^2 = AC : AE$.

2. If the fections are fimilar, then $CD^3 : EF^3 = AC : AE$.

3. If the upper and under furfaces are parallel, then, breadth at C : breadth at E = AC : AE.

96
The ftrain and ftrength of fquare or circular plates of different extent but of equal thicknefs, may be determined from the fame principles.

The fame principles enable us to determine the ftrain and ftrength of fquare or circular plates, of different extent, but equal thicknefs. This may be comprehended in this general propofition.

Similar plates of equal thicknefs fupported all round will carry the fame abfolute weight, uniformly diftributed, or refting on fimilar points, whatever is their extent.

Suppofe two fimilar oblong plates of equal thicknefs, and let their lengths and breadths be L, l, and B, b. Let their ftrength or momentum of cohefion be C, c, and the ftrains from the weights W, w, be S, s.

Suppofe the plates fupported at the ends only, and refifting fracture tranfverfely. The ftrains, being as the weights and lengths, are as WL and $w\,l$, but their cohefion are as the breadths; and fince they are of equal relative ftrength, we have $WL : w\,l = B : b$, and $WLb = w\,l\,B$ and $L : l = w\,B : W\,b$: but fince they are of fimilar fhapes $L : l = B : b$, and therefore $w = W$.

The fame reafoning holds again when they are alfo fupported along the fides, and therefore holds when they are fupported all round (in which cafe the ftrength is doubled).

And if the plates are of any other figure, fuch as circles or ellipfes, we need only conceive fimilar rectangles infcribed in them. Thefe are fupported all round by the continuity of the plates, and therefore will fuftain equal weights; and the fame may be faid of the fegments which lie without them, becaufe the ftrengths of any fimilar fegments are equal, their lengths being as their breadths.

Therefore the thicknefs of the bottoms of veffels holding heavy liquors or grains fhould be as their diameters, and as the fquare root of their depths jointly.

Alfo the weight which a fquare plate will bear is to that which a bar of the fame matter and thicknefs will bear as twice the length of the bar to its breadth.

97
The ftrain of a beam arifing from its own weight.

There is yet another modification of the ftrain which tends to break a body tranfverfely, which is of very frequent occurrence, and in fome cafes muft be very carefully attended to, viz. the ftrain arifing from its own weight.

When a beam projects from a wall, every fection is ftrained by the weight of all that projects beyond it. This may be confidered as all collected at its centre of gravity. Therefore the ftrain on any fection is in the joint ratio of the weight of what projects beyond it, and the diftance of its centre of gravity from the fection.

The determination of this ftrain and of the ftrength neceffary for withftanding it muft be more complicated than the former, becaufe the form of the piece which refults from this adjuftment of ftrain and ftrength influences the ftrain. The general principle muft evidently be, that the ftrength or momentum of cohefion of every fection muft be as the product of the weight beyond it multiplied by the diftance of its centre of gravity. For example:

98
General principle refpecting it.

Plate CCCCLXXXV.

Suppofe the beam DLA (fig. 18.) to project from the wall, and that its fides are parallel vertical planes, fo that the depth is the only variable dimenfion. Let $LB = x$ and $Bb = y$. The element $BbcC$ is $= y\dot{x}$. Let G be the centre of gravity of the part lying without Bb, and g be its diftance from the extremity L. Then $x - g$ is the arm of the lever by which the ftrain is excited in the fection Bb. Let Bb or y be as fome power m of LB; that is, let $y = x^m$. Then the contents of LBb is $\frac{x^{m+1}}{m+1}$. The momentum of gravity round a horizontal axis at L is $y\,x\,\dot{x} = x^{m+1}\dot{x}$, and the whole momentum round the axis is $\frac{x^{m+2}}{m+2}$. The diftance of the

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of the centre of gravity from L is had by dividing this momentum by the whole weight, which is $\frac{x^{m+1}}{m+1}$. The quotient or g is $\frac{x \times \overline{m+1}}{m+2}$. And the distance of the centre of gravity from the section B b is $x - \frac{x \times m+1}{m+2}, = \frac{x \times \overline{m+2} - x \times \overline{m+1}}{m+2}, = \frac{x}{m+2}$. Therefore the strain on the section B b is had by multiplying $\frac{x^{m+1}}{m+1}$ by $\frac{x}{m+2}$. The product is $\frac{x^{m+2}}{m+2 \times m+1}$. This must be as the square of the depth, or as y^2. But y is as x^m, and y^2 as x^{2m}. Therefore we have $m+2 = 2m$, and $m = 2$; that is, the depth must be as the square of the distance from the extremity, and the curve L b A is a parabola touching the horizontal line in L.

99 A conoid equally able in every section to bear its own weight.

It is easy to see that a conoid formed by the rotation of this figure round DL will also be equally able in every section to bear its own weight.

We need not prosecute this farther. When the figure of the piece is given, there is no difficulty in finding the strain; and the circumstance of equal strength to resist this strain is chiefly a matter of curiosity.

100 The more a beam projects, the less able it is to bear its own weight.

It is evident, from what has been already said, that a projecting beam becomes less able to bear its own weight, as it projects farther. Whatever may be the strength of the section DA, the length may be such that it will break by its own weight. If we suppose two beams A and B of the same substance and similar shapes, that is, having their lengths and diameters in the same proportion; and farther suppose that the shorter can just bear its own weight; then the longer beam will not be able to do the same: For the strengths of the sections are as the cubes of the diameters, while the strains are as the biquadrates of the diameters; because the weights are as the cubes, and the levers by which these weights act in producing the strain are as the lengths or as the diameters.

101 Small bodies more able to withstand the strain produced by the weight of the machine than great ones.

These considerations show us, that in all cases where the strain is affected by the weight of the parts of the machine or structure of any kind, the smaller bodies are more able to withstand it than the greater; and there seems to be bounds set by nature to the size of machines constructed of any given materials. Even when the weight of the parts of the machine is not taken into the account, we cannot enlarge them in the same proportion in all their parts. Thus a steam-engine cannot be doubled in all its parts, so as to be still efficient. The pressure on the piston is quadrupled. If the lift of the pump be also doubled in height while it is doubled in diameter, the load will be increased eight times, and will therefore exceed the power. The depth of lift, therefore, must remain unchanged; and in this case the machine will be of the same relative strength as before, independent of its own weight. For the beam being doubled in all its dimensions, its momentum of cohesion is eight times greater, which is again a balance for a quadruple load acting by a double lever.—But if we now consider the increase of the weight of the machine itself, which must be supported, and which must be put in motion by the intervention of its cohesion, we see that the large machine is weaker and less efficient than the small one.

There is a similar limit set by nature to the size of plants and animals formed of the same matter. The cohesion of an herb could not support it if it were increased to the size of a tree, nor could an oak support itself if 40 or 50 times bigger, nor could an animal of the make of a long-legged spider be increased to the size of a man; the articulations of its legs could not support it.

102 Even from this remark for strength and agility.

Hence may be understood the prodigious superiority of the small animals both in strength and agility. A man by falling twice his own height may break his firmest bones. A mouse may fall 20 times its height without risk; and even the tender mite or wood-louse may fall unhurt from the top of a steeple. But their greatest superiority is in respect of nimbleness and agility. A flea can leap above 500 times its own length, while the strength of the human muscles could not raise the trunk from the ground on limbs of the same construction.

The angular motions of small animals (in which consists their nimbleness or agility) must be greater than those of large animals, supposing the force of the muscular fibre to be the same in both. For supposing them similar, the number of equal fibres will be as the square of their linear dimensions; and the levers by which they act are as their linear dimensions. The energy therefore of the moving force is as the cube of these dimensions. But the momentum of inertia, or $\int p \cdot r^2$, is as the 4th power: Therefore the angular velocity of the greater animals is smaller. The number of strokes which a fly makes with its wings in a second is astonishingly great; yet, being voluntary, they are the effects of its agility.

We have hitherto confined our attention to the simplest form in which this transverse strain can be produced. This was quite sufficient for showing us the mechanism of nature by which the strain is resisted; and a very slight attention is sufficient for enabling us to reduce to this every other way in which the strain can be produced. We shall not take up the reader's time with the application of the same principles to other cases of this strain, but refer him to what has been said in the article Roofs. In that article we have shown the analogy between the strain on the section of a beam projecting from a wall and loaded at the extremity, and the strain on the same section of a beam simply resting on supports at the ends, and loaded at some intermediate point or points. The strain on the middle C of a beam AB (fig. 19.) so supported, arising from a weight laid on there, is the same with the strain which half that weight hanging at B would produce on the same section C if the other end of the beam were fixed in a wall. If therefore 1000 pounds hung on the end of a beam projecting 10 feet from a wall will just break it at the wall, it will require 4000 pounds on its middle to break the same beam resting on two props 10 feet asunder. We have also shown in that article the additional strength which will be given to this beam by extending both ends beyond the props, and there framing it firmly into other pillars or supports. We can hardly add any thing to what has been said in that article, except a few observations on the effects of the obliquity of the external force. We have hitherto supposed it to act in the direction BP (fig. 6.) perpendicular to the length of the beam. Suppose it to act in the direction BP′, oblique to BA.

103 Effects of the obliquity of the external force.

In the article Roof we supposed the strain to be the same as if the force p acted at the distance AB′, but still perpendicular to AB: so it is. But the strength of the section Aα is not the same in both cases; for by the obliquity of the action the piece DCKα is pressed to the other. We are not sufficiently acquainted with the corpuscular forces to say precisely what will be the effect of the pressure arising from this obliquity; but we can clearly see, in general, that the point A, which in the instant of fracture is neither stretched nor compressed, must now be farther up, or nearer to

to D; and therefore the number of particles which are exerting coheſive forces is ſmaller, and therefore the ſtrength is diminiſhed. Therefore, when we endeavour to proportion the ſtrength of a beam to the ſtrain ariſing from an external force acting obliquely, we make too liberal allowance by increaſing this external force in the ratio of AB to AB′. We acknowledge our inability to aſſign the proper correction. But this circumſtance is of very great influence. In many machines, and many framings of carpentry, this oblique action of the ſtraining force is unavoidable; and the moſt enormous ſtrains to which materials are expoſed are generally of this kind. In the frames ſet up for carrying the ringſtones of arches, it is hardly poſſible to avoid them: for although the judicious engineer diſpoſes his beams ſo as to ſuſtain only preſſures in the direction of their lengths, tending either to cruſh them or to tear them aſunder, it frequently happens that, by the ſettling of the work, the pieces come to check and bear on each other tranſverſely, tending to break each other acroſs. This we have remarked upon in the article Roofs, with reſpect to a truſs by Mr Price (ſee Roofs, n° 40, 41, 45). Now when a croſs ſtrain is thus combined with an enormous preſſure in the direction of the length of the bream, it is in the utmoſt danger of ſnapping ſuddenly acroſs. This is one great cauſe of the carrying away of maſts. They are compreſſed in the direction of their length by the united force of the ſhrouds, and in this ſtate the tranſverſe action of the wind ſoon completes the fracture.

104 Strain on columns. When conſidering the compreſſing ſtrains to which materials are expoſed, we deferred the diſcuſſion of the ſtrain on columns, obſerving that it was not, in the caſes which uſually occur, a ſimple compreſſion, but was combined with a tranſverſe ſtrain, ariſing from the bending of the column. When the column ACB (fig. 20.) reſting on the ground at B, and loaded at top with a weight A, acting in the vertical direction AB, is bent into a curve ACB, ſo that the tangent at C is perpendicular to the horizon, its condition ſomewhat reſembles that of a beam firmly fixed between B and C, and ſtrongly pulled by the end A, ſo as to bend it between C and A. Although we cannot conceive how a force acting on a ſtraight column AB in the direction AB can bend it, we may ſuppoſe that the force acted firſt in the horizontal direction A b, till it was bent to this degree, and that the rope was then gradually removed from the direction A b to the direction AB, increaſing the force as much as is neceſſary for preſerving the ſame quantity of flexure.

105 Obſervations on Euler's theory of the ſtrength of columns. The firſt author (we believe) who conſidered this important ſubject with ſcrupulous attention was the celebrated Euler, who publiſhed in the Berlin Memoirs for 1757 his Theory of the Strength of Columns. The general propoſition eſtabliſhed by this theory is, that the ſtrength of priſmatical columns is in the direct quadruplicate ratio of their diameters and the inverſe duplicate ratio of their lengths. He proſecuted this ſubject in the Peterſburgh Commentaries for 1778, confirming his former theory. We do not find that any other author has beſtowed much attention on it, all ſeeming to acquieſce in the determinations of Euler, and to conſider the ſubject as of very great difficulty, requiring the application of the moſt refined mathematics. Muſchenbroek has compared the theory with experiment; but the compariſon has been very unſatisfactory, the difference from the theory being ſo enormous as to afford no argument for its juſtneſs. But the experiments do not contradict it, for they are ſo anomalous as to afford no concluſion or general rule whatever.

To ſay the truth, the theory can be conſidered in no other light than as a ſpecimen of ingenious and very artful algebraic analyſis. Euler was unqueſtionably the firſt analyſt in Europe for reſource and addreſs. He knew this, and enjoyed his ſuperiority, and without ſcruple admitted any phyſical aſſumptions which gave him an opportunity of diſplaying his ſkill. The inconſiſtency of his aſſumptions with the known laws of mechaniſm gave him no concern; and when his algebraic proceſſes led him to any concluſion which would make his readers ſtare, being contrary to all our uſual notions, he frankly owned the paradox, but went on in his analyſis, ſaying, "*Sed analyſi magis fidendum.*" Mr Robins has given ſome very riſible inſtances of this confidence in his analyſis, or rather of his confidence in the indolent ſubmiſſion of his readers. Nay, ſo fond was he of this kind of amuſement, that after having publiſhed an untenable Theory of Light and Colours, he publiſhed ſeveral Memoirs, explaining the aberration of the heavenly bodies, and deducing ſome very wonderful conſequences, fully confirmed by experience, from the Newtonian principles, which were oppoſite and totally inconſiſtent with his own theory, merely becauſe the Newtonian theory gave him "*occaſionem analyſeos promovendæ.*" We are thus ſevere in our obſervations, becauſe his theory of the ſtrength of columns is one of the ſtrongeſt inſtances of this wanton kind of proceeding, and becauſe his followers in the Academy of St Peterſburgh, ſuch as Mr Fuſs, Lexill, and others, adopt his concluſions, and merely echo his words. Since the death of Dan. Bernoulli no member of that academy has controverted any thing advanced by their *Profeſſor ſublimis geometriæ*, to whom they had been indebted for their places and for all their knowledge, having been (moſt of them) his amanuenſes, employed by this wonderful man during his blindneſs to make his computations and carry on his algebraic inveſtigations. We are not a little ſurpriſed to ſee Mr Emerſon, a conſiderable mathematician, and a man of very independent ſpirit, haſtily adopting the ſame theory, of which we doubt not but our readers will eaſily ſee the falſity.

Euler conſiders the column ACB as in a condition preciſely ſimilar to that of an elaſtic rod bent into the curve by a cord AB connecting its extremities.—In this he is not miſtaken.—But he then draws CD perpendicular to AB, and conſiders the ſtrain on the ſection C as equal to the momentum or mechanical energy of the weight A acting in the direction DB upon the lever $\times c$ D, moveable round the fulcrum c, and tending to tear aſunder the particles which cohere along the ſection c C $\times$. This is the ſame principle (as Euler admits) employed by James Bernoulli in his inveſtigation of the elaſtic curve ACB. Euler conſiders the ſtrain on the ſection $c \times$ as the ſame with what it would ſuſtain if the ſame power acted in the horizontal direction EF on a point E as far removed from C as the point D is. We reaſoned in the ſame manner (as has been obſerved) in the article Roofs, where the obliquity of action was inconſiderable. But in the preſent caſe, this ſubſtitution leads to the greateſt miſtakes, and has rendered the whole of this theory falſe and uſeleſs. It would be juſt if the column were of materials which are incompreſſible. But it is evident, by what has been ſaid above, that by the compreſſion of the parts the real fulcrum of the lever ſhifts away from the point c, ſo much the more as the compreſſion is greater. In the great compreſſions of loaded columns, and the almoſt unmeaſurable compreſſions of the truſs beams in the centres of bridges, and other caſes of chief importance, the fulcrum is ſhifted far over towards $\times$, ſo that very few fibres reſiſt the fracture by their coheſion; and theſe few have a very feeble energy or momentum, on account of the ſhort arm of the lever by which they act. This is a moſt important conſideration in carpentry, yet makes no element of Euler's theory. The conſequence of this is, that a very ſmall degree of curvature is ſufficient to cauſe the co-

Strength of Materials. beam or strutt to snap in an instant, as is well known to every experienced carpenter. The experiment by Muschenbroek, which Euler makes use of in order to obtain a measure of strength in a particular instance, from which he might deduce all others by his theorem, is an incontestable proof of this. The force which broke the column is not the twentieth part of what is necessary for breaking it by acting at E in the direction EF. Euler takes no notice of this enormous discrepancy, because it must have checked him to abandon the speculation with which he was then amusing himself.

106 This theory false and useless.

The limits of this Work do not afford room to enter minutely upon the refutation of this theory; but we can easily show its uselessness, by its total inconsistency with common observation. It results legitimately from this theory, that if CD have no magnitude, the weight A can have no momentum, and the column cannot be broken— True,—it cannot be broken in this way, snapped by a transverse fracture, if it do not bend; but we know very well that it can be crushed or crippled, and we see this frequently happen. This circumstance or event does not enter into Euler's investigation, and therefore the theory is imperfect at least and useless. Had this crippling been introduced in the form of a physical assumption, every topic of reasoning employed in the process must have been laid aside, as the intelligent reader will easily see. But the theory is not only imperfect, but false. The ordinary reader will be convinced of this by another legitimate consequence of it. Fig. 20. n° 2. is the same with fig. 106 of *Emerson's Mechanics*, where this subject is treated on Euler's principles, and represents a crooked piece of matter resting on the ground at F, and loaded at A with a weight acting in the vertical direction AF. It results from Euler's theory that the strains at *b*, B, D, E, &c. are as *b c*, BC, DI, EK, &c. Therefore the strains at G and H are nothing; and this is asserted by Emerson and Euler as a serious truth; and the piece may be thinned *ad infinitum* in these two places, or even cut through, without any diminution of its strength. The absurdity of this assertion strikes at first hearing. Euler asserts the same thing with respect to a point of contrary flexure. Farther discussion is (we apprehend) needless.

107 Yet Euler's dissertations deserve a perusal.

This theory must therefore be given up. Yet these dissertations of Euler in the Petersburgh Commentaries deserve a perusal, both as very ingenious specimens of analysis, and because they contain maxims of practice which are important. Although they give an erroneous measure of the comparative strength of columns, they show the immense importance of preventing all bendings, and point out with accuracy where the tendencies to bend are greatest, and how this may be prevented by very small forces, and what a prodigious accession of force this gives the column. There is a valuable paper in the same volume by Fuss *on the Strains on framed Carpentry*, which may also be read with advantage.

108 A new theory cannot be substituted in place of Euler's, till many experiments be made.

It will now be asked, what shall be substituted in place of this erroneous theory? what is the true proportion of the strength of columns? We acknowledge our inability to give a satisfactory answer. Such can be obtained only by a previous knowledge of the proportion between the extensions and compressions produced by equal forces, by the knowledge of the absolute compressions producible by a given force, and by a knowledge of the degree of that derangement of parts which is termed crippling. These circumstances are but imperfectly known to us, and there lies before us a wide field of experimental inquiry. Fortunately the force requisite for crippling a beam is prodigious, and a very small lateral support is sufficient to prevent that bending which puts the beam in imminent danger. A judicious engineer will always employ transverse bridles, as they are called, to stay the middle of long beams, which are employed as pillars, strutts, or truss beams, and are exposed, by their position, to enormous pressures in the direction of their lengths. Such stays may be observed, disposed with great judgment and economy, in the centres employed by Mr Perronet in the erection of his great stone arches. He was obliged to correct this omission made by his ingenious predecessor in the beautiful centres of the bridge of Orleans, which we have no hesitation in affirming to be the finest piece of carpentry in the world.

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It only remains on this head to compare these theoretical deductions with experiment.

Experiments on the transverse strength of bodies are easily made, and accordingly are very numerous, especially those made on timber, which is the case most common and most interesting. But in this great number of experiments there are very few from which we can draw much practical information. The experiments have in general been made on such small scantlings, that the unavoidable natural inequalities bear too great a proportion to the strength of the whole piece. Accordingly, when we compare the experiments of different authors, we find them differ enormously, and even the experiments by the same author are very anomalous. The completest series that we have yet seen is that detailed by Belidor in his *Science des Ingenieurs*. They are contained in the following table. The pieces were found, even-grained oak. The column *b* contains the breadths of the pieces in inches; the column *d* contains their depths; the column *l* contains their lengths; column *p* contains the weights (in pounds) which broke them when hung on their middles; and *m* is the column of averages or mediums. 109 Table of experiments made by Belidor.

N	b	d	l	p	m	
1	1	1	18	400 415 405	406	The ends lying loose.
2	1	1	18	600 600 624	608	The ends firmly fixed.
3	2	1	18	810 795 812	805	Loose.
4	1	2	18	1570 1580 1590	1580	Loose.
5	1	1	36	185 195 180	187	Loose.
6	1	1	36	285 280 285	283	Fixed.
7	2	2	36	1550 1620 1585	1585	Loose.
8	$1\frac{1}{2}$	$2\frac{1}{2}$	36	1665 1675 1640	1660	Loose.

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By comparing Experiments 1ſt and 3d, the ſtrength appears proportional to the breadth.

Experiments 3d and 4th ſhew the ſtrength proportional to the ſquare of the depth.

Experiments 1ſt and 5th ſhew the ſtrength nearly in the inverſe proportion of the lengths, but with a ſenſible deficiency in the longer pieces.

Experiments 5th and 7th ſhew the ſtrengths proportional to the breadths and the ſquare of the depth.

Experiments 1ſt and 7th ſhew the ſame thing, compounded with the inverſe proportion of the length: the deficiency relative to the length is not ſo remarkable here.

Experiments 1ſt and 2d and experiments 5th and 6th ſhew the increaſe of ſtrength, by faſtening the ends, to be in the proportion of 2 to 3. The theory gives the proportion of 2 to 4. But a difference in the manner of fixing may produce this deviation from the theory, which only ſuppoſed them to be held down at places beyond the props, as when a joiſt is held in the walls, and alſo reſts on two pillars between the walls. (See what is ſaid on this ſubject in the article Roof, § 19.); where note, that there is a miſtake, when it is ſaid that a beam ſupported at both ends and loaded in the middle will carry twice as much as if one end were fixed in the wall and the weight ſuſpended at the other end. The reaſoning employed there ſhows that it will carry four times as much.

The chief ſource of irregularity in ſuch experiments is the fibrous, or rather plated texture of timber. It conſiſts of annual additions, whoſe coheſion with each other is vaſtly weaker than that of their own fibres. Let fig. 21. repreſent the ſection of a tree, and ABCD, *a b c d* the ſection of two battens that are to be cut out of it for experiment, and let AD and *a d* be the depths, and DC, *dc* the breadths. The batten ABCD will be the ſtrongeſt, for the ſame reaſon that an aſſemblage of planks ſet edgewiſe will form a ſtronger joiſt than planks laid above each other like the plates of a coach-ſpring. Mr Buffon found by many trials that the ſtrength of ABCD was to that of *a b c d* (in oak) nearly as 8 to 7. The authors of the different experiments were not careful that their battens had their plates all diſpoſed ſimilarly with reſpect to the ſtrain. But even with this precaution they would not have afforded ſure grounds of computation for large works; for great beams occupy much, if not the whole, of the ſection of the tree; and from this it has happened that their ſtrength is leſs than in proportion to that of a ſmall lath or batten. In ſhort, we can truſt no experiments but ſuch as have been made on large beams. Theſe muſt be very rare, for they are moſt expenſive and laborious, and exceed the abilities of moſt of thoſe who are diſpoſed to ſtudy this matter.

But we are not wholly without ſuch authority. Mr Buffon and Mr Du Hamel, two of the firſt philoſophers and mechanicians of the age, were directed by government to make experiments on this ſubject, and were ſupplied with ample funds and apparatus. The relation of their experiments is to be found in the Memoirs of the French Academy for 1740, 1741, 1742, 1768; as alſo in Du Hamel's valuable performances *ſur l'Exploitation des Arbres, et ſur la Conſervation et le Tranſport de Bois.* We earneſtly recommend theſe diſſertations to the peruſal of our readers, as containing much uſeful information relative to the ſtrength of timber, and the beſt methods of employing it. We ſhall here give an abſtract of Mr Buffon's experiments.

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111

Mr Buffon's experiments on bars of ſound oak.

He relates a great number which he had proſecuted during two years on ſmall battens. He found that the odds of a ſingle layer, or part of a layer, more or leſs, or even a different diſpoſition of them, had ſuch influence that he was obliged to abandon this method, and to have recourſe to the largeſt beams that he was able to break. The following table exhibits one ſeries of experiments on bars of ſound oak, clear of knots, and four inches ſquare. This is a ſpecimen of all the reſt.

Column 1ſt is the length of the bar in feet clear between the ſupports.

Column 2d is the weight of the bar (the 2d day after it was felled) in pounds. Two bars were tried of each length. Each of the firſt three pairs conſiſted of two cuts of the ſame tree. The one next the root was always found the heavieſt, ſtiffeſt, and ſtrongeſt. Indeed Mr Buffon ſays that this was invariably true, that the heavieſt was always the ſtrongeſt; and he recommends it as a certain (or ſure) rule for the choice of timber. He finds that this is always the caſe when the timber has grown vigorouſly, forming very thick annual layers. But he alſo obſerves that this is only during the advances of the tree to maturity; for the ſtrength of the different circles approaches gradually to equality during the tree's healthy growth, and then it decays in theſe parts in a contrary order. Our tool-makers aſſert the ſame thing with reſpect to beech: yet a contrary opinion is very prevalent; and wood with a fine, that is, a ſmall grain, is frequently preferred. Perhaps no perſon has ever made the trial with ſuch minuteneſs as Mr Buffon, and we think that much deference is due to his opinion.

Column 3d is the number of pounds neceſſary for breaking the tree in the courſe of a few minutes.

Column 4th is the inches which it bent down before breaking.

Column 5th is the time at which it broke.

1	2	3	4	5
7	60	5350	3,5	29'
	56	5275	4,5	22
8	68	4600	3,75	15
	63	4500	4,7	13
9	77	4100	4,85	14
	71	3950	5,5	12
10	84	3625	5,83	15
	82	3600	6,5	15
12	100	3050	7,	
	98	2925	8,	

The experiments on other ſizes were made in the ſame way. A pair at leaſt of each length and ſize was taken. The mean reſults are contained in the following table. The beams were all ſquare, and their ſizes in inches are placed at the head of the columns, and their lengths in feet are in the firſt column.

	4	5	6	7	8	A
7	5312	11525	18950	32200	47649	11525
8	4550	9787	15525	26050	39750	10085
9	4025	8308	13150	22350	32800	8964
10	3612	7125	11250	19475	27750	8068
12	2987	6075	9100	16175	23450	6723
14		5300	7475	13225	19775	5763
16		4350	6362	11000	16375	5042
18		3700	5562	9245	13200	4482
20		3225	4950	8375	11487	4034
22		2975				3667
24		2162				3362
28		1775				2881

Mr Buffon had found by numerous trials that oak-timber lost much of its ftrength in the courfe of drying or feafoning; and therefore, in order to fecure uniformity, his trees were all felled in the fame feafon of the year, were fquared the day after, and tried the third day. Trying them in this green ftate gave him an opportunity of obferving a very curious and unaccountable phenomenon. When the weights were laid brifkly on, nearly fufficient to break the log, a very fenfible fmoke was obferved to iffue from the two ends with a fharp hiffing noife. This continued all the while the tree was bending and cracking. This fhows that the log is affected or ftrained through its whole length; indeed this muft be inferred from its bending through its whole length. It alfo fhows us the great effects of the compreffion. It is a pity Mr Buffon did not take notice whether this fmoke iffued from the upper or compreffed half of the fection only, or whether it came from the whole.

112 Obfervations on Mr Buffon's experiments.

We muft now make fome obfervations on thefe experiments, in order to compare them with the theory which we have endeavoured to eftablifh.

Mr Buffon confiders the experiments with the 5-inch bars as the ftandard of comparifon, having both extended thefe to greater lengths, and having tried more pieces of each length.

Our theory determines the relative ftrength of bars of the fame fection to be inverfely as their lengths. But (if we except the five experiments in the firft column) we find a very great deviation from this rule. Thus the 5-inch bar of 28 feet long fhould have half the ftrength of that of 14 feet, or 2650; whereas it is but 1775. The bar of 14 feet fhould have half the ftrength of that of 7 feet, or 5762; whereas it is but 5300. In like manner, the fourth of 11525 is 2881; but the real ftrength of the 28-feet bar is 1775. We have added a column A, which exhibits the ftrength which each of the 5-inch bars ought to have by the theory. This deviation is moft diftinctly feen in fig. 22. where BK is the fcale of lengths, B being at the point 7 of the fcale and K at 28. The ordinate CB is $= 11525$, and the other ordinates DE, GK, &c. are refpectively $= \frac{7\,\text{CB}}{\text{Length}}$. The lines DF, GH, &c. are made $= 4350$, 1775, &c. expreffing the ftrengths given by experiment. The 10-feet bar and the 24-feet bar are remarkably anomalous. But all are deficient, and the defect has an evident progreffion from the firft to the laft. The fame thing may be fhown of the other columns, and even of the firft, though it is very fmall in that column. It may alfo be obferved in the experiments of Belidor, and in all that we have feen. We cannot doubt therefore of its being a law of nature, depending on the true principles of cohefion and the laws of mechanics.

But it is very puzzling, and we cannot pretend to give a fatisfactory explanation of the difficulty. The only effect which we can conceive the length of a beam to have, is to increafe the ftrain at the fection of fracture by employing the intervening beam as a lever. But we do not diftinctly fee what change this can produce in the mode of action of the fibres in this fection, fo as either to change their cohefion or the place of its centre of effort: yet fomething of this kind muft happen.

We fee indeed fome circumftances which muft contribute to make a fmaller weight fufficient, in Mr Buffon's experiments, to break a long beam than in the exact inverfe proportion of its length.

In the firft place, the weight of the beam itfelf augments the ftrain as much as if half of it were added in form of a weight. Mr Buffon has given the weights of every beam on which he made experiments, which is very nearly 74 pounds *per* cubic foot. But they are much too fmall to account for the deviation from the theory. The half weights of the 5-inch beams of 7, 14, and 28 feet length are only 45, 92, and 182 pounds; which makes the real ftrains in the experiments 11560, 5390, and 1956; which are far from having the proportions of 4, 2, and 1.

Buffon fays that healthy trees are univerfally ftrongeft at the root end; therefore, when we ufe a longer beam, its middle point, where it is broken in the experiment, is in a weaker part of the tree. But the trials of the 4-inch beams fhow that the difference from this caufe is almoft infenfible.

The length muft have fome mechanical influence which the theory we have adopted has not yet explained. It may not however be inadequate to the tafk. The very ingenious inveftigation of the elaftic curve by James Bernoulli and other celebrated mathematicians is perhaps as refined an application of mathematical analyfis as we know. Yet in this inveftigation it was neceffary, in order to avoid almoft infuperable difficulties, to take the fimpleft poffible cafe, viz. where the thicknefs is exceedingly fmall in comparifon with the length. If the thicknefs be confiderable, the quantities neglected in the calculus are too great to permit the conclufion to be accurate, or very nearly fo. Without being able to define the form into which an elaftic body of confiderable thicknefs will be bent, we can fay with confidence, that in an extreme cafe, where the compreffion in the concave fide is very great, the curvature differs confiderably from the Bernoullian curve. But as our inveftigation is incomplete and very long, we do not offer it to the reader. The following more familiar confiderations will, we apprehend, render it highly probable that the relative ftrength of beams decreafes fafter than in the inverfe ratio of their length. The curious obfervation by Mr Buffon of the vapour which iffued with a hiffing noife from the ends of a beam of green oak, while it was breaking by the load on its middle, fhows that the whole length of the piece was affected: indeed it muft be, fince it is bent throughout. We have fhown above, that a certain definite curvature of a beam of a given form is always accompanied by rupture. Now fuppofe the beam A of 10 feet long, and the beam B of 20 feet long, bent to the fame degree, at the place of their fixure in the wall; the weight which hangs on A is nearly double of that which muft hang on B. The form of any portion, fuppofe 5 feet, of thefe two beams, immediately adjoining to the wall, is confiderably different. At the diftance of 5 feet the curvature of A is $\frac{1}{2}$ of its curvature at the wall. The curvature of B in the correfponding point is $\frac{3}{4}$ths of the fame curvature at the wall. Through the whole of the intermediate 5 feet, therefore, the curvature of B is greater than that of A. This muft make it weaker throughout. It muft occafion the fibres to flide more on each other (that it may acquire *this* greater curvature), and thus affect their lateral union;

113 Probable that the relative ftrength of beams decreafes fafter than the inverfe ratio of their length.

gth of erials. union ; and therefore thoſe which are ſtronger will not aſſiſt their weaker neighbours. To this we muſt add, that in the ſhorter beams the force with which the fibres are preſſed laterally on each other is double. This muſt impede the mutual ſliding of the fibres which we mentioned a little ago; nay, this lateral compreſſion may change the law of longitudinal coheſion (as will readily appear to the reader who is acquainted with Boſcovich's doctrines), and increaſe the ſtrength of the very ſurface of fracture, in the ſame way (however inexplicable) as it does in metals when they are hammered or drawn into wire.

The reader muſt judge how far theſe remarks are worthy of his attention. The engineer will carefully keep in mind the important fact, that a beam of quadruple length, inſtead of having $\frac{1}{4}$th of the ſtrength, has only about $\frac{1}{6}$th ; and the philoſopher ſhould endeavour to diſcover the cauſe of this diminution, that he may give the artiſt a more accurate rule of computation.

14 annot ier the e re- be- the ture he entum heſion.

Our ignorance of the law by which the coheſion of the particles changes by a change of diſtance, hinders us from diſcovering the preciſe relation between the curvature and the momentum of coheſion ; and all we can do is to multiply experiments, upon which we may eſtabliſh ſome *empirical* rules for calculating the ſtrength of ſolids. Thoſe from which we muſt reaſon at preſent are too few and too anomalous to be the foundation of ſuch an empirical formula. We may, however, obſerve, that Mr Buffon's experiments give us conſiderable aſſiſtance in this particular : For if to each of the numbers of the column for the 5-inch beams, corrected by adding half the weight of the beam, we add the conſtant number 1245, we ſhall have a ſet of numbers which are very nearly reciprocals of the lengths. Let 1245 be called c, and let the weight which is known by experiment to be neceſſary for breaking the 5-inch beam of the length a be called P. We ſhall have $\frac{\overline{P+c}\times a}{l} - c = p$. Thus the weight neceſſary for breaking the 7-foot bar is 11560. This added to 1245, and the ſum multiplied by 7, gives $\overline{P+c}\times a = 89635$. Let l be 18 ; then $\frac{89635}{18} - 1245 = 3725, = p$, which differs not more than $\frac{1}{20}$th from what experiment gives us. This rule holds equally well in all the other lengths except the 10 and 24 foot beams, which are very anomalous. Such a formula is abundantly exact for practice, and will anſwer through a much greater variety of length, though it cannot be admitted as a true one ; becauſe, in a certain very great length, the ſtrength will be nothing. For other ſizes the conſtant number muſt change in the proportion of d^3, or perhaps of p.

15 ion een ength he e of epth ſec-

The next compariſon which we have to make with the theory is the relation between the ſtrength and the ſquare of the depth of the ſection. This is made by comparing with each other the numbers in any horizontal line of the table. In making this compariſon we find the numbers of the five-inch bars uniformly greater than the reſt. We imagine that there is ſomething peculiar to theſe bars : They are in general heavier than in the proportion of their ſection, but not ſo much ſo as to account for all their ſuperiority. We imagine that this ſet of experiments, intended as a ſtandard for the reſt, has been made at one time, and that the ſeaſon has had a conſiderable influence. The fact however is, that if this column be kept out, or uniformly diminiſhed about $\frac{1}{13}$th in their ſtrength, the different ſizes will deviate very little from the ratio of the ſquare of the depth, as determined by theory. There is however a ſmall deficiency in the bigger beams.

Strength of Materials.

We have been thus anxious in the examination of theſe experiments, becauſe they are the only ones which have been related in ſufficient detail, and made on a proper ſcale for giving us data from which we can deduce confidential maxims for practice. They are ſo troubleſome and expenſive that we have little hopes of ſeeing their number greatly increaſed ; yet ſurely our navy board would do an unſpeakable ſervice to the public by appropriating a fund for ſuch experiments under the management of ſome man of ſcience. 116

Proportion between the abſolute coheſion and the relative ſtrength.

There remains another compariſon which is of chief importance, namely, the proportion between the ABSOLUTE COHESION and the RELATIVE STRENGTH. It may be gueſſed, from the very nature of the thing, that this muſt be very uncertain. Experiments on the abſolute ſtrength muſt be confined to very ſmall pieces, by reaſon of the very great forces which are required for tearing them aſunder. The values therefore deduced from them muſt be ſubject to great inequalities. Unfortunately we have got no detail of any experiments ; all that we have to depend on is two paſſages of Muſchenbroek's *Eſſais de Phyſique* ; in one of which he ſays that a piece of ſound oak $\frac{27}{100}$ths of an inch ſquare is torn aſunder by 1150 pounds ; and in the other, that an oak plank 12 inches broad and 1 thick will juſt ſuſpend 189163 pounds. Theſe give for the coheſion of an inch ſquare 15,755 and 15,763 pounds. Bouguer, in his *Traité du Navire*, ſays that it is very well known that a rod of ſound oak $\frac{1}{4}$th of an inch ſquare will be torn aſunder by 1000 pounds. This gives 16000 for the coheſion of a ſquare inch. We ſhall take this as a round number, eaſily uſed in our computations. Let us compare this with Mr Buffon's trials of beams four inches ſquare.

The abſolute coheſion of this ſection is $16{,}000 \times 16 = 256{,}000$. Did every fibre exert its whole force in the inſtant of fracture, the momentum of coheſion would be the ſame as if it had all acted at the centre of gravity of the ſection at 2 inches from the axis of fracture, and is therefore 512000. The 4-inch beam, 7 feet long, was broken by 5312 pounds hung on its middle. The half of this, or 2656 pounds, would have broken it, if ſuſpended at its extremity, projecting $3\frac{1}{2}$ feet or 42 inches from a wall. The momentum of this ſtrain is therefore $2656 \times 42, = 111552$. Now this is in equilibrio with the actual momentum of coheſion, which is therefore 111552, inſtead of 512000. The ſtrength is therefore diminiſhed in the proportion of 512000 to 111552, or very nearly of 4,59 to 1.

As we are quite uncertain as to the place of the centre of effort, it is needleſs to conſider the full coheſion as acting at the centre of gravity, and producing the momentum 512,000 ; and we may convert the whole into a ſimple multiplyer m of the length, and ſay, *as m times the length is to the depth, ſo is the abſolute coheſion of the ſection to the relative ſtrength.* Therefore let the abſolute coheſion of a ſquare inch be called f, the breadth b, the depth d, and the length l (all in inches), the relative ſtrength, or the external force p, which balances it, is $\frac{f\,b\,d^2}{9{,}18\,l}$, or in round numbers $\frac{f\,b\,d^2}{9\,l}$; for $m = 2 \times 4{,}59$.

This great diminution of ſtrength cannot be wholly accounted for by the inequality of the coheſive forces exerted in the inſtant of fracture ; for in this caſe we know that the centre of effort is at $\frac{1}{3}$d of the height in a rectangular ſection (becauſe the forces really exerted are as the extenſions of the fibres). The relative ſtrength would be $\frac{f\,b\,d^2}{3\,l}$, and p would have been 8127 inſtead of 2656.

We muſt aſcribe this diminution (which is three times greater than that produced by the inequality of the coheſive

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Strength of Materials. five forces) to the compreſſion of the under part of the beam; and we muſt endeavour to explain in what manner this compreſſion produces an effect which ſeems ſo little explicable by ſuch means.

As we have repeatedly obſerved, it is a matter of nearly univerſal experience that the forces *actually* exerted by the particles of bodies, when ſtretched or compreſſed, are very nearly in the proportion of the diſtances to which the particles are drawn from their natural poſitions. Now, altho' we are certain that, in enormous compreſſions, the forces increaſe faſter than in this proportion, this makes no ſenſible change in the preſent queſtion, becauſe the body is broken before the compreſſions have gone ſo far; nay, we imagine that the compreſſed parts are crippled in moſt caſes even before the extended parts are torn aſunder. Muſchenbroek aſſerts this with great confidence with reſpect to oak, on the authority of his own experiments. He ſays, that although oak will ſuſpend half as much again as fir, it will not ſupport, as a pillar, two-thirds of the load which fir will ſupport in that form.

We imagine therefore that the mechaniſm in the *preſent* caſe is nearly as follows:

Let the beam DCK Δ (fig. 23.) be loaded at its extremity with the weight P, acting in the direction KP perpendicular to DC. Let D Δ be the ſection of fracture. Let DA be about $\frac{1}{3}$d of D Δ. A will be the particle or fibre which is neither extended nor compreſſed. Make Δ δ : D *d* = DA : A Δ. The triangles DA *d*, Δ A δ, will repreſent the accumulated attracting and repelling forces. Make AI and A *i* = $\frac{2}{3}$ DA and $\frac{2}{3}$ Δ A. The point I will be that to which the full coheſion D *d* or *f* of the particles in AD muſt be applied, ſo as to produce the ſame momentum which the variable forces at I, D, &c. really produce at their ſeveral points of application. In like manner, *i* is the centre of ſimilar effort of the repulſive forces excited by the compreſſion between A and Δ, and it is the real fulcrum of a bended lever I *i* K, by which the whole effect is produced. The effect is the ſame as if the full coheſion of the ſtretched fibres in AD were accumulated in I, and the full repulſion of all the compreſſed fibres in A Δ were accumulated in *i*. The forces which are balanced in the operation are the weight P, acting by the arm *k i*, and the full coheſion of AD acting by the arm I *i*. The forces exerted by the compreſſed fibres between A and Δ only ſerve to give ſupport to the lever, that it may exert its ſtrain.

We imagine that this does not differ much from the real procedure of nature. The poſition of the point A may be different from what we have deduced from Mr Buffon's experiments, compared with Muſchenbroek's value of the abſolute coheſion of a ſquare inch. If this laſt ſhould be only 12000, DA muſt be greater than we have here made it, in the proportion of 12000 to 16000. For I *i* muſt ſtill be made = $\frac{2}{3}$ A Δ, ſuppoſing the forces to be proportional to the extenſions and compreſſions. There can be no doubt that a part only of the coheſion of D Δ operates in reſiſting the fracture in all ſubſtances which have any compreſſibility; and it is confirmed by the experiments of Mr Du Hamel on willow, and the inferences are by no means confined to that ſpecies of timber. We ſay therefore, that when the beam is broken, the coheſion of AD alone is exerted, and that each fibre exerts a force proportional to its extenſion; and the accumulated momentum is the ſame as if the full coheſion of AD were acting by the lever I *i* = $\frac{2}{3}$d of D Δ.

It may be ſaid, that if only $\frac{1}{3}$d of the coheſion of oak be exerted, it may be cut $\frac{2}{3}$ds through without weakening it. But this cannot be, becauſe the coheſion of the whole is employed in preventing the lateral ſlide ſo often mentioned. We have no experiments to determine that it *may not* be cut through $\frac{1}{3}$d without loſs of its ſtrength. Strength of Materials.

This muſt not be conſidered as a ſubject of mere ſpeculative curioſity: It is intimately connected with all the practical uſes which we can make of this knowledge; for it is almoſt the only way that we can learn the compreſſibility of timber. Experiments on the direct coheſion are indeed difficult, and exceedingly expenſive if we attempt them in large pieces. But experiments on compreſſion are almoſt impracticable. The moſt inſtructive experiments would be, firſt to eſtabliſh, by a great number of trials, the tranſverſe force of a modern batten; and then to make a great number of trials of the diminution of its ſtrength, by cutting it through on the concave ſide. This would very nearly give us the proportion of the coheſion which really operates in reſiſting fractures. Thus if it be found that one-half of the beam may be cut on the under ſide without diminution of its ſtrength (taking care to drive in a ſlice of harder wood), we may conclude that the point A is at the middle, or ſomewhat above it.

Much lies before the curious mechanician, and we are as yet very far from a ſcientific knowledge of the ſtrength of timber.

In the mean time, we may derive from theſe experiments of Buffon a very uſeful practical rule, without relying on any value of the abſolute coheſion of oak. We ſee that the ſtrength is nearly as the breadth, as the ſquare of the depth, and as the inverſe of the length. It is moſt convenient to meaſure the breadth and depth of the beam in inches, and its length in feet. Since, then, a beam four inches ſquare and ſeven feet between the ſupports is broken by 5312 pounds, we muſt conclude that a batten one inch ſquare and one foot between the ſupports will be broken by 581 pounds. Then the ſtrength of any other beam of oak, or the weight which will juſt break it when hung on its middle, A uſeful practical rule deduced from Buffon's experiments.

is $581 \frac{b\,d^2}{l}$.

But we have ſeen that there is a very conſiderable deviation from the inverſe proportion of the lengths, and we muſt endeavour to accommodate our rule to this deviation. We found, that by adding 1245 to each of the ordinates or numbers in the column of the five-inch bars, we had a ſet of numbers very nearly reciprocal of the lengths; and if we make a ſimilar addition to the other columns in the proportion of the cubes of the ſixes, we have nearly the ſame reſult. The greateſt error (except in the caſe of experiments which are very irregular) does not exceed $\frac{1}{15}$th of the whole. Therefore, for a radical number, add to the 5312 the number 640, which is to 1245 very nearly as 4^3 to 5^3. This gives 5952. The 64th of this is 93, which correſponds to a bar of one inch ſquare and ſeven feet long. Therefore 93×7 will be the reciprocal correſponding to a bar of one foot. This is 651. Take from this the preſent empirical

correction, which is $\frac{b\,40}{b\,4}$, or 10, and there remains 641 for the ſtrength of the bar. This gives us for a general rule

$$p = 651 \frac{b\,d^2}{l} - 10\,b\,d^2.$$

Example. Required the weight neceſſary to break an oak beam eight inches ſquare and 20 feet between the props, $p = 651 \times \frac{8 \times 8^2}{20} - 10 \times 8 \times 8^2$. This is 11545, whereas the experiment gives 11487. The error is very ſmall indeed. The rule is moſt deficient in compariſon with the five-inch bars, which we have already ſaid appear ſtronger than the reſt.

 The

Strength of [illegible] The following process is easily remembered by such as are not algebraists.

Multiply the breadth in inches twice by the depth, and call this product t. Multiply t by 551, and divide by the length in feet. From the quotient take 10 times t. The remainder is the number of pounds which will break the beam.

We are not sufficiently sensible of our principles to be confident that the correction 10 t should be in the proportion of the section, although we think it most probable. It is quite empirical, founded on Buffon's experiments. Therefore the safe way of using this rule is to suppose the beam square, by increasing or diminishing its breadth till equal to the depth. Then find the strength by this rule, and diminish or increase it for the change which has been made in its breadth. Thus, there can be no doubt that the strength of the beam given as an example is double of that of a beam of the same depth and half the breadth.

The reader cannot but observe that all this calculation relates to the very greatest weight which a beam will bear for a very few minutes. Mr Buffon uniformly found that two-thirds of this weight sensibly impaired its strength, and frequently broke it at the end of two or three months. One-half of this weight brought the beam to a certain bend, which did not increase after the first minute or two, and may be borne by the beam for any length of time. But the beam contracted a bend, of which it did not recover any considerable portion. One-third seemed to have no permanent effect on the beam; but it recovered its rectilineal shape completely, even after having been loaded several months, provided that the timber was seasoned when first loaded; that is to say, one-third of the weight which would quickly break a seasoned beam, or one-fourth of what would break one just felled, may lie on it for ever without giving the beam a sett.

We have no detail of experiments on the strength of other kinds of timber: only Mr Buffon says, that fir has about [illegible]ths of the strength of oak; Mr Parent makes it $\frac{18}{23}$ths; Emerson, $\frac{2}{3}$ds, &c.

We have been thus minute in our examination of the mechanism of this transverse strain, because it is the greatest to which the parts of our machines are exposed. We wish to impress on the minds of artists the necessity of avoiding this as much as possible. They are improving in this respect, as may be seen by comparing the centres on which stone arches of great span are now turned with those of former times. They were formerly a load of mere joists resting on a multitude of posts, which obstructed the navigation, and were frequently losing their shape by some of the posts sinking into the ground. Now they are more generally trusses, where the beams abutt on each other, and are relieved from transverse strains. But many performances of eminent artists are still very injudiciously exposed to cross strains. We may instance one which is considered as a fine work, viz. the bridge at Walton on Thames. Here every beam of the great arch is a joist, and it hangs together by framing. The finest piece of carpentry that we have seen is the centre employed in turning the arches of the bridge at Orleans, described by Perronet. In the whole there is not one cross strain. The beam, too, of Hornblower's steam-engine, described in that article, is very scientifically constructed.

118 Strain produced by twisting. IV. The last species of strain which we are to examine is that produced by twisting. This takes place in all axles which connect the working parts of machines.

Although we cannot pretend to have a very distinct conception of that modification of the cohesion of a body by which it resists this kind of strain, we can have no doubt that, when all the particles act alike, the resistance must be proportional to the number. Therefore if we suppose the two parts ABCD, ABFE (fig. 24.), of the body EFCD to be of insuperable strength, but cohering more weakly in the common surface AB, and that one part ABCD is pushed laterally in the direction AB, there can be no doubt that it will yield only there, and that the resistance will be proportional to the surface. Strength of fibres. 119 The resistance must be proportional to the number of particles.

In like manner, we can conceive a thin cylindrical tube, of which KAH (fig. 25.) is the section, as cohering more weakly in that section than anywhere else. Suppose it to be grasped in both hands, and the two parts twisted round the axis in opposite directions, as we would twist the two joints of a fluce, it is plain that it will first fail in this section, which is the circumference of a circle, and the particles of the two parts which are contiguous to this circumference will be drawn from each other laterally. The total resistance will be as the number of equally resisting particles, that is, as the circumference (for the tube being supposed very thin, there can be no sensible difference between the dilatation of the external and internal particles). We can now suppose another tube within this, and a third within the second, and so on till we reach the centre. If the particles of each ring exerted the same force (by suffering the same dilatation in the direction of the circumference), the resistance of each ring of the section would be as its circumference and its breadth (supposed indefinitely small), and the whole resistance would be as the surface; and this would represent the resistance of a solid cylinder. But when a cylinder is twisted in this manner by an external force applied to its circumference, the external parts will suffer a greater circular extension than the internal; and it appears that this extension (like the extension of a beam strained transversely) will be proportional to the distance of the particles from the axis. We cannot say that this is demonstrable, but we can assign no proportion that is more probable. This being the case, the forces simultaneously exerted by each particle will be as its distance from the axis. Therefore the whole force exerted by each ring will be as the square of its radius, and the accumulated force actually exerted will be as the cube of the radius; that is, the accumulated force exerted by the whole cylinder, whose radius is CA, is to the accumulated force exerted *at the same time* by the part whose radius is CE, as CA^3 to CE^3.

The whole cohesion now exerted is just two-thirds of what it would be if all the particles were exerting the same attractive forces which are just now exerted by the particles in the external circumference. This is plain to any person in the least familiar with the fluxionary calculus. But such as are not may easily see it in this way.

Let the rectangle AC$c$$a$ be set upright on the surface of the circle along the line CA, and revolve round the axis Cc. It will generate a cylinder whose height is Cc or Aa, and having the circle KAH for its base. If the diagonal Ca be supposed also to revolve, it is plain that the triangle cCa will generate a cone of the same height, and having for its base the circle described by the revolution of ca, and the point C for its apex. The cylindrical surface generated by Aa will express the whole cohesion exerted by the circumference AHK, and the cylindrical surface generated by Ee will represent the cohesion exerted by the circumference ELM, and the solid generated by the triangle CAa will represent the cohesion exerted by the whole circle AHK, and the cylinder generated by the rectangle ACca will represent the cohesion exerted by the same surface if each particle had suffered the extension Aa.

Now it is plain, in the first place, that the solid generated by the triangle eEC is to that generated by aAC as EC^3 to AC^3. In the next place, the solid generated by

Strength of Materials.

a A C is two-thirds of the cylinder, because the cone generated by a C A is one-third of it.

We may now suppose the cylinder twisted till the particles in the external circumference lose their cohesion. There can be no doubt that it will now be wrenched asunder, all the inner circles yielding in succession. Thus we obtain

120 [illegible]

one useful information, viz. that a body of homogeneous texture resists a *twist* with two-thirds of the force with which it resists an attempt to force one part laterally from the other, or with one-third part of the force which will cut it asunder by a square edged tool. For to drive a square-edged tool through a piece of lead, for instance, is the same as forcing a piece of the lead as thick as the tool laterally away from the two pieces on each side of the tool. Experiments of this kind do not seem difficult, and they would give us very useful information.

121 The forces exerted in breaking two cylinders are as the squares of the diameters.

When two cylinders AHK and BNO are wrenched asunder, we must conclude that the external particles of each are just put beyond their limits of cohesion, are equally extended, and are exerting equal forces. Hence it follows, that in the instant of fracture the sum total of the forces actually exerted are as the squares of the diameters.

For drawing the diagonal C e, it is plain that E e, = A a, expresses the distension of the circumference ELM, and that the solid generated by the triangle CE e expresses the cohesion exerted by the surface of the circle ELM, when the particles in the circumference suffer the extension E e equal to A a. Now the solids generated by CA a and CE e being respectively two thirds of the corresponding cylinders, are as the squares of the diameters.

122 Relative strength of the section to the external force employed to break it.

Having thus ascertained the real strength of the section, and its relation to its absolute lateral strength, let us examine its strength relative to the external force employed to break it. This examination is very simple in the case under consideration. The straining force must act by some lever, and the cohesion must oppose it by acting on some other lever. The centre of the section may be the neutral point, whose position is not disturbed.

Let F be the force exerted laterally by an exterior particle. Let a be the radius of the cylinder, and x the indeterminate distance of any circumference, and $\dot{x}$ the indefinitely small interval between the concentric arches; that is, let $\dot{x}$ be the breadth of a ring and x its radius. The forces being as the extensions, and the extensions as the distances from the axis, the cohesion actually exerted at any part of any ring will be $f\frac{x\dot{x}}{a}$. The force exerted by the whole ring (being as the circumference or as the radius) will be $f\frac{x^2\dot{x}}{a}$. The momentum of cohesion of a ring, being as the force multiplied by its lever, will be $f\frac{x^3\dot{x}}{a}$. The accumulated momentum will be the sum or fluent of $f\frac{x^3\dot{x}}{a}$; that is, when $x = a$, it will be $\frac{1}{4}f\frac{a^4}{a}, = \frac{1}{4}fa^3$.

123 The resistance of an axle to [illegible] the cube of its diameter.

Hence we learn that the strength of an axle, by which it resists being wrenched asunder by a force acting at a given distance from the axis, is as the cube of its diameter.

But farther, $\frac{1}{4}fa^3$ is $= fa^2 \times \frac{1}{4}a$. Now fa^2 represents the full lateral cohesion of the section. The momentum therefore is the same as if the full lateral cohesion were accumulated at a point distant from the axis by $\frac{1}{4}$th of the radius or $\frac{1}{8}$th of the diameter of the cylinder.

Therefore let F be the number of pounds which measures the lateral cohesion of a circular inch, d the diameter of the cylinder in inches, and l the length of the lever by which the straining force p is supposed to act, we shall have $F \times \frac{1}{8}d^3 = pl$, and $F\frac{d^3}{8l} = p$.

We see in general that the strength of an axle, by which it resists being wrenched asunder by twisting, is as the cube of its diameter.

We see also that the internal parts are not acting so powerfully as the external. If a hole be bored out of the axle of half its diameter, the strength is diminished only $\frac{1}{8}$th, while the quantity of matter is diminished $\frac{1}{4}$th. Therefore hollow axles are stronger than solid ones containing the same quantity of matter. Thus let the diameter be 5 and that of the hollow 4: then the diameter of another solid cylinder having the same quantity of matter with the tube is 3. The strength of the solid cylinder of the diameter 5 may be expressed by 5^3 or 125. Of this the internal part (of the diameter 4) exerts 64; therefore the strength of the tube is $125-64, =61$. But the strength of the solid axle of the same quantity of matter and diameter 3 is 3^3, or 27, which is not half of that of the tube. 124 Hollow axles more proper than solid ones.

Engineers, therefore, have of late introduced this improvement in their machines, and the axles of cast iron are all made hollow when their size will admit it. They have the additional advantage of being much stiffer, and of affording much better fixure for the flanches, which are used for connecting them with the wheels or levers by which they are turned and strained. The superiority of strength of hollow tubes over solid cylinders is much greater in this kind of strain than in the former or transverse. In this last case the strength of this tube would be to that of the solid cylinder of equal weight as 61 to $32\frac{1}{4}$ nearly. 125 And now generally used.

The apparatus which we mentioned on a former occasion for trying the lateral strength of a square inch of solid matter, enabled us to try this theory of twist with all desirable accuracy. The bar which hung down from the pin in the former trials was now placed in a horizontal position, and loaded with a weight at the extremity. Thus it acted as a powerful lever, and enabled us to wrench asunder specimens of the strongest materials. We found the results perfectly conformable to the theory, in as far as it determined the proportional strength of different sizes and forms: but we found the ratio of the resistance to twisting to the simple lateral resistance considerably different; and it was some time before we discovered the cause. 126 The ratio of resistance to twisting to the simple lateral resistance different.

We had here taken the simplest view that is possible of the action of cohesion in resisting a twist. It is frequently exerted in a very different way. When, for instance, an iron axle is joined to a wooden one by being driven into one end of it, the extensions of the different circles of particles are in a very different proportion. A little consideration will show that the particles in immedate contact with the iron axle are in a state of violent extension; so are the particles of the exterior surface of the wooden part, and the intermediate parts are less strained. It is almost impossible to assign the exact proportion of the cohesive forces exerted in the different parts. Numberless cases can be pointed out where parts of the axle are in a state of compression, and where it is still more difficult to determine the state of the other particles. We must content ourselves with the deductions made from this simple case, which is fortunately the most common. In the experiments just now mentioned the centre of the circle is by no means the neutral point, and it is very difficult to ascertain its place: but when this consideration occurred to us, we easily freed the experiments from this uncertainty, by extending the lever to both sides, and by means of a pulley applied equal force 127 But when the experiment was altered, found the same.

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Fig. 1.

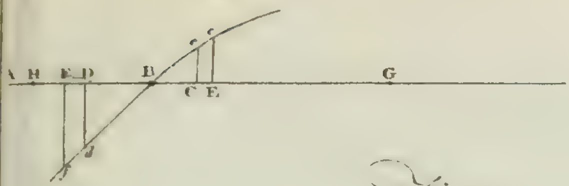


Fig. 3.

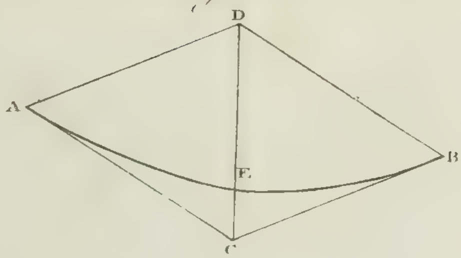


Fig. 2.

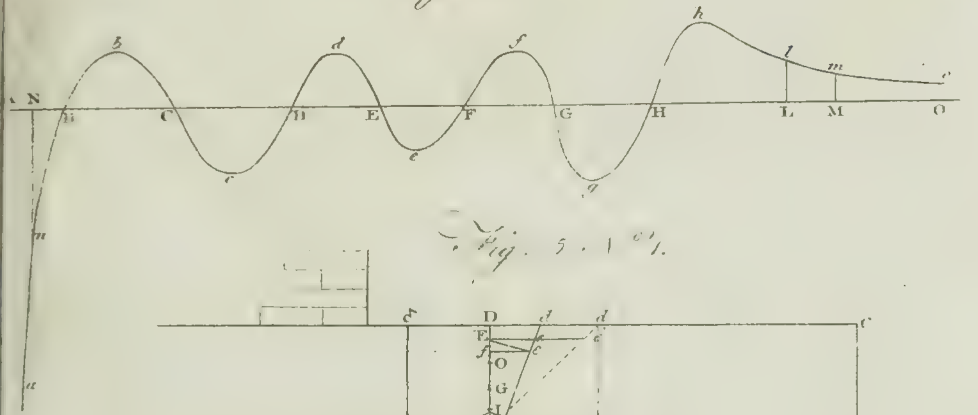


Fig. 4.

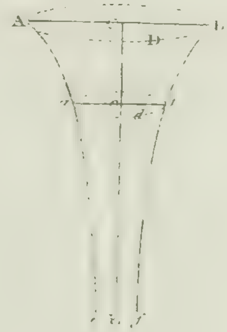


Fig. 5. N.o 1.

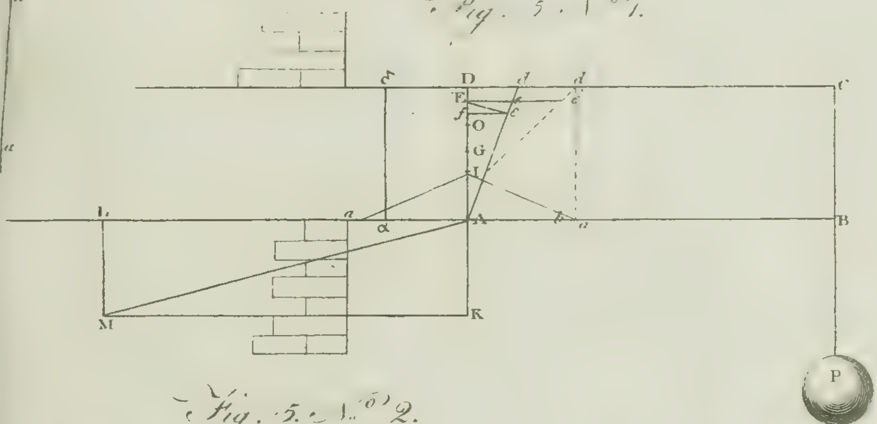


Fig. 5. N.o 2.

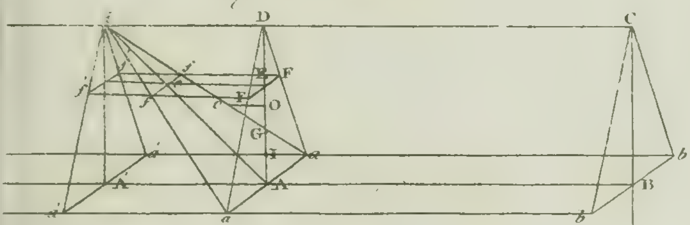


Fig. 6.

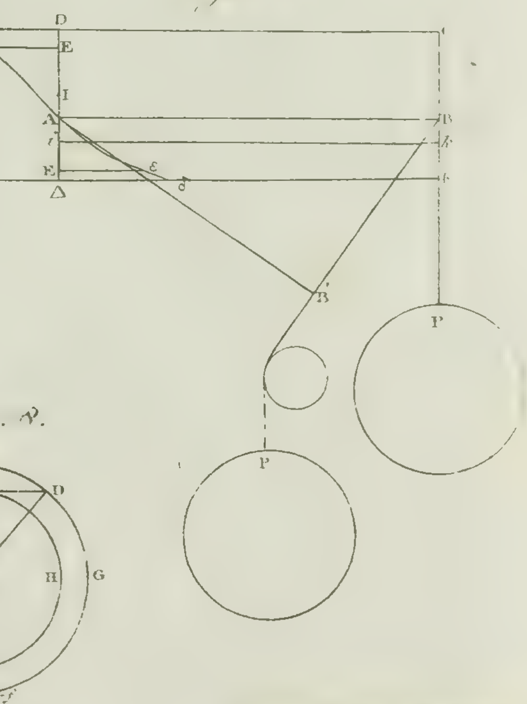


Fig. 5. N.o 3.

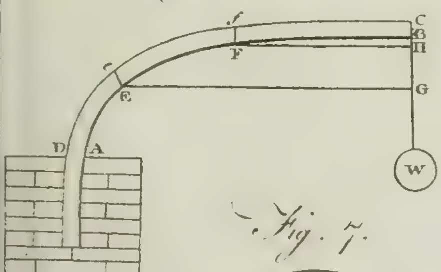


Fig. 8.

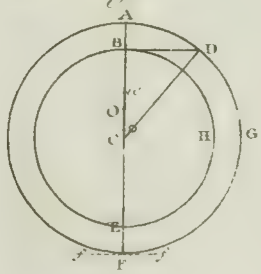
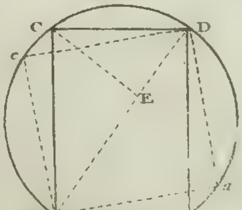


Fig. 7.



A. Bell Prin. Wal. Sculptor fecit

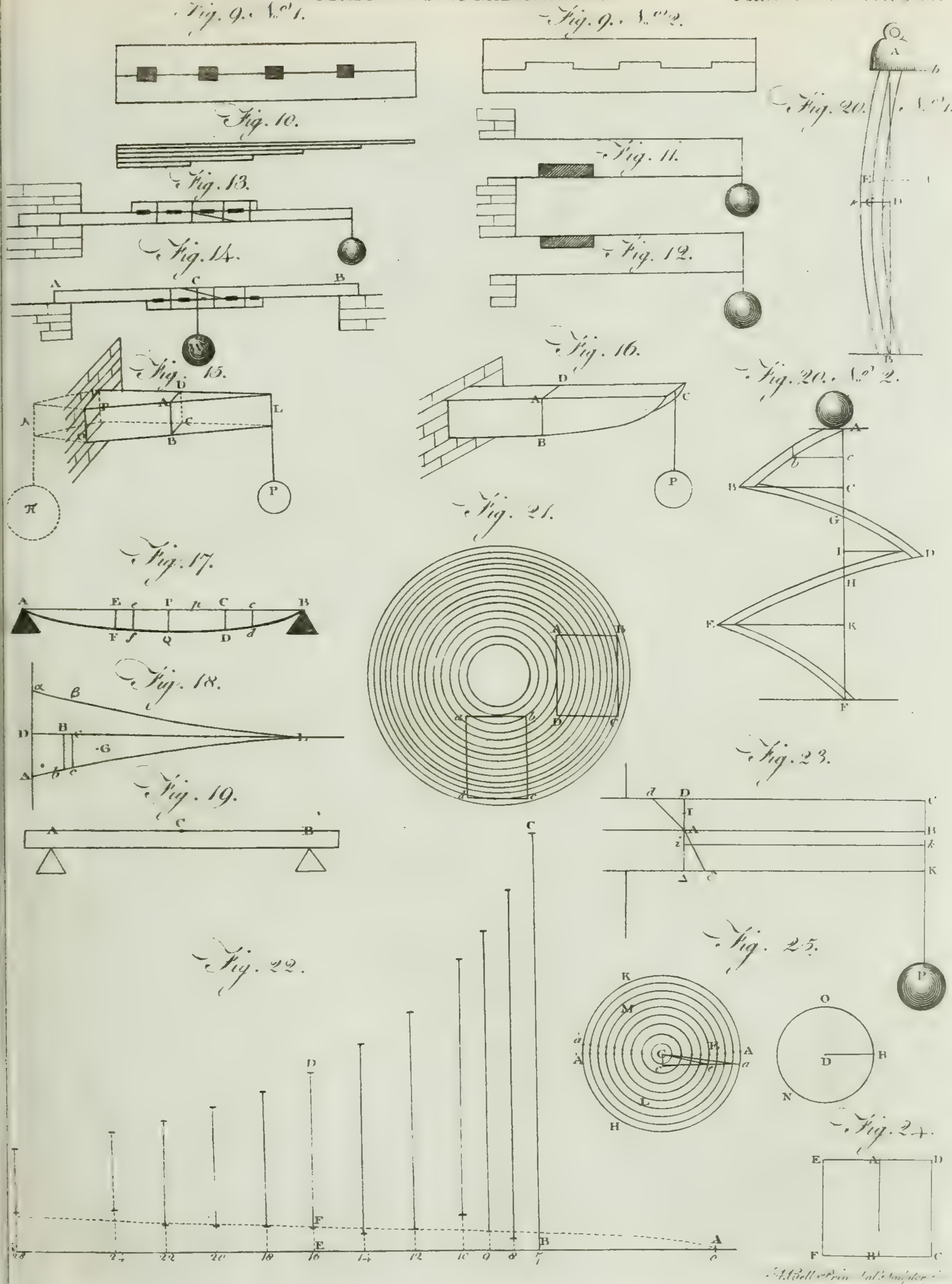


Fig. 9. N.° 1.
Fig. 9. N.° 2.
Fig. 10.
Fig. 11.
Fig. 12.
Fig. 13.
Fig. 14.
Fig. 15.
Fig. 16.
Fig. 17.
Fig. 18.
Fig. 19.
Fig. 20. N.° 1.
Fig. 20. N.° 2.
Fig. 21.
Fig. 22.
Fig. 23.
Fig. 24.
Fig. 25.
A. Bell Prin. Pal. Sculptor

to each arm, acting in oppofite directions. Thus the centre became the neutral point, and the refiftance to twift was found to be ⅔ds of the fimple lateral ftrength.

128 (peri- nts on alk, clay, d wax, of ftory; t thofe timber egular.) We beg leave to mention here that our fuccefs in thefe experiments encouraged us to extend them much farther. We hoped by thefe means to difcover the abfolute cohefion of many fubftances, which would have required an enormous apparatus and a moft unmanageable force to tear them afunder directly. But we could reafon with confidence from the refiftance to twift (which we could eafily meafure), provided that we could afcertain the proportion of the direct and the lateral ftrengths. Our experiments on chalk, finely prepared clay, and white bees-wax (of one melting and one temperature), were very confiftent and fatisfactory. But we have hitherto found great irregularities in this proportion in bodies of a fibrous texture like timber. Thefe are the moft important cafes, and we ftill hope to be able to accomplifh our project, and to give the public fome valuable information. This being our fole object, it was our duty to mention the method which promifes fuccefs, and thus excite others to the tafk; and it will be no mortification to us to be deprived of the honour of being the firft who thus adds to the ftock of experimental knowledge.

When the matter of the axle is of the moft fimple texture, fuch as that of metals, we do not conceive that the length of the axle has any influence on the fracture. It is otherwife if it be of a fibrous texture like timber: the fibres are bent before breaking, being twifted into fpirals like a cork-fcrew. The length of the axle has fomewhat of the influence of a lever in this cafe, and it is eafier wrenched afunder if long. Accordingly we have found it fo; but we have not been able to reduce this influence to calculation.

129 (oncluding marks.) Our readers are requefted to accept of thefe endeavours to communicate information on this important and difficult fubject. We are duly fenfible of their imperfection, but flatter ourfelves that we have in many inftances pointed out the method which muft be purfued for improving our knowledge on this fubject; and we have given the Englifh reader a more copious lift of experiments on the ftrength of materials than he will meet with in our language. Many ufeful deductions might be made from thefe premifes refpecting the manner of difpofing and combining the ftrength of materials in our ftructures. The beft form of joints, mortifes, tenons, fcarphs; the rules for joggling, tabling, faying, fifhing, &c. practifed in the delicate art of maft-making, are all founded on this doctrine: but the difcuffion of thefe would be equivalent to writing a complete treatife of carpentry. We hope that this will be executed by fome intelligent mechanician, for there is nothing in our language on this fubject but what is almoft contemptible; yet there is no mechanic art that is more fufceptible of fcientific treatment. Such a treatife, if well executed, could not fail of being well received by the public in this age of mechanical improvement.

STRENGTHENERS, or Corroborants, fuch medicines as add to the bulk and firmnefs of the folids; and fuch are all agglutinant and aftringent medicines. See Materia Medica, p. 649. art. 6.

STRETCHING, in navigation, is generally underftood to imply the progreffion of a fhip under a great furface of fail, when clofe-hauled. The difference between this term and *ftanding*, confifts apparently in the quantity of fail; which in the latter may be very moderate; but ftretching generally fignifies excefs: as, we faw the enemy at day break ftretching to the fouthward under a croud of fail, &c. *Falconer.*

STRETTO, in Italian mufic, is fometimes ufed to fignify that the meafure is to be fhort and concife, and confequently quick. In this fenfe it ftands oppofed to Largo.

STRIATED leaf, among botanifts, one that has a number of longitudinal furrows on its furface.

STRIKE, a meafure of capacity, containing four bufhels. Alfo an inftrument ufed in meafuring corn.

STRIX, the owl, in ornithology, a genus belonging to the order of *accipitres*. The bill is hooked, but has no cere or wax; the noftrils are covered with fetaceous feathers; the head is very large, as are alfo the ears and eyes; and the tongue is bifid. There are 46 fpecies; the moft remarkable are,

1. The *bubo*, or great-eared owl, in fize is almoft equal to an eagle. Irides bright yellow; head and whole body finely varied with lines, fpots, and fpecks of black, brown, cinereous, and ferruginous. Wings long; tail fhort, marked with dufky bars. Legs thick, covered to the very end of the toes with a clofe and full down of a teftaceous colour. Claws great, much hooked, and dufky.—It has been fhot in Scotland and in Yorkfhire. It inhabits inacceffible rocks and defert places; and preys on hares and feathered game. Its appearance in cities was deemed an unlucky omen; Rome itfelf once underwent a luftration becaufe one of them ftrayed into the capitol. The ancients had them in the utmoft abhorrence; and thought them, like the fcreech-owls, the meffengers of death. Pliny ftyles it *bubo funebris*, and *noctis monftrum*.

> *Solaque culminibus* ferali *carmine* bubo
> *Sæpe queri et longas in fletum ducere voces.* Virgil.
>
> Perch'd on the roof, the bird of night complains,
> In lengthen'd fhrieks and dire funereal ftrains.

2. The *otus*, or long-eared owl, is found, though not frequently, in the north of England, in Chefhire, and in Wales. Mr Haffelquift faw it alive in Cairo, and it is not unfrequent all over Egypt. Its weight, according to Dr Latham, is nine ounces; the length 14 inches and a half; the breadth 34; the irides are of a bright yellow; the bill black; the breaft and belly are of a dull yellow, marked with flender brown ftrokes pointing downwards; the thighs and vent-feathers of the fame colour, but unfpotted. The back and coverts of the wings are varied with deep brown and yellow; the quill-feathers of the fame colour, but near the ends of the outmoft is a broad bar of red; the tail is marked with dufky and reddifh bars, but beneath appears afh-coloured; the horns or ears are about an inch long, and confift of fix feathers variegated with yellow and black; the feet are feathered down to the claws.

3. The *brachyotos*, or fhort-eared owl, is 14 inches long; three feet broad; the head is fmall and hawk-like; the bill is dufky; weight 14 ounces; the circle of feathers that immediately furrounds the eyes is black; the larger circle white, terminated with tawny and black; the feathers on the head, back, and coverts of the wings, are brown, edged with pale dull yellow; the breaft and belly are of the fame colour, marked with a few long narrow ftreaks of brown pointing downwards; the quill-feathers are dufky, barred with red; the tail is of a very deep brown, adorned on each fide of the fhaft of the four middle feathers with a yellow circle which contains a brown fpot; the tip of the tail is white. The horns of this fpecies are very fmall, and each confifts of only a fingle feather; thefe it can raife or deprefs at pleafure; and in a dead bird are with difficulty difcovered. This kind is fcarcer than the former; both are folitary birds, avoiding inhabited places. Thefe fpecies may be called *long-winged owls*; the wings when clofed reaching beyond the end of the tail; whereas in the common kinds they fall fhort of it.—This is a bird of paffage, and has been obferved to vifit Lincolnfhire in the beginning of October, and

Strix.

to retire early in the spring; so probably, as it performs its migrations with the woodcock, its summer-retreat is Norway. During day it lies hid in long old grass; when disturbed, it seldom flies far, but will light, and sit looking at one, at which time the horns may be seen very distinctly. It has not been obferved to perch on trees like other owls; it usually flies in search of prey in cloudy hazy weather. Farmers are fond of seeing these birds in the fields, as they clear them from mice. It is found frequently on the hill of Hoy in the Orkneys, where it flies about and preys by day like a hawk. It is found alfo, as we mentioned before, in Lancafhire, which is a hilly and woody country; and in New England and Newfoundland.

4. The *flammea*, or common white owl. The elegant plumage of this bird makes amends for the uncouthness of its form: a circle of soft white feathers surround the eyes. The upper part of the body, the coverts, and fecondary feathers of the wings, are of a fine pale yellow: on each fide of the fhafts are two grey and two white fpots placed alternate: the exterior fides of the quill-feathers are yellow; the interior white, marked on each fide with four black fpots: the lower fide of the body is wholly white; the interior fides of the feathers of the tail are white; the exterior marked with fome obfcure dufky bars; the legs are feathered to the feet: the feet are covered with fhort hairs: the edge of the middle claw is ferrated. The ufual weight is 11 ounces; its length 14 inches; its breadth 3 feet.— This fpecies is almoft domeftic; inhabiting, for the greateft part of the year, barns, hay lofts, and other out houfes; and is as ufeful in clearing thofe places from mice as the congenial cat: towards twilight it quits its perch, and takes a regular circuit round the fields, fkimming along the ground in queft of field-mice, and then returns to its ufual refidence: in the breeding-feafon it takes to the eaves of churches, holes in lofty buildings, or hollows of trees. During the time the young are in the neft, the male and female alternately fally out in queft of food, make their circuit, beat the fields with the regularity of a fpaniel, and drop inftantly on their prey in the grafs. They very feldom ftay out above five minutes; return with their prey in their claws; but as it is neceffary to fhift it into their bill, they always alight for that purpofe on the roof, before they attempt to enter their neft. This fpecies does not hoot; but fnores and hiffes in a violent manner; and while it flies along will often fcream moft tremendoufly. Its only food is mice. As the young of thefe birds keep their neft for a great length of time, and are fed even long after they can fly, many hundreds of mice will fcarcely fuffice to fupply them with food. Owls caft up the bones, fur, or feathers of their prey, in form of fmall pellets, after they have devoured it, in the fame manner as hawks do. A gentleman, on grubbing up an old pollard-afh that had been the habitation of owls for many generations, found at the bottom many bufhels of this rejected ftuff. Some owls, when they are fatisfied, hide the remainder of their meat like dogs.

5. The *ftridula*, or tawny owl. The female of this fpecies weighs 19 ounces; the length is 15 inches; the breadth 2 feet 8 inches; the irides are dufky; the ears in this, as in all owls, very large; and their fenfe of hearing very exquifite. The colour of this kind is fufficient to diftinguifh it from every other: that of the back, head coverts of the wings, and on the fcapular feathers, being a fine tawny red, elegantly fpotted and powdered with the black or dufky fpots of various fizes: on the coverts of the wings and on the fcapulars are feveral large white fpots: the coverts of the tail are tawny, and quite free from any marks: the tail is varioufly blotched, barred and fpotted with pale red and black; in the two middle feathers the red predominates: the breaft and belly are yellowifh, mixed with white, and marked with narrow black ftrokes pointing downwards: the legs are covered with feathers down to the toes.—This is a hardier fpecies than the former; and the young will feed on any dead thing, whereas thofe of the white owl muft have a conftant fupply of frefh meat. It is the ftrix of Aldrovandus, and what we call the *fcreech owl*; to which the folly of fuperftition had given the power of prefaging death by its cries. The ancients believed that it fucked the blood of young children: a fact fome think not incredible; for Haffelquift defcribes a fpecies found in Syria, which frequently in the evening flies in at the windows, and deftroys the helplefs infant.

> *Nocte volant, puerofque petunt nutricis egentes,*
> *Et vitiant cunis corpora rapta fuis.*
> *Carpere dicuntur lactentia vifcera roftris,*
> *Et plenum poto fanguine guttur habent.*
> *Eft illis ftrigibus nomen, fed nominis hujus*
> *Caufa quod horrenda ftridere nocte folent.* Ovid Faft. vi. 135.

6. The *ulula*, or brown owl, agrees with the former in its marks; differing only in the colours: in this, the head, wings, and back, are of a deep brown, fpotted with black in the fame manner as the former: the coverts of the wings and the fcapulars are adorned with fimilar white fpots: the exterior edges of the four firft quill-feathers in both are ferrated: the breaft in this is of a very pale afh-colour mixed with tawny, and marked with oblong jagged fpots: the feet too are feathered down to the very claws: the circle round the face is afh coloured, fpotted with brown.—Both thefe fpecies inhabit woods, where they refide the whole day: in the night they are very clamorous; and when they hoot, their throats are inflated to the fize of an hen's egg. In the dufk they approach our dwellings; and will frequently enter pigeon-houfes, and make great havoc in them. They deftroy numbers of little leverets, as appears by the legs frequently found in their nefts. They alfo kill abundance of moles, and fkin them with as much dexterity as a cook does a rabbit. They build in hollow trees or ruined edifices; lay four eggs, of an elliptic form, and of a whitifh colour.

7. The *pafferina*, or little owl, is very rare in England; it is fometimes found in Yorkfhire, Flintfhire, and alfo near London: in fize it fcarcely exceeds a thrufh, though the fulnefs of its plumage makes it appear larger: the irides are of a light yellow; the bill of a paper-colour; the feathers that encircle the face are white tipt with black; the head brown, fpotted with white; on the breaft is a mixture of white and brown; the belly is white, marked with a few brown fpots; the tail of the fame colour with the back; in each feather barred with white; in each adorned with circular white fpots, placed oppofite to one another on both fides of the fhaft; the legs and feet are covered with feathers down to the claws.—The Italians make ufe of this owl to decoy fmall birds to the limed twig; the method of which is exhibited in Olina's *Uccellieru*, p. 65. Mr Steuart, author of the Antiquities of Athens, informed Mr Pennant, that this fpecies of owl was very common in Attica; that they were birds of paffage, and appeared there in the beginning of April in great numbers; that they bred there; and that they retired at the fame time as the ftorks, whofe arrival they a little preceded.

8. The fpectacle owl of Cayenne, which is accurately defcribed by Dr Latham, is 21 inches in length: the upper parts of the body are of a reddifh colour; the lower parts of Lath. Sy vol. vii. 50.

of a rufous white: the head and neck are white, and not ſo full of feathers as those of owls generally are, and from this circumſtance it appears not unlike a hawk: a large patch of dark brown ſurrounds each eye, giving the bird much the appearance of wearing ſpectacles; the legs are covered with feathers quite to the toes, and are of a yellowiſh colour. A ſpecimen of this curious bird may be ſeen in the Leverian muſeum.

STROBILUS, in botany, a pericarp formed from an amentum by the hardening of the ſcales,

STROKING, or rubbing gently with the hand, a method which has been employed by ſome perſons for curing diſeaſes.

Mr Greatrakes or Greatrix, the famous Iriſh ſtroker, is ſaid to have performed many wonderful cures. He gives the following account of his diſcovery of this art, and of the ſucceſs with which he practiſed it "About 1662 I had an impulſe (ſays he), or a ſtrange perſuaſion in my own mind (of which I am not able to give any rational account to another), which did very frequently ſuggeſt to me, that there was beſtowed on me the gift of curing the king's evil; which, for the extraordinarineſs of it, I thought fit to conceal for ſome time; but at length I communicated this to my wife, and told her, that I did verily believe that God had given me the bleſſing of curing the king's evil; for whether I were in private or public, ſleeping or waking, ſtill I had the ſame impulſe. But her reply to me was, that ſhe conceived this was a ſtrange imagination; yet, to prove the contrary, a few days after there was one William Maher of Salterbridge in the pariſh of Liſmore, who brought his ſon William to my houſe, deſiring my wife to cure him, who was a perſon ready to afford her charity to her neighbours, according to her ſmall ſkill in chirurgery. On which my wife told me, there was one that had the king's evil very grievouſly in the eyes, cheek, and throat; whereupon I told her, that ſhe ſhould now ſee whether this were a bare fancy or imagination, as ſhe thought it, or the dictates of God's Spirit on my heart. Then I laid my hands on the places affected, and prayed to God for Jeſus ſake to heal him; and bid the parent two or three days afterwards to bring the child to me again, which accordingly he did; and I then ſaw the eye was almoſt quite whole; and the node, which was almoſt as big as a pullet's egg, was ſuppurated; and the throat ſtrangely amended; and, to be brief (to God's glory I ſpeak it) within a month diſcharged itſelf quite, and was perfectly healed, and ſo continues, God be praiſed."

Then there came to him one Margaret Macſhane of Ballinecly, in the pariſh of Liſmore, who had been afflicted with the evil above ſeven years, in a much more violent degree; and ſoon after, his fame increaſing, he cured the ſame diſeaſe in many other perſons for three years. He did not meddle all this time with any other diſtemper; till about the end of theſe three years, the ague growing epidemical, he found, as formerly, that there was beſtowed on him the gift of curing that diſeaſe. He cured Colonel Phaire, of Cahirmony in the county of Corke, of an ague, and afterwards many other perſons of different diſtempers, by ſtroking; ſo that his name was wonderfully cried up, as if ſome divine perſon had been ſent from above. January 1665 6, he came over to England, at the requeſt of the earl of Orrery; in order to cure the lady of the lord-viſcount Conway, of Ragley in Warwickſhire, who had for many years laboured under a moſt violent headache. He ſtaid at Ragley three weeks or a month; and though he failed in his endeavours to relieve that lady, he cured vaſt numbers of people in thoſe parts and at Worceſter.

Though we are no friends to the marvellous, nor believe it poſſible that either the king's evil or ague can be cured by ſtroking or friction of any kind, whether gentle or ſevere, we have no heſitation to acknowledge that many cures might be performed by Mr Greatrakes. Every reflecting perſon who reads the foregoing account which he gives of himſelf will ſee that he was an enthuſiaſt, and believed himſelf guided by a particular revelation; and ſuch is the credulity of mankind, that his pretenſions were readily admitted, and men crouded with eagerneſs to be relieved of their diſeaſes. But it is well known to phyſicians, that in many caſes the imagination has accompliſhed cures as wonderful as the force of medicine. It is owing chiefly to the influence of imagination that we have ſo many accounts from people of veracity of the wonderful effects of quack medicines. We are perfectly aſſured that theſe medicines, by their natural operation, can never produce the effects aſcribed to them; for there is no kind of proportion between the medicine and the effect produced, and often no connection between the medicine and the diſeaſe

STROMATEUS, in ichthyology, a genus of fiſhes belonging to the order of *apodes*. The head is compreſſed; the teeth are placed in the jaws and palate; the body is oval and ſlippery; and the tail is forked. There are three ſpecies according to Gmelin, the fiatola, paru, and cumarca.

STROMBOLI, the moſt northern of the Lipari iſlands. It is a volcano, which conſtantly diſcharges much fire and ſmoke. It riſes in a conical form above the ſurface of the ſea. On the eaſt ſide it has three or four little craters ranged near each other, not at the ſummit, but on the declivity, nearly at two-thirds of its height. But as the ſurface of the volcano is very rugged, and interſected with hollow ways, it may be naturally concluded, that at the time of ſome great eruption, the ſummit and a part of this ſide fell in, as muſt have happened alſo to Veſuvius; conſequently, the common chimney is at this day on the declivity, although always in the centre of the whole baſe. It is inhabited notwithſtanding its fires; but care is taken to avoid the proximity of the crater, which is yet much to be feared. "I was aſſured (ſays M. de Luc) by an Engliſhman, who, like me, had the curioſity to viſit theſe iſles, that the fine weather having invited him and his company to land at Stromboli, they aſcended a volcano, whoſe craters at that time threw out nothing; but that while they were attentively viewing them, unapprehenſive of any danger, they were ſuddenly ſaluted by ſuch a furious diſcharge, as to be obliged to retreat with precipitation, and not without one of the company being wounded by a piece of ſcoria." Of all the volcanoes recorded in hiſtory, Stromboli ſeems to be the only one that burns without ceaſing. Etna and Veſuvius often lie quiet for many months, and even years, without the leaſt appearance of fire; but Stromboli is ever at work, and for ages paſt has been looked upon as the great lighthouſe of theſe ſeas. E. Long. 15. 45. N. Lat. 39. 0.

STROMBUS, in natural hiſtory, a genus of *vermes*, belonging to the order of *teſtacea*. The animal is a limax; the ſhell is univalve and ſpiral; the opening is much dilated, and ends in a canal which turns to the left. Gmelin enumerates 53 ſpecies; of which only one is peculiar to Britain, the pes pelecani. The ſpires are ten; the lip is fingered; the point very ſharp; the length two inches.

STRONGOLI, a town of the kingdom of Naples, with a biſhop's ſee. It is ſituated on a rugged mountain, is about three miles from the ſea, and ſeven north from St Severino. It is ſuppoſed to be the ancient *Petelia*, which made a conſpicuous figure in the ſecond Punic war by its obſtinate reſiſtance againſt Hannibal. Near its walls Marcellus the rival

Strontites
Struthio

val of Hannibal was ſlain in a ſkirmiſh. E. Long. 17. 26. N. Lat. 39. 20.

STRONTITES, or STRONTIAN EARTH, a new ſpecies of earth lately diſcovered at Strontian in Scotland.

Who the diſcoverer of this earth was we have not learned; but Dr Kirwan ſays, the firſt information he received of it was from Dr Crawford in the year 1790. In the Miners Journal for February 1791 a good deſcription of its external appearance, with ſome account of its chemical properties, was publiſhed from the obſervations of Mr Sulzer. Dr Kirwan examined it in October 1793, and found it to be a new earth between the barytic and common limeſtone. Dr Hope, who is now joint profeſſor of chemiſtry with Dr Black in the univerſity of Edinburgh, read a paper on the 4th November 1792 before the Royal Society of Edinburgh, intitled "An Account of a Mineral from Strontian, and of a peculiar Species of Earth which it contains;" an abridgement of which is publiſhed in the third volume of the Edinburgh Philoſophical Tranſactions. Mr Schmeiſſer read a paper on the ſame ſubject before the Royal Society of London in May 1794, which is publiſhed in their Tranſactions for that year, p. 418, &c.

Tranſactions of the Iriſh Academy, vol. v.

Its external characters are theſe: Its colour is whitiſh or light green; its luſtre common; its tranſparency intermediate between the ſemitranſparent and opaque; its fracture ſtriated, preſenting oblong diſtinct concretions, ſomewhat uneven and bent; its hardneſs moderate, being eaſily ſcratched, but not ſcraped. It is very brittle; and its ſpecific gravity from 3,4 to 3,644.

For a full account of its chemical qualities we muſt refer to the books already mentioned, as all the accounts of it which we have ſeen are too long to inſert here, and as we do not conſider the circumſtance of its being a newly diſcovered earth a ſufficient reaſon for running into a tedious detail till its utility be aſcertained. We ſhall, however, mention ſome of its moſt remarkable qualities. It requires 180 times its weight of water at a low temperature to diſſolve it. When diſſolved in boiling water, and allowed to cool, it depoſits tranſparent cryſtals, which when expoſed to the air become white and powdery. It is not affected by the ſulphuric acid; but when diluted, 10,000 parts of it will diſſolve one of ſtrontites. Diluted nitric acid diſſolves it rapidly. The muriatic acid, whether diluted or oxygenated, diſſolves it in a ſimilar manner.

Strontites has a ſtrong reſemblance to barytes, but eſſentially differs from it. Its ſpecific gravity is leſs; it parts with its carbonic acid when urged by heat ſomewhat more readily, and without ſuffering fuſion; when calcined, it imbibes moiſture with vaſtly greater avidity, ſwelling and cracking with more heat and noiſe. Strontites diſſolves much more abundantly in hot water than barytes; and the form of the cryſtals of theſe pure earths is very diſſimilar. The compounds generated by ſtrontites differ from thoſe of barytes. It will ſuffice to mention the nitrate and muriate. This earth, united to nitric and muriatic acid, forms ſalts that ſuffer changes from expoſure to air, which do not happen to the nitrate and muriate of barytes. They are likewiſe much more ſoluble in water, and have cryſtals of a peculiar figure. The combinations of ſtrontites with acids are not, like thoſe of barytes, decompoſed by pruſſiate of lime or of potaſh. Strontites and its compounds tinge flame, which barytes does not. Laſtly, theſe earths diſagree in the order of their attractions. From theſe conſiderations it is concluded, that the mineral is not aerated barytes.

Tranſactions of the Royal Society of Edinburgh, vol. iii.

It alſo is diſtinguiſhed from calcareous ſpar or limeſtone: for it is much heavier, and retains its fixed air with more obſtinacy in the fire. The incomparably greater ſolubility of the pure earth in hot than in cold water, and the cryſtalline form it aſſumes, ſufficiently diſtinguiſh it from lime, which the diſpoſition of the nitrate and muriate to cryſtallize no leſs tends to do.

The moſt remarkable quality of ſtrontites is that of tinging flame of a red colour. The muriate has it in the moſt eminent degree, and its effects are well exhibited by putting a portion of the ſalt on the wick of a candle, which is thereby made to burn with a very beautiful blood-red flame. The nitrate ſtands next, then cryſtallized ſtrontites, and after it the acetite. A hundred parts of ſtrontites are compoſed of 61.21 of earth, 30.20 of carbonic acid, and 8.59 of water.

STROPHE, in ancient poetry, a certain number of verſes, including a perfect ſenſe, and making the firſt part of an ode. See POETRY, n° 130.

STRUMÆ, ſcrophulous tumors ariſing on the neck and throat, conſtituting what is commonly called the *king's evil*. See MEDICINE, n° 349.

STRUMPFIA, in botany; a genus of plants belonging to the claſs of *ſyngeneſia*, and to the order of *monogamia*. The calyx is quinquedentate and ſuperior; the corolla is pentapetalous; and the berry monoſpermous. There is only one ſpecies, the maritima.

STRUTHIO, in natural hiſtory; a genus of birds belonging to the order of *grallæ* of Linnæus; but, according to the new claſſification of Dr Latham, it forms, along with the dodo, caſſuarius, and rhea, a ſeparate order under the name of *ſtruthious*. As the dodo or didus, and rhea, have been already deſcribed in their proper place, we will now give ſome account of the oſtrich and caſſowary.

I. The OSTRICH (the *Camelus* of Linnæus) has a bill ſomewhat conical; the wings are ſo ſhort as to be unfit for flying; the thighs and ſides of the body are naked; the feet are formed for running, having two toes, one only of which is furniſhed with a nail. In this reſpect it differs entirely from the caſſowary, which has three toes complete. The oſtrich is without doubt the largeſt of all birds: it is nearly eight feet in length, and when ſtanding upright from ſix to eight feet in height. We are told in the Gentleman's Magazine *, that two oſtriches were ſhewn in London in the year 1750, and that the male was 10 feet in height, and weighed three hundred weight and a quarter. The head and bill ſomewhat reſemble thoſe of a duck; and the neck may be likened to that of a ſwan, but that it is much longer; the legs and thighs reſemble thoſe of an hen; though the whole appearance bears a ſtrong reſemblance to that of a camel. But though uſually ſeven feet high from the top of the head to the ground, from the back it is only four; ſo that the head and neck are above three feet long. From the top of the head to the rump, when the neck is ſtretched out in a right line, it is ſix feet long, and the tail is about a foot more. One of the wings, without the feathers, is a foot and an half; and being ſtretched out, with the feathers, is three feet.

Plate ccccli.

* Vol. p. 55

The plumage is much alike in all; that is, generally black and white; though ſome of them are ſaid to be grey. There are no feathers on the ſides, nor yet on the thighs, nor under the wings. The lower part of the neck, about half way, is covered with ſtill ſmaller feathers than thoſe on the belly and back; and thoſe alſo are of different colours.

All theſe feathers are of the ſame kind, and peculiar to the oſtrich; for other birds have ſeveral ſorts, ſome of which are ſoft and downy, and others hard and ſtrong. Oſtrich-feathers are almoſt all as ſoft as down, being utterly unfit to ſerve the animal for flying, and ſtill leſs adapted to be a proper defence againſt external injury. The feathers of

of other birds have the webs broader on one ſide than the other, but thoſe of the oſtrich have their ſhaft exactly in the middle. The upper part of the head and neck are covered with a very fine clear white hair, that ſhines like the briſtles of a hog; and in ſome places there are ſmall tufts of it, conſiſting of about 12 hairs, which grow from a ſingle ſhaft about the thickneſs of a pin.

At the end of each wing there is a kind of ſpur almoſt like the quill of a porcupine. It is an inch long, being hollow and of an horny ſubſtance. There are two of theſe on each wing; the largeſt of which is at the extremity of the bone of the wing, and the other a foot lower. The neck ſeems to be more ſlender in proportion to that of other birds, from its not being furniſhed with feathers. The ſkin in this part is of a livid fleſh-colour, which ſome, improperly, would have to be blue. The bill is ſhort and pointed, and two inches and an half at the beginning. The external form of the eye is like that of a man, the upper eye-lid being adorned with eye-laſhes which are longer than thoſe on the lid below. The tongue is ſmall, very ſhort, and compoſed of cartilages, ligaments, and membranes, intermixed with fleſhy fibres. In ſome it is about an inch long, and very thick at the bottom; in others it is but half an inch, being a little forked at the end.

The thighs are very fleſhy and large, being covered with a white ſkin inclining to redneſs, and wrinkled in the manner of a net, whoſe meſhes will admit the end of the finger. Some have very ſmall feathers here and there on the thighs; and others again have neither feathers nor wrinkles. What are called the legs of birds, in this are covered before with large ſcales. The end of the foot is cloven, and has two very large toes, which, like the leg, are covered with ſcales. Theſe toes are of unequal ſizes. The largeſt, which is on the inſide, is ſeven inches long, including the claw, which is near three-fourths of an inch in length, and almoſt as broad. The other toe is but four inches long, and is without a claw.

The internal parts of this animal are formed with no leſs ſurpriſing peculiarity. At the top of the breaſt, under the ſkin, the fat is two inches thick; and on the fore-part of the belly it is as hard as ſuet, and about two inches and an half thick in ſome places. It has two diſtinct ſtomachs. The firſt, which is lowermoſt, in its natural ſituation ſomewhat reſembles the crop in other birds; but it is conſiderably larger than the other ſtomach, and is furniſhed with ſtrong muſcular fibres, as well circular as longitudinal. The ſecond ſtomach or gizzard has outwardly the ſhape of the ſtomach of a man; and upon opening is always found filled with a variety of diſcordant ſubſtances: hay, graſs, barley, beans, bones, and ſtones, ſome of which exceed in ſize a pullet's egg. The kidneys are eight inches long and two broad, and differ from thoſe of other birds in not being divided into lobes. The heart and lungs are ſeparated by a midriff as in quadrupeds: and the parts of generation alſo bear a very ſtrong reſemblance and analogy.

The oſtrich is a native only of the torrid regions of Africa, and has long been celebrated by thoſe who have had occaſion to mention the animals of that region. Its fleſh is proſcribed in Scripture as unfit to be eaten; and moſt of the ancient writers deſcribe it as well known in their times. Like the race of the elephant, it is tranſmitted down without mixture; and has never been known to breed out of that country which firſt produced it. It ſeems formed to live among the ſandy and burning deſerts of the torrid zone; and, as in ſome meaſure it owes its birth to their genial influence, ſo it ſeldom migrates into tracts more mild or more fertile. The Arabians aſſert that the oſtrich never drinks; and the place of its habitation ſeems to confirm the aſſertion. In theſe formidable regions oſtriches are ſeen in large flocks, which to the diſtant ſpectator appear like a regiment of cavalry, and have often alarmed a whole caravan. There is no deſert, how barren ſoever, but what is capable of ſupplying theſe animals with proviſion; they eat almoſt every thing; and theſe barren tracts are thus doubly grateful, as they afford both food and ſecurity. The oſtrich is of all other animals the moſt voracious. It will devour leather, graſs, hair, iron, ſtones, or any thing that is given. Thoſe ſubſtances which the coats of the ſtomach cannot ſoften, paſs whole; ſo that glaſs, ſtones, or iron, are excluded in the form in which they were devoured. In an oſtrich diſſected by Ranby, there appeared ſuch a quantity of heterogeneous ſubſtances, that it was wonderful how any animal could digeſt ſuch an overcharge of nouriſhment. Valiſnieri alſo found the firſt ſtomach filled with a quantity of incongruous ſubſtances; graſs, nuts, cords, ſtones, glaſs, braſs, copper, iron, tin, lead, and wood; a piece of ſtone was found among the reſt that weighed more than a pound. He ſaw one of theſe animals that was killed by devouring a quantity of quicklime. It would ſeem that the oſtrich is obliged to fill up the great capacity of its ſtomach in order to be at eaſe; but that nutritious ſubſtances not occurring, it pours in whatever offers to ſupply the void.

In their native deſerts, however, it is probable they live chiefly upon vegetables, where they lead an inoffenſive and ſocial life; the male, as Thevenot aſſures us, aſſorting with the female with connubial fidelity. They are ſaid to be very much inclined to venery; and the make of the parts in both ſexes ſeems to confirm the report. It is probable alſo they copulate like other birds, by compreſſion. They lay very large eggs, ſome of them being above five inches in diameter, and weighing above fifteen pounds. Theſe eggs have a very hard ſhell, ſomewhat reſembling thoſe of the crocodile, except that thoſe of the latter are leſs and rounder.

The ſeaſon for laying depends on the climate where the animal is bred. In the northern parts of Africa, this ſeaſon is about the beginning of July; in the ſouth, it is about the latter end of December. Theſe birds are very prolific, and lay generally from 40 to 50 eggs at one clutch, which are as big as a child's head. It has been commonly reported, that the female depoſits them in the ſand, and covering them up, leaves them to be hatched by the heat of the climate, and then permits the young to ſhift for themſelves. Very little of this, however, is true: no bird has a ſtronger affection for her young than the oſtrich, nor none watches her eggs with greater aſſiduity. It happens, indeed, in thoſe hot climates, that there is leſs neceſſity for the continual incubation of the female; and ſhe more frequently leaves her eggs, which are in no danger of being chilled by the weather: but though ſhe ſometimes forſakes them by day, ſhe always carefully broods over them by night; and Kolben, who has ſeen great numbers of them at the Cape of Good Hope, affirms, that they ſit on their eggs like other birds, and that the male and the female take this office by turns, as he had frequent opportunities of obſerving. Nor is it more true what is ſaid of their forſaking their young after they are excluded the ſhell. On the contrary, the young ones are not even able to walk for ſeveral days after they are hatched. During this time the old ones are very aſſiduous in ſupplying them with graſs, and very careful to defend them from danger; nay, they encounter every danger in their defence. The young, when brought forth, are of an aſh-colour the firſt year, and are covered with feathers all over. But in time theſe feathers drop; and thoſe parts which

which are covered assume a different and more becoming plumage.

The beauty of a part of this plumage, particularly the long feathers that compose the wings and tail, is the chief reason that man has been so active in pursuing this harmless bird to its deserts, and hunting it with no small degree of expence and labour. The ancients used those plumes in their helmets; the military wear them in their hats: and the ladies make them an ornament in their dress. Those feathers which are plucked from the animal while alive are much more valued than those taken when dead, the latter being dry, light, and subject to be worm-eaten.

Besides the value of their plumage, some of the savage nations of Africa hunt them also for their flesh; which they consider as a dainty. They sometimes also breed these birds tame, to eat the young ones, of which the females are said to be the greatest delicacy. Some nations have obtained the name of *Struthophagi*, or *ostrich-eaters*, from their peculiar fondness for this food; and even the Romans themselves were not averse to it. Even among the Europeans now, the eggs of the ostrich are said to be well tasted, and extremely nourishing; but they are too scarce to be fed upon, although a single egg be a sufficient entertainment for eight men.

As the spoils of the ostrich are thus valuable, it is not to be wondered at that man has become their most assiduous pursuer. For this purpose the Arabians train up their best and fleetest horses, and hunt the ostrich still in view. Perhaps, of all other varieties of the chase, this, though the most laborious, is yet the most entertaining. As soon as the hunter comes within sight of his prey, he puts on his horse with a gentle gallop, so as to keep the ostrich still in sight; yet not so as to terrify him from the plain into the mountains. Of all known animals, the ostrich is by far the swiftest in running; upon observing himself, therefore, pursued at a distance, he begins to run at first but gently; either insensible of his danger, or sure of escaping. In this situation, he somewhat resembles a man at full speed; his wings, like two arms, keep working with a motion correspondent to that of his legs; and his speed would very soon snatch him from the view of his pursuers; but, unfortunately for the silly creature, instead of going off in a direct line, he takes his course in circles; while the hunters still make a small course within, relieve each other, meet him at unexpected turns, and keep him thus still employed, still followed, for two or three days together. At last, spent with fatigue and famine, and finding all power of escape impossible, he endeavours to hide himself from those enemies he cannot avoid, and covers his head in the sand or the first thicket he meets. Sometimes, however, he attempts to face his pursuers; and though in general the most gentle animal in nature, when driven to desperation he defends himself with his beak, his wings, and his feet. Such is the force of his motion, that a man would be utterly unable to withstand him in the shock.

The Struthophagi have another method of taking this bird: they cover themselves with an ostrich's skin, and passing an arm through the neck, thus counterfeit all the motions of this animal. By this artifice they approach the ostrich, which becomes an easy prey. He is sometimes also taken by dogs and nets; but the most usual way is that mentioned above.

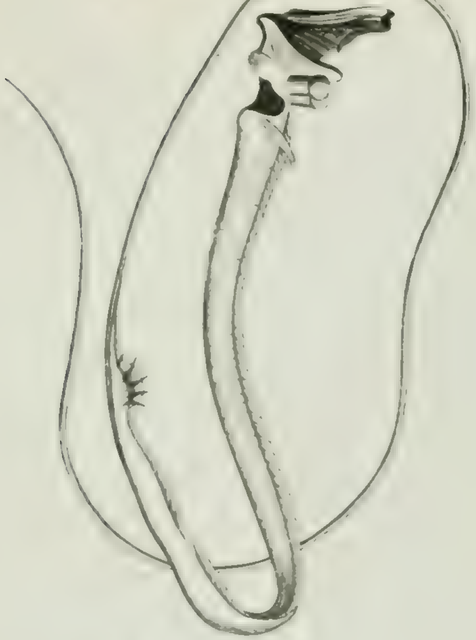
When the Arabians have thus taken an ostrich, they cut its throat; and making a ligament below the opening, they shake the bird as one would rinse a barrel; then taking off the ligature, there runs out from the wound in the throat a considerable quantity of blood mixed with the fat of the animal, and this is considered as one of their greatest dainties. They next flea the bird; and of the skin, which is strong and thick, sometimes make a kind of vest, which answers the purposes of a cuirass and a buckler.

There are others also, more compassionate or more provident, do not kill their captive, but endeavour to tame it, for the purposes of supplying those feathers which are in so great request. The inhabitants of Dara and Lybia breed up whole flocks of them, and they are tamed with very little trouble. But it is not for their feathers alone that they are prized in this domestic state; they are often ridden upon and used as horses. Moore assures us, that at Joar he saw a man travelling upon an ostrich; and Adanson asserts, that at the factory of Podore he had two ostriches, which were then young, the strongest of which ran swifter than the best English racer, although he carried two negroes on his back. As soon as the animal perceived that it was thus loaded, it set off running with all its force, and made several circuits round the village; till at length the people were obliged to stop it by barring up the way. How far this strength and swiftness may be useful to mankind even in a polished state, is a matter that perhaps deserves inquiry.

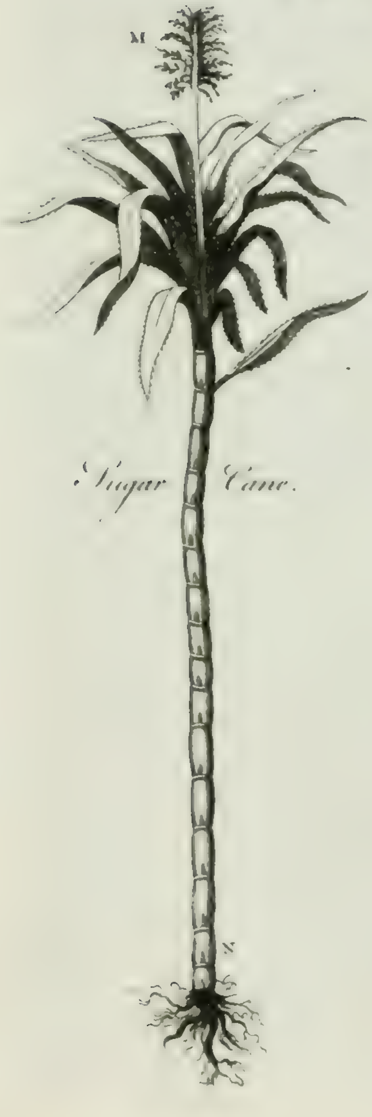
II. The Cassowary (the *Casuarius* of Linnæus, and *Galeated Cassowary* of Dr Latham) was first brought into Europe from Java by the Dutch about the year 1597. It is nearly equal in size to the ostrich, but its legs are much thicker and stronger in proportion. This conformation gives it an air of strength and force, which the fierceness and singularity of its countenance conspire to render formidable. It is five feet and an half long from the point of the bill to the extremity of the claws. The legs are two feet and an half high from the belly to the end of the claws. The head and neck together are a foot and an half; and the largest toe, including the claw, is five inches long. The claw alone of the least toe is three inches and a half in length. The wing is so small that it does not appear, it being hid under the feathers of the back. In other birds, a part of the feathers serve for flight, and are different from those that serve merely for covering; but in the cassowary all the feathers are of the same kind, and outwardly of the same colour. They are generally double, having two long shafts, which grow out of a short one, which is fixed in the skin. Those that are double are always of an unequal length; for some are 14 inches long, particularly on the rump, while others are not above three. The beards that adorn the stem or shaft are about half-way to the end, very long, and as thick as an horse hair, without being subdivided into fibres. The stem or shaft is flat, shining, black, and knotted below; and from each knot there proceeds a beard; likewise the beards at the end of the large feathers are perfectly black, and towards the root of a grey tawny colour; shorter, more soft, and throwing out fine fibres like down; so that nothing appears except the ends, which are hard and black; because the other part, composed of down, is quite covered. There are feathers on the head and neck; but they are so short and thinly sown, that the bird's skin appears naked, except towards the hinder part of the head, where they are a little longer. The feathers which adorn the rump are extremely thick; but do not differ in other respects from the rest, excepting their being longer. The wings, when they are deprived of their feathers, are but three inches long; and the feathers are like those on other parts of the body. The ends of the wings are adorned with five prickles, of different lengths and thickness, which bend like a bow: these are hollow from the roots to the very points, having only that slight substance within which all quills are known to have. The longest of these prickles is 11 inches; and it is a quarter of an inch in diameter at the root, being thicker there than towards the extremity; the point seems broken off.

Plate CCCCLXXXVI

Stylephorus chordatus.



Styrax Benzoin.



Sugar Cane.

Struthio (Ostrich.)

A. Bell Prin. Wal. Sculptor fecit.

[Stru]thio.

The part, however, which moſt diſtinguiſhes this animal is the head: which, though ſmall, like that of an oſtrich, does not fail to inſpire ſome degree of terror. It is bare of feathers, and is in a manner armed with an helmet of horny ſubſtance, that covers it from the root of the bill to near half the head backwards. This helmet is black before and yellow behind. Its ſubſtance is very hard, being formed by the elevation of the bone of the ſkull; and it conſiſts of ſeveral plates, one over another, like the horn of an ox. Some have ſuppoſed that this was ſhed every year with the feathers; but the moſt probable opinion is, that it only exfoliates ſlowly like the beak. To the peculiar oddity of this natural armour may be added the colour of the eye in this animal, which is a bright yellow; and the globe being above an inch and a half in diameter, give it an air equally fierce and extraordinary. The hole of the ear is very large and open, being only covered with ſmall black feathers. The ſides of the head, about the eye and ear, being deſtitute of any covering, are blue, except the middle of the lower eyelid, which is white. The part of the bill which anſwers to the upper jaw in other animals is very hard at the edges above, and the extremity of it is like that of a turkey-cock. The end of the lower mandible is ſlightly notched, and the whole is of a greyiſh brown, except a green ſpot on each ſide. As the beak admits a very wide opening, this contributes not a little to the bird's menacing appearance. The neck is of a violet colour, inclining to that of ſlate; and it is red behind in ſeveral places, but chiefly in the middle. About the middle of the neck before, at the riſe of the large feathers, there are two proceſſes formed by the ſkin, which reſemble ſomewhat the gills of a cock, but that they are blue as well as red. The ſkin which covers the forepart of the breaſt, on which this bird leans and reſts, is hard, callous, and without feathers. The thighs and legs are covered with feathers, and are extremely thick, ſtrong, ſtraight, and covered with ſcales of ſeveral ſhapes; but the legs are thicker a little above the foot than in any other place. The toes are likewiſe covered with ſcales, and are but three in number; for that which ſhould be behind is wanting. The claws are of a hard ſolid ſubſtance, black without and white within.

The internal parts are equally remarkable. The caſſowary unites with the double ſtomach of animals that live upon vegetables the ſhort inteſtines of thoſe that live upon fleſh. The inteſtines of the caſſowary are 13 times ſhorter than thoſe of the oſtrich. The heart is very ſmall, being but an inch and an half long, and an inch broad at the baſe. Upon the whole, it has the head of a warrior, the eye of a lion, the defence of a porcupine, and the ſwiftneſs of a courſer.

Thus formed for a life of hoſtility, for terrifying others, and for its own defence, it might be expected that the caſſowary was one of the moſt fierce and terrible animals of the creation. But nothing is ſo oppoſite to its natural character: it never attacks others; and inſtead of the bill, when attacked, it rather makes uſe of its legs, and kicks like a horſe, or runs againſt its purſuer, beats him down, and treads him to the ground.

The manner in which this animal moves is not leſs extraordinary than its appearance. Inſtead of going directly forward, it ſeems to kick up behind with one leg; and then making a bound onward with the other, it goes with ſuch prodigious velocity, that the ſwifteſt racer would be left far behind.

The ſame degree of voracioufneſs which we perceived in the oſtrich obtains as ſtrongly here. The caſſowary ſwallows every thing that comes within the capacity of its gullet. The Dutch aſſert, that it can devour not only glaſs, iron, and ſtones, but even live and burning coals, without teſtifying the ſmalleſt fear or feeling the leaſt injury. It is ſaid, that the paſſage of the food through its gullet is performed ſo ſpeedily, that even the very eggs which it has ſwallowed whole paſs through it unbroken in the ſame form they went down. In fact, the alimentary canal of this animal, as was obſerved above, is extremely ſhort; and it may happen, that many kinds of food are indigeſtible in its ſtomach, as wheat or currants are to man, when ſwallowed whole.

Struthio || Strymon.

The caſſowary's eggs are of a grey-aſh colour, inclining to green. They are not ſo large nor ſo round as thoſe of the oſtrich. They are marked with a number of little tubercles of a deep green, and the ſhell is not very thick. The largeſt of theſe is found to be 15 inches round one way, and about 12 the other.

The ſouthern parts of the moſt eaſtern Indies ſeem to be the natural climate of the caſſowary. His domain, if we may ſo call it, begins where that of the oſtrich terminates. The latter has never been found beyond the Ganges; while the caſſowary is never ſeen nearer than the iſlands of Banda, Sumatra, Java, the Molucca iſlands, and the correſponding parts of the continent. Yet even here this animal ſeems not to have multiplied in any conſiderable degree, as we find one of the kings of Java making a preſent of one of theſe birds to the captain of a Dutch ſhip, conſidering it as a very great rarity.

2. The *Caſuarius Novæ Hollandiæ*, or New Holland caſſowary, differs conſiderably from the common caſſowary. It is a much larger bird, ſtanding higher on its legs, and having the neck longer than in the common one. Total length ſeven feet two inches. The bill is not greatly different from that of the common caſſowary; but the horny appendage or helmet on the top of the head in this ſpecies is totally wanting: the whole of the head and neck is alſo covered with feathers, except the throat and fore part of the neck about half way, which are not ſo well feathered as the reſt; whereas in the common caſſowary the head and neck are bare and carunculated as in the turkey.

Governor Phillip's Voyage to Botany Bay.

The plumage in general conſiſts of a mixture of brown and grey, and the feathers are ſomewhat curled or bent at the ends in the natural ſtate: the wings are ſo very ſhort as to be totally uſeleſs for flight, and indeed are ſcarcely to be diſtinguiſhed from the reſt of the plumage, were it not for their ſtanding out a little. The long ſpines which are ſeen in the wings of the common ſort are in this not obſervable, nor is there any appearance of a tail. The legs are ſtout, formed much as in the galeated caſſowary, with the addition of their being jagged or ſawed the whole of their length at the back part.

This bird is not uncommon in New Holland, as ſeveral of them have been ſeen about Botany Bay and other parts. Although it cannot fly, it runs ſo ſwiftly, that a greyhound can ſcarcely overtake it. The fleſh is ſaid to be in taſte not unlike beef.

STRUTHIOLA, in botany; a genus of plants belonging to the claſs of *tetrandria*, and order of *monogynia*. The corolla is wanting; the calyx is tubulous, with eight glandules at its mouth; the berry is without juice, and monoſpermous. The ſpecies are three, the virgata, erecta, and nana, all of foreign extraction.

STRYCHNOS, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *monogynia*; and in the natural ſyſtem ranging under the 28th order, *Luridæ*. The corolla is quinquefid; the berry is unilocular, with a woody bark. The ſpecies are three, the nux vomica, colubrina, and potatorum, natives of foreign countries.

STRYMON (anc. geog.), formerly *Conozus*; a river conſtituting

Strype. Stuart. ſtituting the ancient limits of Macedonia and Thrace; riſing in mount Scombrus (Ariſtotle). Authors differ as to the modern name of this river.

STRYPE (John), was deſcended from a German family, born at London, and educated at Cambridge. He was vicar of Low Layton in Eſſex, and diſtinguiſhed himſelf by his compilations of Lives and Memoirs; in which, as Dr Birch remarks, his fidelity and induſtry will always give a value to his writings, however deſtitute they may be of the graces of ſtyle. He died in 1737, after having enjoyed his vicarage near 68 years.

STUART (Dr Gilbert), was born at Edinburgh in the year 1742. His father Mr George Stuart was profeſſor of humanity in the univerſity, and a man of conſiderable eminence for his claſſical taſte and literature. For theſe accompliſhments he was probably indebted in no ſmall degree to his relation the celebrated Ruddiman, with whom both he and his ſon converſed familiarly, though they afterwards united to injure his fame.

Gilbert having finiſhed his claſſical and philoſophical ſtudies in the grammar ſchool and univerſity, applied himſelf to juriſprudence, without following or probably intending to follow the profeſſion of the law. For that profeſſion he has been repreſented as unqualified by indolence; by a paſſion which at a very early period of life he diſplayed for general literature; or by boundleſs diſſipation:—and all theſe circumſtances may have contributed to make him relinquiſh purſuits in which he could hope to ſucceed only by patient perſeverance and ſtrict decorum of manners. That he did not waſte his youth in idleneſs, is, however, evident from An Hiſtorical Diſſertation concerning the Antiquity of the Britiſh Conſtitution, which he publiſhed before he had completed his twenty-ſecond year, and which had ſo much merit as to induce the univerſity of Edinburgh to confer upon the author, though ſo young a man, the degree of LL.D.

After a ſtudious interval of ſome years, he produced a valuable work, under the title of A View of Society in Europe, in its Progreſs from Rudeneſs to Refinement; or, Inquiries concerning the Hiſtory of Laws, Government, and Manners. He had read and meditated with patience on the moſt important monuments of the middle ages; and in this volume (which ſpeedily reached a ſecond edition) he aimed chiefly at the praiſe of originality and invention, and diſcovered an induſtry that is ſeldom connected with ability and diſcernment. About the time of the publication of the firſt edition of this performance, having turned his thoughts to an academical life, he aſked for the profeſſorſhip of public law in the univerſity of Edinburgh. According to his own account he had been promiſed that place by the miniſter, but had the mortification to ſee the profeſſorſhip beſtowed on another, and all his hopes blaſted by the influence of Dr Robertſon, whom he repreſented as under obligations to him.

To the writer of this article, who was a ſtranger to theſe rival candidates for hiſtorical fame, this part of the ſtory ſeems very incredible; as it is not eaſy to conceive how it ever could be in the power of Dr Stuart to render to the learned Principal any eſſential ſervice. It was believed indeed by the earl of Buchan, and by others, who obſerved that the illiberal jealouſy not unfrequent in the world of letters, was probably the ſource of this oppoſition; which entirely broke the intimacy of two perſons who, before that time, were underſtood to be on the moſt friendly footing with each other. Ingratitude, however, is as likely to have been the vice of Dr Stuart as of Dr Robertſon; for we have been told by a writer *, who, at leaſt in one inſtance, has completely proved what he affirms, that "ſuch was Gilbert Stuart's laxity of principle as a man, that he conſidered ingratitude as one of the moſt venial ſins; ſuch was his conceit as a writer, that he regarded no one's merits but his own; ſuch were his diſappointments, both as a writer and a man, that he allowed his peeviſhneſs to ſour into malice, and indulged his malevolence till it ſettled in corruption."

* Chalmers in his Life of Ruddiman.

Stuart. Stucco. Soon after this diſappointment Dr Stuart went to London, where he became from 1768 to 1774 one of the writers of the Monthly Review. In 1772 Dr Adam, rector of the high ſchool at Edinburgh, publiſhed a Latin Grammar, which he intended as an improvement of the famous Ruddiman's. Stuart attacked him in a pamphlet under the name of *Buſbby*, and treated him with much ſeverity. In doing this, he was probably actuated more by ſome perſonal diſlike of Dr Adam than by regard for the memory of his learned relation; for on other occaſions he ſhowed ſufficiently that he had no regard to Ruddiman's honour as a grammarian, editor, or critic.

In 1774 he returned to his native city, and began the Edinburgh Magazine and Review, in which he diſcuſſed the liberty and conſtitution of England, and diſtinguiſhed himſelf by an inquiry into the character of John Knox the reformer, whoſe principles he reprobated in the ſevereſt terms. About this time he reviſed and publiſhed Sullivan's Lectures on the Conſtitution of England. Soon after he turned his thoughts to the hiſtory of Scotland, and publiſhed Obſervations concerning its Public Law and Conſtitutional Hiſtory; in which he examined with a critical care the preliminary book to Dr Robertſon's Hiſtory. His next work was The Hiſtory of the Reformation; a book which deſerves praiſe for the eaſy dignity of the narrative, and for ſtrict impartiality. His laſt great work, The Hiſtory of Scotland from the Eſtabliſhment of the Reformation to the Death of Queen Mary, which appeared in 1782, has been very generally read and admired. His purpoſe was to vindicate the character of the injured queen, and expoſe the weakneſs of the arguments by which Dr Robertſon had endeavoured to prove her guilty: but though the ſtyle of this work is his own, it contains very little matter which was not furniſhed by Goodall and Tytler; and it is with the arms which theſe two writers put into his hands that Dr Stuart vanquiſhed his great antagoniſt

In 1782 he once more viſited London, and engaged in the Political Herald and Engliſh Review; but the jaundice and dropſy increaſing on him, he returned by ſea to his native country, where he died in the houſe of his father on the 13th of Auguſt 1786.

In his perſon Dr Stuart was about the middle ſize and juſtly proportioned. His countenance was modeſt and expreſſive, ſometimes glowing with ſentiments of friendſhip, of which he was truly ſuſceptible, and at others darting that ſatire and indignation at folly and vice which appear in ſome of his writings. He was a boon companion; and, with a conſtitution that might have ſtood the ſhock of ages, he fell a premature martyr to intemperance. His talents were certainly great, and his writings are uſeful; but he ſeems to have been influenced more by paſſion than prejudice, and in his character there was not much to be imitated.

STUCCO, in building, a compoſition of white marble pulveriſed, and mixed with plaſter of lime; and the whole being ſifted and wrought up with water, is to be uſed like common plaſter: this is called by Pliny *marmoratum opus*, and *albarium opus*.

A patent has been granted to Mr B. Higgins for inventing a new kind of ſtucco, or water-cement, more firm and durable than any heretofore. Its compoſition, as extracted

tracted from the specification signed by himself, is as follows: "Drift-sand, or quarry (A) sand, which consists chiefly of hard quartose flat-faced grains with sharp angles; which is the freest, or may be most easily freed by washing, from clay, salts, and calcareous, gypseous, or other grains less hard and durable than quartz; which contains the smallest quantity of pyrites or heavy metallic matter inseparable by washing; and which suffers the smallest diminution of its bulk in washing in the following manner—is to be preferred before any other. And where a coarse and a fine sand of this kind, and corresponding in the size of their grains with the coarse and fine sands hereafter described, cannot be easily procured, let such sand of the foregoing quality be chosen as may be sorted and cleansed in the following manner:

"Let the sand be sifted in streaming clear water, thro' a sieve which shall give passage to all such grains as do not exceed one-sixteenth of an inch in diameter; and let the stream of water and the sifting be regulated so that all the sand, which is much finer than the Lynn-sand commonly used in the London glass-houses, together with clay and every other matter specifically lighter than sand, may be washed away with the stream, whilst the purer and coarser sand, which passes through the sieve, subsides in a convenient receptacle, and whilst the coarse rubbish and rubble remain on the sieve to be rejected.

"Let the sand which thus subsides in the receptacle be washed in clean streaming water through a finer sieve, so as to be further cleansed and sorted into two parcels; a coarser, which will remain in the sieve which is to give passage to such grains of sand only as are less than one-thirtieth of an inch in diameter, and which is to be saved apart under the name of *coarse sand*; and a finer, which will pass thro' the sieve and subside in the water, and which is to be saved apart under the name of *fine sand*.—Let the coarse and the fine sand be dried separately, either in the sun or on a clean iron-plate, set on a convenient surface, in the manner of a sand-heat (B).

"Let lime be chosen (C) which is stone-lime, which heats the most in slaking, and slakes the quickest when duly watered; which is the freshest made and closest kept; which dissolves in distilled vinegar with the least effervescence, and leaves the smallest residue insoluble, and in this residue the smallest quantity of clay, gypsum, or martial matter.

"Let the lime chosen according to these important rules be put in a brass-wired sieve to the quantity of 14 pounds. Let the sieve be finer than either of the foregoing; the finer, the better it will be: let the lime be slaked (D) by plunging it in a butt filled with soft water, and raising it out quickly and suffering it to heat and fume, and by repeating this plunging and raising alternately, and agitating the lime, until it be made to pass through the sieve into the water; and let the part of the lime which does not easily pass through the sieve be rejected: and let fresh portions of the lime be thus used, until as many (E) ounces of lime have passed through the sieve as there are quarts of water in the butt. Let the water thus impregnated stand in the butt closely covered (F) until it becomes clear; and through wooden (G) cocks placed at different heights in the butt, let the clear liquor be drawn off as fast (H) and as low as the lime subsides, for use. This clear liquor I call the *cementing liquor* (I). The freer the water is from saline matter, the better will be the cementing liquor made with it.

 "Let

(A) "This is commonly called *pit-sand*.

(B) "The sand ought to be stirred up continually until it is dried, and is then to be taken off; for otherwise the evaporation will be very slow, and the sand which lies next the iron plate, by being overheated, will be discoloured.

(C) "The preference given to stone-lime is founded on the present practice in the burning of lime, and on the closer texture of it, which prevents it from being so soon injured by exposure to the air as the more spongy chalk-lime is; not on the popular notion that stone-lime has something in it whereby it excels the best chalk in the cementing properties. The gypsum contained in lime-stone remains unaltered, or very little altered, in the lime, after the burning; but it is not to be expected that clay or martial matter should be found in their native state in well-burned lime; for they concrete or vitrify with a part of the calcareous earth, and constitute the hard grains or lumps which remain undissolved in weak acids, or are separable from the slaked lime by sifting it immediately through a sieve.

(D) "This method of impregnating the water with lime is not the only one which may be adopted. It is, however, preferred before others, because the water clears the sooner in consequence of its being warmed by the slaking lime; and the gypseous part of the lime does not diffuse itself in the water so freely in this way as it does when the lime is slaked to fine powder in the common method, and is then blended with the water; for the gypseous part of the lime slakes at first into grains rather than into fine powder, and will remain on the sieve after the pure lime has passed through, long enough to admit of the intended separation; but when the lime is otherwise slaked, the gypseous grains have time to slake to a finer powder, and passing through the sieve, dissolve in the water along with the lime. I have imagined that other advantages attended this method of preparing the lime-water, but I cannot yet speak of them with precision.

(E) "If the water contains no more acidulous gas than is usually found in river or rain water, a fourth part of this quantity of lime, or less, will be sufficient.

(F) "The calcareous crust which forms on the surface of the water ought not to be broke, for it assists in excluding the air, and preventing the absorption of acidulous gas whereby the lime-water is spoiled.

(G) "Brass-cocks are apt to colour a part of the liquor.

(H) "Lime-water cannot be kept many days unimpaired, in any vessels that are not perfectly air-tight. If the liquor be drawn off before it clears, it will contain whiting, which is injurious; and if it be not instantly used after it is drawn limpid from the butt into open vessels, it will grow turbid again, and deposit the lime changed to whiting by the gas absorbed from the air. The calcareous matter which subsides in the butt resembles whiting the more nearly as the lime has been more sparingly employed; in the contrary circumstances, it approaches to the nature of lime; and in the intermediate state, it is fit for the common composition of the plasterers for inside stucco.

(I) "At the time of writing this specification, I preferred this term before that of lime-water, on grounds which I had not sufficiently examined.

Stucco.

" Let 56 pounds of the aforeſaid choſen lime be ſlaked, by gradually ſprinkling on it, and eſpecially on the unſlaked pieces, the cementing liquor, in a cloſe (K) clean place. Let the ſlaked part be immediately (L) ſifted through the laſt-mentioned fine braſs-wired ſieve: Let the lime which paſſes be uſed inſtantly, or kept in air-tight veſſels, and let the part of the lime which does not paſs through the ſieve be rejected (M).— This finer richer part of the lime which paſſes through the ſieve I call *purified lime*.

" Let bone-aſh be prepared in the uſual manner, by grinding the whiteſt burnt bones, but let it be ſifted, to be much finer than the bone-aſh commonly ſold for making cupels.

" The moſt eligible materials for making my cement being thus prepared, take 56 pounds of the coarſe ſand and 42 pounds of the fine ſand; mix them on a large plank of hard wood placed horizontally; then ſpread the ſand ſo that it may ſtand to the height of ſix inches, with a flat ſurface on the plank; wet it with the cementing liquor; and let any ſuperfluous quantity of the liquor, which the ſand in the condition deſcribed cannot retain, flow away off the plank. To the wetteſt ſand add 14 pounds of the purified lime in ſeveral ſucceſſive portions, mixing and beating them up together in the mean time with the inſtruments generally uſed in making fine mortar: then add 14 pounds of the bone-aſh in ſucceſſive portions, mixing and beating all together. The quicker and the more perfectly theſe materials are mixed and beaten together, and the ſooner the cement thus formed is uſed, the better (N) it will be. This I call the *water-cement coarſe grained*, which is to be applied in building, pointing, plaſtering, ſtuccoing, or other work, as mortar and ſtucco now are; with this difference chiefly, that as this cement is ſhorter than mortar or common ſtucco, and dries ſooner, it ought to be worked expeditiouſly in all caſes; and in ſtuccoing, it ought to be laid on by ſliding the trowel upwards on it; that the materials uſed along with this cement in building, or the ground on which it is to be laid in ſtuccoing, ought to be well wetted with the cementing liquor in the inſtant of laying on the cement; and that the cementing liquor is to be uſed when it is neceſſary to moiſten the cement, or when a liquid is required to facilitate the floating of the cement.

" When ſuch cement is required to be of a finer texture, take 98 pounds of the fine ſand, wet it with the cementing liquor, and mix it with the purified lime and the bone-aſh in the quantities and in the manner above deſcribed; with this difference only, that 15 pounds of lime, or (O) thereabouts, are to be uſed inſtead of 14 pounds, if the greater part of the ſand be as fine as Lynn ſand. This I call *water-cement fine-grained*. It is to be uſed in giving the laſt coating, or the finiſh to any work intended to imitate the finer-grained ſtones or ſtucco. But it may be applied to all the uſes of the water-cement coarſe grained, and in the ſame manner.

" When for any of the foregoing purpoſes of pointing, building, &c. ſuch a cement is required much cheaper and coarſer-grained, then much coarſer clean ſand than the foregoing coarſe ſand, or well-waſhed fine rubble, is to be provided. Of this coarſe ſand or rubble take 56 pounds, of the foregoing coarſe ſand 28 pounds, and of the fine ſand 14 pounds; and after mixing theſe, and wetting them with the cementing liquor in the foregoing manner, add 14 pounds, or ſomewhat leſs, of the (P) purified lime, and then 14 pounds or ſomewhat leſs of the bone-aſh, mixing them together in the manner already deſcribed. When my cement is required to be white, white ſand, white lime, and the whiteſt bone-aſh are to be choſen. Grey ſand, and grey bone-aſh formed of half-burnt bones, are to be choſen to make the cement grey; and any other colour of the cement is obtained, either by chooſing coloured ſand, or by the admixture of the neceſſary quantity of coloured talc in powder, or of coloured, vitreous, or metallic powders, or other durable colouring ingredients commonly uſed in paint.

" To the end that ſuch a water-cement as I have deſcribed may be made as uſeful as it is poſſible in all circumſtances; and that no perſon may imagine that my claim and right under theſe letters-patent may be eluded by divers variations, which may be made in the foregoing proceſs without producing any notable defect in the cement; and to the end that the principles of this art, as well as the art itſelf, of making my cement, may be gathered from this ſpecification and perpetuated to the public; I ſhall add the following obſervations:

" This my water-cement, whether the coarſe or fine grained, is applicable in forming artificial ſtone, by making alternate layers of the cement and of flint, hard ſtone, or brick,

(K) " The vapour which ariſes in the ſlaking of lime contributes greatly to the ſlaking of theſe pieces which lie in its way; and an unneceſſary waſte of the liquor is prevented, by applying it to the lime heaped in a pit or in a veſſel, which may reſtrain the iſſue of the vapour, and direct it through the maſs. If more of the liquor be uſed than is neceſſary to ſlake the lime, it will create error in weighing the ſlaked powder, and will prevent a part of it from paſſing freely thro' the ſieve. The liquid is therefore to be uſed ſparingly, and the lime which has eſcaped its action is to be ſprinkled apart with freſh liquor.

(L) " When the aggregation of the lumps of lime is thus broken, it is impaired much ſooner than it is in the former ſtate, becauſe the air more freely pervades it.

(M) " Becauſe it conſiſts of heterogeneous matter or of ill burnt lime; which laſt will ſlake and paſs through the ſieve, if the lime be not immediately ſifted after the ſlaking, agreeable to the text.

(N) " Theſe proportions are intended for a cement made with ſharp ſand, for incruſtation in expoſed ſituations, where it is neceſſary to guard againſt the effects of hot weather and rain. In general, half this quantity of bone-aſhes will be found ſufficient; and although the incruſtation in this latter caſe will not harden deeply ſo ſoon, it will be ultimately ſtronger, provided the weather be favourable.

" The injuries which lime and mortar ſuſtain by expoſure to the air, before the cement is finally placed in a quieſcent ſtate, are great; and therefore our cement is the worſe for being long beaten, but the better as it is quickly beaten until the mixture is effected, and no longer.

(O) " The quantity of bone-aſhes is not to be increaſed with that of the lime; but it is to be leſſened as the expoſure and purpoſes of the work will admit.

(P) " Becauſe leſs lime is neceſſary, as the ſand is coarſer.

brick, in moulds of the figure of the intended ſtone, and by expoſing the maſſes ſo formed to the open (Q) air to harden.

"When ſuch cement is required for water (R) fences, two thirds of the preſcribed quantity of bone-aſhes are to be omitted; and in the place thereof an equal meaſure of powdered terras is to be uſed; and if the ſand employed be not of the coarſeſt ſort, more terras muſt be added, ſo that the terras ſhall be by weight one-ſixth part of the weight of the ſand.

"When ſuch a cement is required of the fineſt grain (S) or in a fluid form, ſo that it may be applied with a bruſh, flint powder, or the powder of any quartoſe or hard earthy ſubſtance, may be uſed in the place of ſand; but in a quantity ſmaller, as the flint or other powder is finer; ſo that the flint-powder, or other ſuch powder, ſhall not be more than ſix times the weight of the lime, nor leſs than four times its weight. The greater the quantity of lime within theſe limits, the more will the cement be liable to crack by quick drying, and *vice verſa*.

"Where ſuch ſand as I prefer cannot be conveniently procured, or where the ſand cannot be conveniently waſhed and ſorted, that ſand which moſt reſembles the mixture of coarſe and fine ſand above preſcribed, may be uſed as I have directed, provided due attention is paid to the quantity of the lime, which is to be greater (T) as the quantity is finer, and *vice verſa*.

"Where ſand cannot be eaſily procured, any durable ſtony body, or baked earth groſsly powdered (U), and ſorted nearly to the ſizes above preſcribed for ſand, may be uſed in the place of ſand, meaſure for meaſure, but not weight for weight, unleſs ſuch groſs powder be as heavy ſpecifically as ſand.

"Sand may be cleanſed from every ſofter, lighter, and leſs durable matter, and from that part of the ſand which is too fine, by various methods preferable (X), in certain circumſtances, to that which I have deſcribed.

"Water may be found naturally free from fixable gas, ſelenite, or clay; ſuch water may, without any notable inconvenience, be uſed in the place of the cementing liquor; and water approaching this ſtate will not require ſo much lime as I have ordered to make the cementing liquor; and a cementing liquor ſufficiently uſeful may be made by various methods of mixing lime and water in the deſcribed proportions, or nearly ſo.

"When ſtone-lime cannot be procured, chalk-lime, or ſhell-lime, which beſt reſembles ſtone-lime, in the characters above written of lime, may be uſed in the manner deſcribed, except that fourteen pounds and a half of chalk-lime will be required in the place of fourteen pounds of ſtone-lime. The proportion of lime which I have preſcribed above may be increaſed without inconvenience, when the cement or ſtucco is to be applied where it is not liable to dry quickly; and in the contrary circumſtance, this proportion may be diminiſhed; and the defect of lime in quantity or quality may be very advantageouſly ſupplied (Y), by cauſing a conſiderable quantity of the cementing liquor to ſoak into the work, in ſucceſſive portions, and at diſtant intervals of time, ſo that the calcareous matter of the cementing liquor, and the matter attracted from the open air, may fill and ſtrengthen the work.

"The powder of almoſt every well-dried or burnt animal ſubſtance may be uſed inſtead of bone-aſh; and ſeveral earthy powders, eſpecially the micaceous and the metallic; and the elixated aſhes of divers vegetables whoſe earth will not burn to lime; and the aſhes of mineral fuel, which are of the calcareous kind, but will not burn to lime, will anſwer the ends of bone-aſh in ſome degree.

"The quantity of bone-aſh deſcribed may be leſſened without injuring the cement, in thoſe circumſtances eſpecially which admit the quantity of lime to be leſſened, and in thoſe wherein the cement is not liable to dry quickly. And the art of remedying the defects of lime may be advantageouſly practiſed to ſupply the deficiency of bone-aſh, eſpecially in building, and in making artificial ſtone with this cement.

STUD,

(Q) "But they muſt not be expoſed to the rain until they are almoſt as ſtrong as freſh Portland ſtone; and even then they ought to be ſheltered from it as much as the circumſtances will admit. Theſe ſtones may be made very hard and beautiful, with a ſmall expence of bone-aſh, by ſoaking them, after they have dried thoroughly and hardened, in the lime liquor, and repeating this proceſs twice or thrice, at diſtant intervals of time. The like effect was experienced in incruſtations.

(R) "In my experiments, mortar made with terras-powder, in the uſual method, does not appear to form ſo ſtrong a cement for water-fences as that made, according to the ſpecification, with coarſe ſand; and I ſee no more reaſon for avoiding the uſe of ſand in terras-mortar, than there would be for rejecting ſtone from the embankment. The bone-aſhes meant in this place are the dark grey or black ſort. I am not yet fully ſatisfied about the operation of them in this inſtance.

(S) "The qualities and uſes of ſuch fine calcareous cement are recommended chiefly for the purpoſe of ſmoothing and finiſhing the ſtronger cruſtaceous works, or for waſhing walls to a lively and uniform colour. For this laſt intention, the mixture muſt be as thin as new cream, and laid on briſkly with a bruſh, in dry weather; and a thick and durable coat is to be made by repeated waſhing; but is not to be attempted by uſing a thicker liquor; for the coat made with this laſt is apt to ſcale, whilſt the former endures the weather much longer than any other thin calcareous covering that has been applied in this way. Fine yellow-ochre is the cheapeſt colouring ingredient for ſuch waſh, when it is required to imitate Bath-ſtone, or the warm-white ſtones.

(T) "If ſea-ſand be well waſhed in freſh water, it is as good as any other round ſand.

(U) "The cement made with theſe and the proper quantities of purified lime and lime-water, are inferior to the beſt, as the grains of theſe powders are more periſhable and brittle than thoſe of ſand. They will not therefore be employed, unleſs for the ſake of evaſion, or for want of ſand: in this latter caſe, the finer powder ought to be waſhed away.

(X) "This and the next paragraph is inſerted with a view to evaſions, as well as to ſuggeſt the eaſier and cheaper methods which may be adopted in certain circumſtances, by artiſts who underſtand the principles which I endeavoured to teach.

(Y) "This practice is noticed, as the remedy which may be uſed for the defects ariſing from evaſive meaſures, and as the method of giving ſpongy incruſtations containing bone-aſhes the greateſt degree of hardneſs."

STUD, in the manege, a collection of breeding horses and mares.

STUDDING-SAILS, certain light sails extended, in moderate and steady breezes, beyond the skirts of the principal sails, where they appear as wings upon the yard-arms.

STUFF, in commerce, a general name for all kinds of fabrics of gold, silver, silk, wool, hair, cotton, or thread, manufactured on the loom; of which number are velvets, brocades, mohairs, satins, taffetas, cloths, serges, &c.

STUKELY (Dr William), a celebrated antiquarian, descended from an ancient family in Lincolnshire, was born at Holbech in 1687, and educated in Bennet college, Cambridge. While an under-graduate, he often indulged a strong propensity to drawing and designing; but made physic his principal study, and first began to practise at Boston in his native country. In 1717 he removed to London, where, on the recommendation of Dr Mead, he was soon after elected a fellow of the Royal Society; he was one of the first who revived that of the antiquarians in 1718, and was their secretary for many years during his residence in town. In 1729 he took holy orders by the encouragement of archbishop Wake; and was soon after presented by lord chancellor King with the living of All Saints in Stamford. In 1741 he became one of the founders of the Egyptian society, which brought him acquainted with the benevolent duke of Montague, one of the members; who prevailed on him to leave Stamford, and presented him to the living of St George the Martyr, Queen Square. He died of a stroke of the palsy in 1765. In his physical capacity, his Dissertation on the Spleen was well received; and his *Itinerarium Curiosum*, the first fruit of his juvenile excursions, was a good specimen of what was to be expected from his riper age. His great learning, and profound researches into the dark remains of antiquity, enabled him to publish many elaborate and curious works: his friends used to call him the *arch-druid* of his age. His discourses, intitled *Palæographia Sacra*, on the vegetable creation, bespeak him a botanist, philosopher, and divine.

STUM, in the wine-trade, denotes the unfermented juice of the grape after it has been several times racked off and separated from its sediment. The casks are for this purpose well matched or fumigated with brimstone every time, to prevent the liquor from fermenting, as it would otherwise readily do, and become wine. See MUST.

STUPIDITY. The Greek word μωροτης corresponds most with our English word *stupidity* or *foolishness*, when used to express that state of mind in which the intellects are defective. The immediate causes are said to be, a deficiency of vital heat, or a defect in the brain. Stupid children sometimes become sprightly youths; but if stupidity continues to the age of puberty, it is hardly ever removed. If stupidity follows upon a violent passion, an injury done to the head, or other evident cause, and if it continues long, it becomes incurable. But the stupidity which consists in a loss of memory, and succeeds a lethargy, spontaneously ceases when the lethargy is cured.

STUPOR, a numbness in any part of the body, whether occasioned by ligatures obstructing the blood's motion, by the palsy, or the like.

STUPPA, or STUPE, in medicine, is a piece of cloth dipped in some proper liquor, and applied to an affected part.

STURDY, a distemper to which cattle are subject, called also the *turning evil*. See FARRIERY.

STURGEON. See ACCIPENSER.

STURMIUS (John), a learned philologer and rhetorician, was born at Sleida in Eifel near Cologne in 1507. He studied at first in his native country with the sons of count de Manderscheid, whose receiver his father was. He afterward pursued his study at Liege in the college of St Jerom, and then went to Louvain in 1524. Five years he spent there, three in learning and two in teaching. He set up a printing-press with Rudger Rescius professor of the Greek tongue, and printed several Greek authors. He went to Paris in 1529, where he was highly esteemed, and read public lectures on the Greek and Latin writers, and on logic. He married there, and kept a great number of boarders: but as he liked what were called the *new opinions*, he was more than once in danger; and this undoubtedly was the reason why he removed to Strasburg in 1537, in order to take possession of the place offered him by the magistrates. The year following he opened a school, which became famous, and by his means obtained of Maximilian II. the title of an university in 1566. He was very well skilled in polite literature, wrote Latin with great purity, and was a good teacher. His talents were not confined to the school; for he was frequently intrusted with deputations in Germany and foreign countries, and discharged these employments with great honour and diligence. He showed extreme charity to the refugees on account of religion: He not only laboured to assist them by his advice and recommendations; but he even impoverished himself for them. He died in his 82d year, after he had been for some time blind. He published many books; the principal of which are, 1. *Partitiones Dialecticæ*. 2. *De Educatione Principum*. 3. *De Nobilitate Anglicana*. 4. *Linguæ Latinae resolvendæ Ratio*. 5. Excellent Notes on Aristotle's and Hermogenes's Rhetoric, &c.

He ought not to be confounded with *John Sturmius*, a native of Mechlin, and physician and professor of mathematics at Louvain, who also wrote several works.

STURNUS, the STARLING; a genus of birds belonging to the order of *passeres*. The beak is subulated, depressed, and somewhat blunt; the superior mandible is entire, and somewhat open at the edges; the nostrils are marginated above; and the tongue is sharp and emarginated. There are 15 species according to Dr Latham; the vulgaris, capensis, ludovicianus, militaris, cellaris, caranculatus, gallinaceus, sericeus, viridis, olivaceus, moritanicus, loyca, dauuricus, junceti, and mexicanus.

The *vulgaris*, or common starling, is the only species of the sturnus that is indigenous. The weight of the male of this species is about three ounces; that of the female rather less. The length is eight inches three quarters: Latham Synop. vol. ii.
the bill is brown or yellow, but in old birds generally yellow. The whole plumage is black, very resplendent, with changeable blue, purple, and copper: each feather marked with a pale yellow spot. The lesser coverts are edged with yellow, and slightly glossed with green. The quill-feathers and tail dusky: the former edged with yellow on the exterior side; the last with dirty white. The legs of a reddish brown.

The stare breeds in hollow trees, eaves of houses, towers, ruins, cliffs, and often in high rocks over the sea, such as that of the isle of Wight. It lays four or five eggs, of a pale-greenish ash-colour; and makes its nest of straw, small fibres of roots, and the like. In winter, stares assemble in vast flocks: they collect in myriads in the fens of Lincolnshire, and do great damage to the fen-men, by roosting on the reeds, and breaking them down by their weight; for reeds are the thatch of the country, and are laid up in harvest with great care. These birds feed on worms and insects; and it is said that they will get into pigeon-houses, for the sake of sucking the eggs. Their flesh is so bitter as to be scarce eatable. They are fond of following oxen and other large cattle as they feed in the meadows, attracted, it is said, by the insects which flutter round them, or by those, perhaps,

which ſwarm in their dung, or in meadows in general. From this habit is derived the German name *Rinder Staren.* They are alſo accuſed of feeding on the carcaſes that are expoſed on gibbets; but it is probably in ſearch only of inſects. They live ſeven or eight years, or even longer, in the domeſtic ſtate. The wild ones cannot be decoyed by the call, becauſe they regard not the ſcream of the owl. A method has been diſcovered of taking entire families, by fixing to the walls and the trees where they lodge pots of earthen ware of a convenient form, which the birds often prefer to place their neſts in. Many are alſo caught by the gin and draw-net. In ſome parts of Italy it is common to employ tame weaſels to drag them out of their neſts, or rather their holes; for the artifice of man conſiſts in employing one enſlaved race to extend his dominion over the reſt.

The ſtare, it is ſaid, can be taught to ſpeak either French, German, Latin, Greek, &c. and to pronounce phraſes of ſome length. Its pliant throat accommodates itſelf to every inflection and every accent. It can readily articulate the letter R, and acquires a ſort of warbling which is much ſuperior to its native ſong. This bird is ſpread through an extenſive range in the ancient continent. It is found in Sweden, Germany, France, Italy, the Iſle of Malta, the Cape of Good Hope, and is everywhere nearly the ſame; whereas thoſe American birds which have been called ſtares, preſent a great diverſity of appearance.

STYE, or Stythe, in the eye. See Crithe.

STYLE, a word of various ſignifications, originally deduced from *ſtylos*, a kind of bodkin wherewith the ancients wrote on plates of lead, or on wax, &c. and which is ſtill uſed to write on ivory-leaves and paper prepared for that purpoſe, &c.

Style, in dialling, denotes the gnomon or cock of a dial raiſed on the plane thereof to project a ſhadow.

Style, in botany. See Botany, Sect. iv. p. 434.

Style, in language, is the peculiar manner in which a man expreſſes his conceptions. It is a picture of the ideas which riſe in his mind, and of the order in which they are there produced.

The qualities of a good ſtyle may be ranked under two heads; perſpicuity and ornament. It will readily be admitted, that perſpicuity ought to be eſſentially connected with every kind of writing; and to attain it, attention muſt be paid, firſt to ſingle words and phraſes, and then to the conſtruction of ſentences. When conſidered with reſpect to words and phraſes, it requires theſe three qualities; purity, propriety, and preciſion. When conſidered with regard to ſentences, it requires a clear arrangement of the words and unity in the ſenſe; to which, if ſtrength and harmony be added, the ſtyle will become ornamented.

One of the moſt important directions to be obſerved by him who wiſhes to form a good ſtyle, is to acquire clear and preciſe ideas on the ſubject concerning which he is to write or ſpeak. To this muſt be added frequency of compoſition, and an acquaintance with the ſtyle of the beſt authors. A ſervile imitation, however, of any author is carefully to be avoided; for he who copies, can hardly avoid copying faults as well as beauties. A ſtyle cannot be proper unleſs it be adapted to the ſubject, and likewiſe to the capacity of our hearers, if we are to ſpeak in public. A ſimple, clear, and unadorned ſtyle, ſuch as that of Swift, is fitteſt for intricate diſquiſition; a ſtyle elegant as Addiſon's, or impetuous like Johnſon's, is moſt proper for fixing the attention on truths, which, though known, are too much neglected. We muſt not be inattentive to the ornaments of ſtyle, if we wiſh that our labours ſhould be read and admired: but he is a contemptible writer, who looks not beyond the dreſs of language, who lays not the chief ſtreſs upon his matter, and who does not regard ornament as a ſecondary and inferior recommendation. For further obſervations on the different kinds of ſtyle, ſee Oratory, n° 99, &c.

Style, in juriſprudence, the particular form or manner of proceeding in each court of juriſdiction, agreeable to the rules and orders eſtabliſhed therein: thus we ſay, the ſtyle of the court of Rome, of chancery, of parliament, of the privy-council, &c.

Style, in muſic, denotes a peculiar manner of ſinging, playing, or compoſing; being properly the manner that each perſon has of playing, ſinging, or teaching; which is very different both in reſpect of different geniuſes, of countries, nations, and of the different matters, places, times, ſubjects, paſſions, expreſſions, &c. Thus we ſay, the ſtyle of Paleſtrina, of Lully, of Corelli, of Handel, &c.; the ſtyle of the Italians, French, Spaniards, &c.

Old Style, the Julian method of computing time, as the *New Style* is the Gregorian method of computation. See Kalendar.

STYLEPHORUS chordatus, a genus of fiſhes belonging to the order of *apodes*. This very curious genus was diſcovered by Dr Shaw, who read a deſcription of it before the Linnæan Society in the year 1788. The eyes are fixed on cylindrical pillars which lie cloſe together. The roſtrum, or narrow part which is terminated by the mouth, is connected to the back part of the head by a flexible leathery duplicature, which permits it either to be extended in ſuch a manner that the mouth points directly upwards, or to fall back ſo as to be received into a ſort of caſe, formed by the upper part of the head. There are three pairs of branchiæ ſituate under the throat. The pectoral fins are ſmall; the dorſal fin runs from the head to within about an inch and a half of the tail; the caudal fin is ſhort, and is furniſhed with five remarkable ſpines. The body is extremely long, and compreſſed very much, and gradually diminiſhes as it approaches the tail, which terminates in a proceſs or ſtring of an enormous length, and finiſhes in a very fine point. This ſtring, or caudal proceſs, ſeems to be ſtrengthened throughout its whole length, or at leaſt as far as the eye can trace it, by a ſort of double fibre or internal part. The ſtylephorus chordatus is a native of the Weſt Indian Sea. It was taken between the iſlands of Cuba and Martinico, near a ſmall cluſter of little iſlands about nine leagues from ſhore, and was ſeen ſwimming near the ſurface. The whole length of this uncommon animal from the head to the extremity of the caudal proceſs is about thirty-two inches, of which the proceſs itſelf meaſures twenty-two.

Plate CCCCLXXXVI.

Tranſactions of the Linnæan Society, vol. i.

STYLET, a ſmall dangerous kind of poniard which may be concealed in the hand, chiefly uſed in treacherous aſſaſſinations. The blade is uſually triangular, and ſo ſmall that the wound it makes is almoſt imperceptible.

STYLITES, pillar saints, in eccleſiaſtical hiſtory, an appellation given to a kind of ſolitaries, who ſtood motionleſs upon the tops of pillars, raiſed for this exerciſe of their patience, and remained there for ſeveral years, amidſt the admiration and applauſe of the ſtupid populace. Of theſe we find ſeveral mentioned in ancient writers, and even as low as the twelfth century, when they were totally ſuppreſſed.

The founder of the order was St Simeon Stylites, a famous anchoret in the fifth century, who firſt took up his abode on a column ſix cubits high; then on a ſecond of twelve cubits, a third of twenty-two, a fourth of thirty-ſix, and on another of forty cubits, where he thus paſſed thirty-ſeven years of his life. The tops of theſe columns were only three feet in diameter, and were defended by a rail that reached almoſt to the girdle, ſomewhat reſembling a

pulpit.

pulpit. There was no lying down in it. The faquirs, or devout people of the East, imitate this extraordinary kind of life to this day.

STYLOCERATOIDES, STYLO-GLOSSUS, *Stylo-Hyoideus*, *Stylo-Pharyngæus*, STYLOIDES. — The names of different muscles in the human body. See *Table of the Muscles under* ANATOMY.

STYLOSANTHES, in botany: A genus of the *decandria* order, belonging to the *diadelphia* class of plants; and in the natural method ranking under the 32d order, *Papilionaceæ*. The calyx is tubulated, very long, having the corolla attached to it. The legumen or pod biarticulated and hooked. Of this there are two species, both natives of Jamaica, viz. 1. *Procumbens*, the *hedysarum procumbens* of Linnæus; a figure of which may be seen in Sloane's Natural History of Jamaica. 2. *Viscosa*, the *trifolium* 2. of Browne; a figure of which is also given by Sloane.

STYPTIC, in pharmacy, a medicine which by its astringency stops hemorrhagies, &c. See PHARMACY, n° 547.

STYRAX, the STORAX-TREE, in botany: A genus of plants belonging to the class of *decandria*, and to the order of *monogynia*; and in the natural system ranging under the 18th order, *Bicornes*. Linnæus only mentions one species of this genus, the *styrax-officinale*; but Aiton, in his *Hortus Kewensis*, has added two more; namely, the *grandifolium* and *levigatum*; and we believe a fourth may now be added, the *styrax benzoin*.

The *officinale* usually rises above twenty feet in height; it sends off many strong branches, which are covered with a roughish bark of a grey colour: the leaves are broad, elliptical, entire, somewhat pointed, on the upper surface smooth, and of a light green colour, on the under surface covered with a whitish down; they are placed alternately, and stand upon short footstalks: the flowers are large, white, and disposed in clusters upon short peduncles, which terminate the branches: the corolla is monopetalous, funnel-shaped, and divided at the limb into five lance-shaped segments: the filaments are ten, placed in a regular circle, and seem to adhere towards the base: the antheræ are erect and oblong: the germen is oval, and supports a slender style, with a simple stigma: the fruit is a pulpy pericarpium, which contains one or two nuts of an oval compressed figure.

The resinous drug called *storax* issues in a fluid state from incisions made in the trunk or branches of the tree. Two sorts of this resin have been commonly distinguished in the shops. 1. *Storax in the tear*: is scarcely, if ever, found in separate tears, but in masses, sometimes composed of whitish and pale reddish brown tears, and sometimes of an uniform reddish yellow or brownish appearance; unctuous and soft like wax, and free from visible impurities. This is supposed to be the sort which the ancients received from Pamphylia in reeds or canes, and which was thence named *calamita*.

2. *Common storax*: in large masses, considerably lighter and less compact than the former, and having a large admixture of woody matter like saw-dust. This appears to be the kind intended by the London college, as they direct their *styrax calamita* to be purified, for medicinal use, by softening it with boiling water, and pressing it out from the feces betwixt warm iron plates; a process which the first sort does not stand in need of. And indeed there is rarely any other than this impure storax to be met with in the shops.

Storax, with some of the ancients, was a familiar remedy as a resolvent, and particularly used in catarrhal complaints, coughs, asthmas, menstrual obstructions, &c. and from its affinity to the balsams it was also prescribed in ulcerations of the lungs, and other states of pulmonary consumption. And our pharmacopœias formerly directed the *pilulæ e styrace*; but this odoriferous drug has now no place in any of the officinal compounds; and though a medicine which might seem to promise some efficacy in nervous debilities, yet by modern practitioners it is almost totally disregarded.

The *styrax benzoin* is described by Dr Dryander in the Philosophical Transactions for 1787, p. 308, &c. It has been characterized by oblong acuminated leaves, which are downy underneath, and nearly of the length of the racemi. The botanical character of this tree was mistaken by modern botanists till Dr Dryander ascertained it to be a styrax. Benzoin was long supposed to be the produce of a species of *laurus*. Linnæus detected this error: but he committed another; for he tells us, that it is furnished by a shrub which, in the country where it grows, is called *croton bezoe*; and afterwards, in his *Supplementum Plantarum*, describes the same plant a second time, under the name of *terminalia benzoin*.

This tree, which is a native of Sumatra, is deemed in six years of sufficient age for affording the benzoin, or when its trunk acquires about seven or eight inches in diameter; the bark is then cut through longitudinally, or somewhat obliquely, at the origin of the principal lower branches, from which the drug exudes in a liquid state, and by exposure to the sun and air soon concretes, when it is scraped off from the bark with a knife or chisel. The quantity of benzoin which one tree affords never exceeds three pounds, nor are the trees found to sustain the effects of these annual incisions longer than ten or twelve years. The benzoin which issues first from the wounded bark is the purest, being soft, extremely fragrant, and very white; that which is less esteemed is of a brownish colour, very hard, and mixed with various impurities, which it acquires during its long continuance upon the trees. Eschelskron distinguishes benzoin into three kinds, viz. *camayan poeti*, or white benjamin, which, upon being melted in a bladder by the heat of the sun, appears marked with red streaks or veins. *Camayan bamatta* is less white than the former, and often spotted with white circles, called eyes, from the number of which its goodness is estimated: it likewise melts by the heat of the sun. *Camayan itam*, or black benjamin, which requires to be melted in hot water for its preservation in bladders. In Arabia, Persia, and other parts of the East, the coarser kinds of benjamin are consumed for fumigating and perfuming the temples, and for destroying insects.

The benzoin which we find here in the shops is in large brittle masses, composed partly of white, partly of yellowish or light brown, and often also of darker coloured pieces: that which is clearest, and contains the most white matter, called by authors *benzoe amygdaloides*, is accounted the best. This resin has very little taste, impressing on the palate only a slight sweetness: its smell, especially when rubbed or heated, is extremely fragrant and agreeable. It totally dissolves in rectified spirit, (the impurities excepted, which are generally in a very small quantity), into a deep yellowish red liquor, and in this state discovers a degree of warmth and pungency, as well as sweetness. It imparts, by digestion, to water also a considerable share of its fragrance, and a slight pungency: the filtered liquor, gently exhaled, leaves not a resinous or mucilaginous extract, but a crystalline matter, seemingly of a saline nature, amounting to one-tenth or one eighth of the weight of the benzoin. Exposed to the fire in proper vessels, it yields a quantity of a white saline concrete, called *flores benzoes*, of an acidulous taste and grateful odour, soluble in rectified spirit, and in water by the assistance of heat.

Storax, Styx.

The principal use of this fragrant resin is in perfumes, and as a cosmetic; for which last purpose, a solution of it in spirit of wine is mixed with so much water as is sufficient to render it milky, as twenty times its quantity or more. It promises, however, to be applicable to other uses, and to approach in virtue, as in fragrance, to storax and balsam of Tolu. It is said to be of great service in disorders of the breast, for resolving obstructions of the pulmonary vessels, and promoting expectoration: in which intentions the flowers are sometimes given, from three or four grains to fifteen. The white powder, precipitated by water from solutions of the benzoin in spirit, has been employed by some as similar and superior to the flowers, but appears to be little other than the pure benzoin in substance: it is not the same but the resinous matter of the benzoin, that is most disposed to be precipitated from spirit by water. The flowers, snuffed up the nose, are said to be a powerful errhine.

Liquid storax is a resinous juice obtained from a tree called by Linnæus *liquidambar styraciflua*, a native of Virginia and Mexico, and lately naturalized in this country. The juice called liquidambar is said to exude from incisions made in the trunk of this tree, and the liquid storax to be obtained by boiling the bark or branches in water. Two sorts of liquid storax are distinguished by authors: one, the purer part of the resinous matter that rises to the surface in boiling, separated by a strainer, of the consistence of honey, tenacious like turpentine, of a reddish or ash brown colour, moderately transparent, of an acrid unctuous taste, and a fragrant smell, faintly resembling that of the solid storax, but somewhat disagreeable: the other, the more impure part, which remains on the strainer, is not transparent, in smell and taste is much weaker, and contains a considerable proportion of the substance of the bark. What is most commonly met with under this name in the shops is of a weak smell and a grey colour, and is supposed to be an artificial composition.

Liquid storax has been employed chiefly in external applications. Among us, it is at present almost wholly in disuse.

STYX (fab. hist.), a celebrated river of hell, round which it flows nine times. The gods held the waters of the Styx in such veneration, that to swear by them was reckoned an oath altogether inviolable. If any of the gods had perjured themselves, Jupiter obliged them to drink the waters of the Styx, which lulled them for one whole year into a senseless stupidity, for the nine following years they were deprived of the ambrosia and the nectar of the gods, and after the expiration of the years of their punishment, they were restored to the assembly of the deities, and to all their original privileges. It is said that this veneration was shown to the Styx, because it received its name from the nymph Styx, who with her three daughters assisted Jupiter in his war against the Titans.

Styx was a river which it was necessary for departed shades to pass before they could enter the infernal regions; and it was the office of Charon to ferry them over in a boat which was kept for that purpose. The ghosts of those who had not been honoured with the rites of sepulture were obliged to wander an hundred years before Charon could admit them into his boat to convey them before the judges of Hades. What could have given rise to this fable of Charon and his boat, it is not very material to inquire. Mythological writers have said, that the Greeks learned it from the Egyptians, which is indeed probable enough; that the Egyptians framed both this, and some other fables relating to the dead, from certain customs peculiar to their country; that in particular there was, not far from Memphis, a famous burying-place, to which the dead bodies were conveyed in a boat across the lake Acherusia; and that Charon was a boatman who had long officiated in that service. The learned Dr Blackwell says, in his life of Homer, that, in the old Egyptian language, *Charoni* signified "ferryman."

Transf. of R. Soc. of Edinburgh, vol. ii.

Suabia || Subclavian.

SUABIA, a circle of Germany, bounded on the north by the circle of Franconia and that of the Lower Rhine; on the west by the circle of the Lower Rhine and Alsace; on the south by Switzerland; and on the east by the circle of Bavaria. Of all the circles of the empire, Suabia is the most divided; it contains four ecclesiastic and thirteen lay principalities, nineteen independent prelacies and abbeys, twenty six earldoms and lordships, and thirty-one free cities. The prime directors of the circle, as they are termed, are the bishop of Constance and the duke of Wirtemberg. The duke has the sole direction of all that relates to war.

The mixture of the various forms of government and religious sects; the oppression exercised by the great on the poor; the game constantly played by the emperor, who possesses many pieces of detached country in Suabia, which depend not on the circle, and can, in consequence of his privileges as archduke of Austria, extend his possessions in it by various ways; are circumstances (says baron Riesbeck) which give the cultivation of the country, and the character of the inhabitants, a most extraordinary cast. In several of the post towns where you stop, you see the highest degree of cultivation in the midst of the most savage wildness; a great degree of knowledge and polish of manners, mixed with the grossest ignorance and superstition; traces of liberty, under the deepest oppression; national pride, together with the contempt and neglect of the native country; in short, all the social qualities in striking contrast and opposition to each other. Those parts of Suabia which belong to the great potentates, such as Wirtemberg, Austria, and Baden, are certainly the most improved. The whole of Suabia may comprehend about nine hundred German square miles, and two millions of people. More than half of these are subjects of the three above mentioned princes, though they are not proprietors of near one half of the lands.

Baron Riesbeck's Travels through Germany, vol. i.

SUARES (Francis), a Jesuit, was born in Granada on the 5th of January 1548. He was a professor of theology at Alcala, Salamanca, Rome, and Coimbra in Portugal. He died at Lisbon in 1617 with the greatest resignation; "I never thought (said he) that it was so easy to die." His memory was astonishing, he could repeat the whole of his voluminous works by heart. His writings fill 23 folio volumes, and are mostly on theological and moral subjects. His Treatise of Laws has been reprinted in this country. His Defence of the Catholic Faith against the Errors of England was written at the request of pope Paul V. This book was publicly burnt at London by order of James I. When Suares heard it, he is said to have exclaimed, "O that I too could seal with my blood the truths which I have defended with my pen!"

SUBAH, the general name of the viceroyships, or greater governments, into which the Mogul empire was divided, consisting of several provinces. The jurisdiction of a subahdar, the same as subahship, subaedaree, or nizamut.

SUBAHDAR, the viceroy, lord-lieutenant, or governor, holding a subah; the same as nabob or nazim. Also the black commander of a company of Seapoys.

SUBALTERN, a subordinate officer, or one who discharges his post under the command and subject to the direction of another; such are lieutenants, sub-lieutenants, cornets, and ensigns, who serve under the captain.

SUBCLAVIAN, in anatomy, is applied to any thing under the arm-pit or shoulder, whether artery, nerve, vein, or muscle.

SUB-DEACON, an inferior minister, who anciently attended at the altar, prepared the sacred vessels, delivered them to the deacons in time of divine service, attended the doors of the church during communion-service, went on the the bishop's embassies with his letters or messages to foreign churches, and was invested with the first of the holy orders. They were so subordinate to the superior rulers of the church, that, by a canon of the council of Laodicea, they were forbidden to sit in the presence of a deacon without his leave. According to the canons, a person must be twenty two years of age to be promoted to the order of subdeacon. See DEACON.

SUBDOMINANT, in music, a name given by M. Rameau to the fourth note of the tone, which of consequence is the same interval from the tonic when descending as the dominant in rising. This denomination arises from the affinity which this author finds by inversion between the minor mode of the subdominant and the major mode of the tonic.

SUBDUPLE RATIO, is when any number or quantity is contained in another twice. Thus 3 is said to be subduple of 6, as 6 is duple of 3. See RATIO.

SUBDUPLICATE RATIO of any two quantities, is the ratio of their square roots.

SUBER, the CORK-TREE, in botany. See QUERCUS.

SUBJECT, a person under the rule and dominion of a sovereign prince or state.

SUBJECT is also used for the matter of an art or science, or that which it considers, or whereon it is employed: thus the human body is the subject of medicine.

SUBINFEUDATION, was where the inferior lords, in imitation of their superiors, began to carve out and grant to others minuter estates than their own, to be held of themselves; and were so proceeding downwards *in infinitum*, till the superior lords observed, that by this method of subinfeudation they lost all their feodal profits, of wardships, marriages, and escheats, which fell into the hands of these mesne or middle lords, who were the immediate superiors of the terre-tenant, or him who occupied the land. This occasioned the stat. of Westm. 3. or *quia emptores*, 18 Edw. I. to be made; which directs, that, upon all sales or feoffments of lands, the feoffee shall hold the same, not of his immediate feoffer, but of the chief lord of the fee of whom such feoffer himself held it. And from hence it is held, that all manors existing at this day must have existed by immemorial prescription; or at least ever since the 18 Edw. I. when the statute of *quia emptores* was made.

Blackstone's Commentary, vol. ii

SUBITO, in the Italian music, is used to signify that a thing is to be performed quickly and hastily: thus we meet with *volti subito*, turn over the leaf quickly.

SUBJUNCTIVE, in grammar. See GRAMMAR.

SUBLIMATE, a chemical preparation, consisting of quicksilver united with the marine acid. See CHEMISTRY-*Index*.

SUBLIMATION, in chemistry, the condensing and collecting, in a solid form, by means of vessels aptly constructed, the fumes of bodies raised from them by the application of a proper heat. See CHEMISTRY, n° 581.

SUBLIME, or SUBLIMITY. See the article GRANDEUR and SUBLIMITY

SUBLINGUAL ARTERY. See ANATOMY.

SUBLINGUAL Glands, in anatomy, two glands under the tongue, placed one on each side thereof.

SUBMULTIPLE, in geometry, &c. A submultiple number, or quantity, is that which is contained a certain number of times in another, and which, therefore, repeated a certain number of times, becomes exactly equal thereto. Thus 3 is a submultiple of 21. In which sense a submultiple coincides with an aliquot part.

SUBMULTIPLE Ratio, is that between the quantity contained and the quantity containing. Thus the ratio of 3 to 21 is submultiple. In both cases submultiple is the reverse of multiple: 21, *e. gr.* being a multiple of 3, and the ratio of 21 to 3 a multiple ratio.

SUBORDINARIES. See HERALDRY, Chap. III. Sect. II. page 454.

SUBORDINATION, a relative term, expressing an inferiority betwixt one person and another.

SUBORNATION, in law, a secret, underhand, preparing, instructing, or bringing in a false witness; and from hence *subornation of perjury* is the preparing or corrupt alluring to perjury. The punishment for this crime was formerly death, then banishment or cutting out the tongue, afterwards forfeiture of goods; and it is now a fine and imprisonment, and never more to be received as evidence. The statute 2 Geo. II. c. 25. superadded a power for the court to order the offender to be sent to the house of correction for a term not exceeding seven years, or be transported for the same period.

SUBPŒNA, in law, a writ whereby common persons are called into chancery, in such cases where the common law hath provided no ordinary remedy; and the name of it proceeds from the words therein, which charge the party called to appear at the day and place assigned, *sub pœna centum librarum*, &c. The subpœna is the leading process in the courts of equity; and by statute, when a bill is filed against any person, process of subpœna shall be taken out to oblige the defendant to appear and answer the bill, &c.

SUBPOENA ad testificandum, a writ or process to bring in witnesses to give their testimony. If a witness on being served with this process does not appear, the court will issue an attachment against him; or a party, plaintiff or defendant, injured by his non-attendance, may maintain an action against the witness. See *Blackst. Com.* Vol. III. p. 369.

SUBPOENA in Equity, a process in equity, calling on a defendant to appear and answer to the complainant's bill. See statute 5th Geo. II. c. 25. which enacts, that where the party cannot be found to be served with a subpœna, and absconds (as believed) to avoid being served, a day shall be appointed him to appear to the bill of the plaintiff; which is to be inserted in the London Gazette, read in the parish-church where the defendant last lived, and fixed up at the Royal Exchange: and if the defendant doth not appear upon that day, the bill shall be taken *pro confesso*.

SUBREPTITIOUS, a term applied to a letter, licence, patent, or other act, fraudulently obtained of a superior, by concealing some truth which, had it been known, would have prevented the concession or grant.

SUBROGATION, or SURROGATION, in the Civil Law, the act of substituting a person in the place, and intitling him to the rights, of another. In its general sense, subrogation implies a succession of any kind, whether of a person to a person, or of a person to a thing.

There are two kinds of subrogation: the one *conventional*, the other *legal*. *Conventional* subrogation is a contract whereby a creditor transfers his debt, with all appurtenances thereof, to the profit of a third person. *Legal* subrogation is that which the law makes in favour of a person who discharges an antecedent creditor; in which case there is a legal translation of all rights of the ancient creditor to the person of the new one.

SUBSCRIPTION, in general, signifies the signature put at the bottom of a letter, writing, or instrument.

In commerce, it is used for the share or interest which particular persons take in a public stock or a trading company,

Subscription || Subularia.

pany, by writing their names, and the shares they require, in the books or register thereof.

Subscription to articles of faith is required of the clergy of every established church, and of some churches not established. Whether such subscription serves any good purpose, in a religious or theological view, is a very doubtful question. It may be necessary in an establishment, as a test of loyalty to the prince, and of attachment to the constitution, civil and ecclesiastical, but it cannot produce uniformity of opinion. As all language is more or less ambiguous, it becomes difficult, if not impossible, to determine in what sense the words of long established creeds are to be interpreted; and we believe that the clergy of the churches of England and Scotland seldom consider themselves as fettered by the Thirty-nine Articles, or the Confession of Faith, when composing instructions either for their respective parishes or for the public at large. See Independents.

Subscription, in the commerce of books, signifies an engagement to take a certain number of copies of a book intended to be printed, and a reciprocal obligation of the bookseller or publisher to deliver the said copies, on certain terms.—These subscriptions, which had their rise in England about the middle of the last century, were lately very frequent in France and Holland, and are now very common among ourselves.

SUBSEQUENT, something that comes after another, particularly with regard to the order of time.

SUBSIDY, in law, signifies an aid or tax granted to the king by parliament, for the necessary occasions of the kingdom; and is to be levied on every subject of ability, according to the rate or value of his lands or goods: but this word, in some of our statutes, is confounded with that of customs. See Tax.

SUBSTANCE, the subject to which we suppose qualities belong. Thus gold is the substance to which the qualities of ductility, yellowness, density, &c. belong. See Metaphysics, n° 145.

SUBSTANTIAL, in the schools, something belonging to the nature of substance.

SUBSTANTIVE, in grammar. See Grammar.

SUBSTISTUTE, a person who officiates for another in his absence.

SUBSTITUTION, in the civil law, a disposition of a testament, whereby the testator substitutes one heir for another, who has only the usufruit, and not the property, of the thing left him.

SUBSTRACTION, or Subtraction, in arithmetic, the second rule, or rather operation, in arithmetic, whereby we deduct a less number from a greater, to learn their precise difference. See Arithmetic and Algebra.

SUBTANGENT of a Curve, the line that determines the intersection of a tangent with the axis; or that determines the point wherein the tangent cuts the axis prolonged.

SUBTENSE, formed from *sub* "under," and *tendo* "I stretch," in geometry, a right line which is opposite to an angle, and drawn between the two extremities of the arch which measures that angle.

SUBTERRANEOUS, whatever is under ground: thus naturalists speak of subterraneous fires, subterraneous damps, &c.

Subterraneous Cavern. See Quarries.

SUBTILE, in physics, an appellation given to whatever is extremely small, fine, and delicate; such as the animal-spirits, the effluvia of ordorous bodies, &c. are supposed to be.

SUBULARIA, Rough-leaved Alysson, or *Awl-wort*, in botany: A genus of plants belonging to the class of *tetradynamia*, and order of *siliculosa*; and in the natural order ranging under the 39th order, *siliquosæ*. The filicula is entire and ovate; the valves are ovate, concave, and contrary to the partitions. The style is shorter than the silicula. There is only one species, the *aquatica*, which is a native of Britain. It is about an inch high. The leaves are awl-shaped, and grow in clusters round the root. The stalk is naked, and produces four or five small white flowers growing alternately on short footstalks. It flowers under water, whereas most aquatic plants emerge above water at the time of flowering. The Author of Nature has, however, carefully prevented the tender flower from receiving any injury from the water, by making the petals close, and form themselves into a kind of arch. This plant grows on the borders of the Highland lakes, in Loch Tay, in Scotland, also in Wales and Ireland.

Subulated || Succession.

SUBULATED, something shaped like an awl.

SUCCEDANEUM, in pharmacy, denotes a drug substituted in the place of another.

SUCCESSION, in metaphysics, the idea which we get by reflecting on the ideas that follow one another in our mind; and from the succession of ideas we get the idea of *time*. See Metaphysics, n° 93. and 209.

Succession, in law. See Descent.

Succession to the Crown. See *Hereditary Right.*—From the days of Egbert, the first sole monarch of England, even to the present, the four cardinal maxims mentioned in that article have ever been held constitutional canons of succession. It is true, as Sir William Blackstone observes, this succession, through fraud or force, or sometimes through necessity, when in hostile times the crown descended on a minor or the like, has been very frequently suspended; but has generally at last returned back into the old hereditary channel, though sometimes a very considerable period has intervened. And even in those instances where this succession has been violated, the crown has ever been looked upon as hereditary in the wearer of it. Of which the usurpers themselves were so sensible, that they for the most part endeavoured to vamp up some feeble show of a title by descent, in order to amuse the people, while they gained the possession of the kingdom. And, when possession was once gained, they considered it as the purchase or acquisition of a new estate of inheritance, and transmitted, or endeavoured to transmit it, to their own posterity by a kind of hereditary right of usurpation. (See *Black. Com.* v. i. 197—217.) From the historical view there given, it appears, that the title to the crown is at present hereditary, though not quite so absolutely hereditary as formerly: and the common stock, or ancestor, from whom the descent must be derived, is also different Formerly, the common stock was King Egbert; then William the Conqueror; afterwards, in James I.'s time, the two common stocks united; and so continued till the vacancy of the throne in 1688: now it is the Princess Sophia, in whom the inheritance was vested by the new king and parliament. Formerly, the descent was absolute, and the crown went to the next heir without any restriction: but now, upon the new settlement, the inheritance is conditional; being limited to such heirs only, of the body of the Princess Sophia, as are Protestant members of the church of England, and are married to none but Protestants.

And in this due medium consists the true constitutional notion of the right of succession to the imperial crown of these kingdoms. The extremes between which it steers are each of them equally destructive of those ends for which societies were formed and are kept on foot. Where the magistrate, upon every succession, is elected by the people, and may

may by the express provision of the laws be deposed (if not punished) by his subjects, this may sound like the perfection of liberty, and look well enough when delineated on paper; but in practice will be ever productive of tumult, contention, and anarchy. And, on the other hand, divine indefeasible hereditary right, when coupled with the doctrine of unlimited passive obedience, is surely of all constitutions the most thoroughly slavish and dreadful. But when such an hereditary right as our laws have created and vested in the royal stock, is closely interwoven with those liberties which are equally the inheritance of the subject; this union will form a constitution, in theory the most beautiful of any, in practice the most approved, and, we trust, in duration the most permanent.

In France the succession to the monarchy was limited to heirs male (see Salic); but in Navarre the crown was inherited by the heir of line, whether male or female. The case stands thus: Philip the Fourth, king of France, surnamed the *Fair*, in the year 1285 espoused Jane queen of Navarre in her own right; and as king consort of this latter kingdom added the title of Navarre to his former one of France. Louis X. son and heir of Philip and Jane (surnamed *Hutin*, or the *Boisterous*), succeeded to both crowns. By Margaret his first wife, who had been crowned queen of Navarre, he left one daughter Joan or Jane. His second wife Clementia was pregnant at the time of his decease, and was delivered of a posthumous son, whom most of the French annalists recognize as John I. of France, though he lived no longer than three weeks. On his death the kingdom of France passed to Philip V. (surnamed the *Long*), and that of Navarre (to which the Salic law could by no construction extend) to Joanna the only child and heir of Louis and Margaret. From Joanna, in lineal succession, the kingdom of Navarre passed to Jane d'Albret, mother of Henry IV. of France, and wife of Anthony of Vendosme, who as king consort wore the crown of Navarre. On the accession of Henry to the kingdom of France, the two monarchies were united, and the four succeeding princes assumed the joint titles. But if ever the monarchy be restored in France, Mary, princess royal and daughter of Louis XVI. will have the same right to the throne of Navarre that her uncle has to the throne of France; for she is the undoubted heir of line of the great and illustrious Henry IV.

SUCCINIC Acid, an acid extracted from amber by sublimation in a gentle heat, and rises in a concrete form into the neck of the subliming vessel. The operation must not be pushed too far, or by too strong a fire, otherwise the oil of the amber rises along with the acid. The salt is dried upon blotting paper, and purified by repeated solution and crystallization.

Lavoisier's Elements of Chemistry.

The acid is soluble in 24 times its weight of cold water, and in a much smaller quantity of hot water. It possesses the qualities of an acid in a very small degree, and only affects the blue vegetable colours very lightly. The affinities of this acid with the salifiable bases were determined by Mr de Morveau, who is the first chemist that has endeavoured to ascertain them.

SUCCINUM, Amber, in mineralogy, a species of bitumen classed under the inflammable substances. As a full account of this mineral was given under the word Amber, nothing remains but to mention a few things which recent experiments enable us to add. According to Dr Kirwan, 100 grains of amber afford about 72 of petroleum, 4.5 of succinic acid, and a residue of fixed matter and water. Mr Scheele says, that, when distilled, it yields an aqueous acid resembling vinegar in its qualities. This would induce us to believe it to be of vegetable origin. But its origin is a point not yet ascertained. Its specific gravity is from 1,065 to 1,100, and melts at 550 of Fahrenheit. Wallerius affirms, that mirrors, prisms, &c. may be made of amber.

SUCCORY, in botany. See Cichorium.

SUCCOTH (anc. geog.), a town which lay between the brook Jabbok and the river Jordon, where Jacob fixed his tents. There was another Succoth where the Israelites first encamped after their departure from Rameses towards the Red Sea. Succoth signifies *tents*.

SUCCUBUS, a term used by some writers for a dæmon who assumes the shape of a woman, and as such lies with a man; in which sense it stands opposed to *incubus*, which was a dæmon in form of a man, that lies with a woman. But the truth is, the succubus is only a species of the nightmare. See Medicine, n° 320.

SUCCULA, in mechanics, an axis or cylinder, with staves in it to move it round; but without any tympanum or peritrochium.

SUCCULENT Plants, among botanists, such whose leaves are thick and full of juice.

SUCKER, in ichthyology. See Cyclopterus.

SUCKERS, in gardening, the same with Offsets.

SUCKING-fish. See Echeneis.

SUCKLING (Sir John), an English poet and dramatic writer, was the son of Sir John Suckling, comptroller of the household to king Charles I. and born at Witham in Essex in 1613. He discovered an uncommon propensity to the acquiring of languages, insomuch that he is reported to have spoken Latin at five years of age, and to have written it at nine. When he was grown up, he travelled; but seems to have affected nothing more than the character of a courtier and fine gentleman; which he so far attained, that he was allowed to have the peculiar happiness of making every thing he did become him. In his travels he made a campaign under the great Gustavus Adolphus; and his loyalty, if not his valour, appeared in the beginning of our civil wars; for, after his return to England, he raised a troop of horse for the king's service entirely at his own charge; and mounted them so completely and richly, that they are said to have cost him 12,000 l. This troop, with Sir John at its head, behaved so ill in the engagement with the Scots, upon the English borders, in 1639, as to occasion the famous lampoon composed by Sir John Mennis; "Sir John he got him an ambling nag," &c. This ballad, which was set to a brisk tune, was much sung by the parliamentarians, and continues to be sung to this day. This disastrous expedition, and the ridicule that attended it, was supposed to have hastened his death; being seized by a fever, of which he died, at 28 years of age. He was a sprightly wit, and an easy versifier, but no great poet. His works, consisting of a few poems, letters, and plays, have nevertheless gone through several editions.

SUCTION, the act of sucking or drawing up a fluid, as air, water, milk, or the like, by means of the mouth and lungs; or, in a similar manner, by artificial means. See Pneumatics and Hydrostatics.

SUDATORY, a name given by the ancient Romans to their hot or sweating rooms; sometimes also called *Laconica*.

SUDEROE. See *Ferro-Islands*.

SUDORIFIC, an appellation given to any medicine that causes or promotes sweat.

SUESSIONES, a branch of the Remi, a people of Gallia Belgica (Pliny); called sometimes *Suessones*, in the lower age *Suessi*; situated between the Remi to the east, the Nervii to the north, the Veromandui to the west, and the Meldæ to the south, in the tract now called *le Soissonois*.—*Suessiones*, *Suessones*, and *Suessonæ*, the name of their city in the

the lower age; thought to have been formerly called *Noviodunum* (Cæſar), is now called *Soiſſons*.

SUET, Sevum, or *Sebum*, in anatomy, the ſolid fat found in ſeveral animals, as ſheep, oxen, &c. but not in the human ſpecies. See the article Fat.—It is of the ſevum that tallow is made.

SUETONIUS tranquillus (Caius), a famous Latin hiſtorian, was born at Rome, and became ſecretary to the emperor Adrian, about the 118th year of the Chriſtian era; but that poſt was taken from him three years after, when ſeveral perſons fell under that prince's diſpleaſure for not ſhowing the empreſs Sabina all the reſpect ſhe deſerved. During his diſgrace he compoſed many works, which are loſt. Thoſe now extant are his Hiſtory of the XII firſt Emperors and a part of his Treatiſe of the Illuſtrious Grammarians and Rhetoricians. Pliny the Younger was his intimate friend, and perſuaded him to publiſh his books. His Hiſtory of the XII Roman Emperors has been much commended by moſt of our polite ſcholars. He repreſents, in a continued ſeries of curious and intereſting particulars, without any digreſſions or reflections, the actions of the emperors, without omitting their vices, which he expoſes with all their deformity, and with the ſame freedom mentions the good qualities of the very ſame perſons; but the horrid diſſoluteneſs and obſcene actions he relates of Tiberius, Caligula, Nero, &c. have made ſome ſay, that he wrote the lives of the emperors with the ſame licentiouſneſs with which they lived. The edition of this hiſtory procured by Grævius at Utrecht in 1672, with the excellent Commentaries of Torrentius and Caſaubon, and the notes of ſome other learned critics, is much eſteemed. Burman alſo publiſhed an edition in two vols 4to with notes.

SUEVI, the Catti or Chatti of Cæſar (Strabo), placed on the Rhine: the reaſon of Cæſar's calling them thus does not appear, though conſiderably diſtant from the proper Suevi or Alemanni.

Suevi (Tacitus), a common name of the people ſituated between the Elbe and the Viſtula, diſtinguiſhed otherwiſe by particular names; as in Ptolemy, *Suevi Angeli*, *Suevi Sennones*.

SUEVUS (anc. geog.), a river of Germany, thought to be the ſame with the Viadrus or Oder, emptying itſelf at three mouths into the Baltic, the middlemoſt of which is called *Swine* or *Swene*; which laſt comes nearer the name *Suevus*.

SUEZ, a ſmall ſea-port town, ſituated near the northern extremity of the Red Sea, and about 30 hours journey eaſt from Cairo. The country around it is a ſandy plain, without the ſmalleſt ſpot of verdure. The only water which can be drunk is brought from El-Naba, or the ſpring, at the diſtance of three hours journey; and it is ſo brackiſh, that without a mixture of rum it is inſupportable to Europeans. The town itſelf is a collection of miſerable ruins, the khans being the only ſolid buildings; yet from March till June, the ſeaſon when the Jidda and Yambo fleet arrives, the town becomes crowded; but after its departure nobody remains except the governor, who is a Mamlouk, 12 or 14 perſons who form his houſehold, and the garriſon. The fortreſs is a defenceleſs heap of ruins, which the Arabs conſider as a citadel, becauſe it contains ſix braſs four pounders, and two Greek gunners, who turn their heads aſide when they fire. The harbour is a wretched quay, where the ſmalleſt boats are unable to reach the ſhore, except at the higheſt tides. There, however, the merchandiſe is embarked, to convey it over the banks of ſand to the veſſels which anchor in the road. This road, ſituated a league from the town, is ſeparated from it by a ſhore which is left dry at low water; it has no works for its defence, ſo that the veſſels which M. Volney tells us he has ſeen there, to the number of 28 at a time, might be attacked without oppoſition; for the ſhips themſelves are incapable of reſiſtance, none having any other artillery than four ruſty ſwivels.

...ney's ...vels, ... i.

Suez.

Suez has always been, notwithſtanding its local diſadvantages, a place of great trade, on account of its geographical ſituation. It was by the gulph of Suez that the commodities of India were formerly conveyed to Europe, till the diſcovery of the paſſage by the Cape of Good Hope converted that trade into a new channel. As the iſthmus of Suez, which ſeparates the Red Sea from the Mediterranean, is not more than 70 miles, it has been frequently propoſed to join theſe two ſeas together by a canal. As there are no mountains nor remarkable inequalities of ſurface, this plan would at firſt view appear eaſy to be executed. But though the difference of levels would not prevent a junction, the great difficulty ariſes from the nature of the correſponding coaſts of the Mediterranean and the Red Sea, which are of a low and ſandy ſoil, where the waters form lakes, ſhoals, and moraſſes, ſo that veſſels cannot approach within a conſiderable diſtance. It will therefore be found ſcarcely poſſible to dig a permanent canal amid theſe ſhifting ſands: not to mention, that the ſhore is deſtitute of harbours, which muſt be entirely the work of art. The country beſides has not a drop of freſh water, and to ſupply the inhabitants, it muſt be brought as far as from the Nile.

The beſt and only method therefore of effecting this junction, is that which has been already ſucceſsfully practiſed at different times; which is, by making the river itſelf the medium of communication, for which the ground is perfectly well calculated; for Mount Mokattam ſuddenly terminating in the latitude of Cairo, forms only a low and ſemicircular mound, round which is a continued plain from the banks of the Nile as far as the point of the Red Sea. The ancients, who early underſtood the advantage to be derived from this ſituation, adopted the idea of joining the two ſeas by a canal connected with the river. Strabo * obſerves, that this was firſt executed under Seſoſtris, who reigned about the time of the Trojan war; and this work was ſo conſiderable as to occaſion it to be remarked, "that it was 100 cubits (or 170 feet) wide, and deep enough for large veſſels." After the Greeks conquered the country, it was reſtored by the Ptolemies, and again renewed by Trajan. In ſhort, even the Arabs themſelves followed theſe examples. "In the time of Omar ebn el-Kattab (ſays the hiſtorian El Makin), the cities of Mecca and Medina ſuffering from famine, the Calif ordered Amrou governor of Egypt to cut a canal from the Nile to Kolzoum, that the contributions of corn and barley appointed for Arabia might be conveyed that way."

* *Lib. xvii.*

This canal is the ſame which runs at preſent to Cairo, and loſes itſelf in the country to the north-eaſt of Berket-el-Hadj, or the Lake of the Pilgrims.

The place on the weſt coaſt of the gulph of Suez, where the children of Iſrael are ſuppoſed to have entered it, is called *Badea*, about ſix miles to the north of Cape Korondel, on the other ſide of the gulph, as we are informed in a letter from the ingenious Edward Wortley Montague, F. R. S. to Dr Watſon, containing an account of his journey from Cairo to the Written Mountains in the deſert of Sinai. Oppoſite to Badea is a ſtrong current which ſets to the oppoſite ſhore, about ſouth-eaſt, with a whirlpool called *Birque Pharaone*, the *well* or *pool of Pharaoh*, being the place where his hoſt is ſaid to have been deſtroyed. We are told by the ſame gentleman, that the Egyptian ſhore from Suez to Badea is ſo rocky and ſteep, that there was no entering upon the gulph but at one of theſe two places.

Suez ‖ Suffolk.

The British nation, we believe, never attempted to carry on commerce with any of the ports of the Red Sea beyond Jidda, till, on the ſuggeſtion of Mr Bruce, in 1776, ſome British merchants at Bengal equipped two or three veſſels for Suez, laden with piece-goods of Bengal and coaſt manufactures. The command of the veſſels was committed to Captain Greig, a meritorious ſeaman; and the management of the goods was entruſted to Mr Straw, a gentleman diſtinguiſhed for his mercantile knowledge. The ſale turned out to advantage; but ſuch great expences were incurred in making preſents to the bey of Cairo and Suez, as to conſume the whole profits gained by the ſale of the cargo. The great purpoſe of the expedition was, however, accompliſhed, as a firman was obtained from the government of Cairo to trade by the way of Suez. In conſequence of this, three ſhips went to Suez the following year, and as many in 1778. The opening of this trade alarmed the jealouſy of the Eaſt India Company; they applied to our government, and orders were given to relinquiſh this promiſing commerce These orders reached Egypt ſooner than Bengal, and the conſequence was fatal to the unfortunate adventurers who viſited Suez that year (1779). By a plan concerted between the beys, a large body of Bedouin Arabs attacked the caravan paſſing from Suez to Cairo with goods valued at 12 lacks of rupees. The goods were plundered, the Europeans were ſtripped and left naked in the deſert, expoſed to the burning rays of the ſun, without a drop of water to quench their thirſt, or food to ſupport life. Moſt of them died, and ſome of their bodies were afterwards found mangled and disfigured by wolves. We have been favoured with a particular account of the ſufferings of our countrymen by a correſpondent, which, we are ſorry, we have not room to inſert. Thoſe who wiſh to obtain a more full account may conſult the Annual Regiſter 1781 or 1782.

SUFFETULA (anc. geog.), a town of Africa, in the dominions of Carthage; probably ſo called from Suffetes, the title of the magiſtrates of that city. It is now called *Spaitla*, in the kingdom of Tunis, and has many elegant remains of antiquity. There are three temples in a great meaſure entire; one of them of the Compoſite order, the other two Corinthian. "A beautiful and perfect capital of the Compoſite order (ſays Mr Bruce), the only perfect one that now exiſts, is deſigned in all its parts in a very large ſize; and with the detail of the reſt of the ruin, is a precious monument of what that order was, now in the collection of the king." The town itſelf (he ſays) is ſituated in the moſt beautiful ſpot in Barbary, ſurrounded by great numbers of juniper-trees, and watered by a pleaſant ſtream, which ſinks under the earth at that place, without appearing any more.

SUFFOCATION, in medicine, the privation of reſpiration or breathing. See the articles Drowning, Hanging, &c.

SUFFOLK, a county of England. Its name is contracted from *Southfolk*, ſo called from its ſituation in regard to Norfolk. It is bounded on the weſt by Cambridgeſhire; on the ſouth by Eſſex, from which it is parted by the river Stour; on the eaſt by the German Ocean; and on the north by Norfolk, ſeparated from it by the Leſſer Ouſe and the Waveney. From weſt to eaſt it is 52 miles in length, about 20 at a medium in breadth, and 196 in circumference. It contains 22 hundreds, 29 market towns, 575 pariſhes, upwards of 34,000 houſes, and more than 200,000 inhabitants. The whole is divided into two parts, viz. the Liberty of St Edmund, and the Geldable; the former of which contain the weſt parts of the county, and the other the eaſt; and there is a grand jury for each at the aſſizes. The air is reckoned as wholeſome and pleaſant as any in the kingdom, nor is it otherwiſe upon the ſea coaſt, which is dry and ſandy, and free from ſalt marſhes. The ſoil, except to the weſt and upon the ſea-coaſt, is very rich, being a compound of clay and marle. Towards the ſea there are large heaths and tracts of ſand; but theſe produce hemp, rye, and peaſe, and feed great flocks of ſheep. About Newmarket the ſoil is much the ſame; but in high Suffolk or the woodlands, beſides wood, there are very rich paſtures, where abundance of cattle are fed. In other parts of the county, as about Bury, there is plenty of corn. As this county is noted for the richneſs of its paſtures, ſo is it for butter and cheeſe, eſpecially the former, which is ſaid to be remarkably good; ſo that being packed up in firkins, it is ſold for all uſes both by ſea and land, and conveyed to many parts of England, eſpecially to London. The inland parts of the county are well ſupplied with wood for fuel, and thoſe upon the ſea-coaſt with coals from Newcaſtle. The manufactures of the county are chiefly woollen and linen cloth. It lies in the dioceſe of Norwich, has two archdeacons, viz. of Sedbury and Suffolk; gives title of earl to a branch of the Howards; ſends two members to parliament for the county, and two for each of the following places, Ipſwich, Dunwich, Orford, Aldborough, Sudbury, Eye, and St Edmund's-Bury. The county is extremely well watered by the following rivers, which either traverſe its borders, or run acroſs into the German Ocean, viz. the Leſſer Ouſe, the Waveney, the Blithe, the Deben, the Orwell or Gipping, and the Stour.

Suffragan ‖ Sugar.

SUFFRAGAN, an appellation given to ſimple biſhops with regard to archbiſhops, on whom they depend, and to whom appeals lie from the biſhops courts.

Suffragan is likewiſe the appellation given to a biſhop, who is occaſionally appointed to reſide in a town or village, and aſſiſt the dioceſan.

SUFFRAGE, denotes a vote given in an aſſembly, where ſomething is deliberated on, or where a perſon is elected to an office or benefice.

SUFFRUTEX, among botaniſts, denotes an underſhrub, or the loweſt kind of woody plants, as lavender.

SUGAR, a ſolid ſweet ſubſtance obtained from the juice of the ſugar-cane; or, according to chemiſts, an eſſential ſalt, capable of cryſtallization, of a ſweet and agreeable flavour, and contained in a greater or leſs quantity in almoſt every ſpecies of vegetables, but moſt abundant in the ſugar-cane.

As the ſugar-cane is the principal production of the Weſt Indies, and the great ſource of their riches; as it is ſo important in a commercial view, from the employment which it gives to ſeamen, and the wealth which it opens for merchants; and beſides is now become a neceſſary of life—it may juſtly be eſteemed one of the moſt valuable plants in the world. The quantity conſumed in Europe is eſtimated at nine millions Sterling, and the demand would probably be greater if it could be ſold at a reduced price. Since ſugar then is reckoned ſo precious a commodity, it muſt be an object of deſire to all perſons of curioſity and reſearch, to obtain ſome general knowledge of the hiſtory and nature of the plant by which it is produced, as well as to underſtand the proceſs by which the juice is extracted and refined. We will therefore firſt inquire in what countries it originally flouriſhed, and when it was brought into general uſe, and became an article of commerce.

From the few remains of the Grecian and Roman authors which have ſurvived the ravages of time, we can find no proofs that the juice of the ſugar-cane was known at a very early period. There can be no doubt, however, that in thoſe countries where it was indigenous its value was not long con-

concealed. It is not improbable that it was known to the ancient Jews; for there is some reason to suppose, that the Hebrew word קנה, which occurs frequently in the Old Testament, and is by our translators rendered sometimes *calamus* and sometimes *sweet-cane*, does in fact mean the sugar-cane. The first passage in which we have observed it mentioned is Exod. xxx. 23. where Moses is commanded to make an ointment with myrrh, cinnamon, kené, and cassia. Now the kené does not appear to have been a native of Egypt nor of Judea; for in Jeremiah vi. 20. it is mentioned as coming from a far country. "To what purpose cometh there to me incense from Sheba and the sweet-cane from a far country?" This is not true of the calamus aromaticus, which grows spontaneously in the Levant, as well as in many parts of Europe. If the cinnamon mentioned in the passage of Exodus quoted above was true cinnamon, it must have come from the East Indies, the only country in the world from which cinnamon is obtained. There is no difficulty therefore in supposing, that the sugar-cane was exported from the same country. If any credit be due to etymology, it confirms the opinion that kené denotes the sugar-cane; for the Latin word *canna* and the English word *cane* are evidently derived from it. It is also a curious fact, that *sacchar* or *shaker* ‡, in Hebrew, signifies *inebriation*, from which the Greek word σακχαρ "sugar" is undoubtedly to be traced.

The sugar-cane was first made known to the western parts of the world by the conquests of Alexander the Great. Strabo * relates that Nearchus his admiral found it in the East Indies in the year before Christ 325. It is evidently alluded to in a fragment of Theophrastus, preserved in Photius. Varro, who lived A. C. 68, describes it in a fragment quoted by Isidorus § as a fluid pressed from reeds of a large size, which was sweeter than honey ||. Dioscorides, about the year 35 before Christ, says "that there is a kind of honey called *saccharon*, which is found in India and Arabia Felix. It has the appearance of salt, and is brittle when chewed. If dissolved in water, it is beneficial to the bowels and stomach, is useful in diseases of the bladder and kidneys, and, when sprinkled on the eye, removes those substances that obscure the sight." This is the first account we have of its medical qualities. Galen often prescribed it as a medicine. Lucan relates, that an oriental nation in alliance with Pompey used the juice of the cane as a common drink.

Quique bibunt tenera dulces ab arundine succos.
Lib. iii. 237.

Pliny says it was produced in Arabia and India, but that the best came from the latter country. It is also mentioned by Arrian, in his Periplus of the Red Sea, by the name of Σακχαρ (*sachar*) as an article of commerce from India to the Red Sea. Ælian ¶, Tertullian ‖, and Alexander Aphrodisæus †, mention it as a species of honey procured from canes (A).

That the sugar-cane is an indigenous plant in some parts of the East Indies, we have the strongest reason to believe; for Thunberg found it in Japan, and has accordingly mentioned it as a native of that country in his *Flora Japonica*, published in 1784. Osbeck also found it in China in 1751. It may indeed have been transplanted from some other country; but as it does not appear from history that the inhabitants of Japan or China ever carried on any commerce with remote nations, it could only be conveyed from some neighbouring country. Marco Polo, a noble Venetian, who travelled into the East about the year 1250, found sugar in abundance in Bengal. Vasco de Gama, who doubled the Cape of Good Hope in 1497, relates, that a considerable trade in sugar was then carried on in the kingdom of Calicut. On the authority of Dioscorides and Pliny, too, we should be disposed to admit, that it is a native of Arabia, did we not find, on consulting Niebuhr's Travels, that that botanist has omitted it when enumerating the most valuable plants of that country. If it be a spontaneous production of Arabia, it must still flourish in its native soil. Mr Bruce found it in Upper Egypt. If we may believe the relation of Giovan Lioni, a considerable trade was carried on in sugar in Nubia in 1500: it abounded also at Thebes, on the Nile, and in the northern parts of Africa, about the same period.

5 *Introduced into Europe probably during the crusades.*

There is reason to believe that the sugar-cane was introduced into Europe during the crusades; expeditions which however romantic in their plan, and unsuccessful in their execution, were certainly productive of many advantages to the nations of Europe. Albertus Aquensis, a monkish writer, observes, that the Christian soldiers in the Holy Land frequently derived refreshment and support during a scarcity of provisions by sucking the canes. This plant flourished also in the Morea, and in the islands of Rhodes and Malta; from which it was transported into Sicily. The date of this transaction it is not easy to ascertain; but we are sure that sugar was cultivated in that island previous to the year 1166; for Lafitau the Jesuit, who wrote a history of the Portuguese discoveries, mentions a donation made that year to the monastery of St Bennet, by William the second king of Sicily, of a mill for grinding sugar-canes, with all its rights, members, and appurtenances.

From Sicily, where the sugar cane still flourishes on the sides of mount Hybla, it was conveyed to Spain, Madeira, the Canary and Cape de Verd islands, soon after they were discovered in the 15th century. *D'Orville's Travels.*

6 *Supposed by some not a native of America or the West Indies.*

An opinion has prevailed, that the sugar-cane is not a native of the western continent, or its adjacent islands the West Indies, but was conveyed thither by the Spaniards or Portuguese soon after the discovery of America by Columbus. From the testimony of Peter Martyr, in the third book of his first decade, composed during Columbus's second voyage, which commenced in 1493 and ended in 1495, it appears, that the sugar-cane was known at that time in Hispaniola. It may be said, that it was brought thither by Columbus; but for this assertion we have found no direct evidence; and though we had direct evidence, this would not prove that the sugar cane was not an indigenous plant of the West Indies. There are authors of learning who, after investigating this subject with attention, do not hesitate to maintain, that it is a native both of the islands and of the continent of America.

7 *This opinion opposed by Labat.*

P. Labat has supported this opinion with much appearance of truth ‡; and, in particular, he appeals to the testimony of Thomas Gage, an Englishman, who visited New Spain in 1625. Gage enumerates sugar-canes among the provisions with which the Charaibes of Guadaloupe supplied his ship. "Now (says Labat) it is a fact that the Spaniards had never cultivated an inch of ground in the Smaller Antilles. Their ships commonly touched at those islands indeed for wood and water; and they left swine in the view of supplying with fresh provisions such of their countrymen as might call there in future; but it would be absurd in the highest

(A) For a more minute account of the history of sugar in the early and middle ages, a paper of the Manchester Transactions, in Volume IV. by Dr Falconer, may be consulted.

Sugar. highest degree to suppose, that they would plant sugar-canes, and at the same time put hogs ashore to destroy them.

"Neither had the Spaniards any motive for bestowing this plant on islands which they considered as of no kind of importance, except for the purpose that has been mentioned; and to suppose that the Charaibes might have cultivated, after their departure, a production of which they knew nothing, betrays a total ignorance of the Indian disposition and character.

8 From testimony. "For (continues Labat) we have fuller testimony, and such as places the fact beyond all contradiction, that the sugar-cane is the natural production of America. For, besides the evidence of Francis Ximenes, who, in a Treatise on American Plants, printed at Mexico, affirms, that the sugar-cane grows without cultivation, and to an extraordinary size, on the banks of the river Plata, we are assured by Jean de Lery, a Protestant minister, who was chaplain in 1556 to the Dutch garrison in the fort of Coligny, on the river Janeiro, that he himself found sugar-canes in great abundance in many places on the banks of that river, and in situations never visited by the Portuguese. Father Hennepin, and other voyagers bear testimony in like manner to the growth of the cane near the mouth of the Mississippi; and Jean de Laet to its spontaneous production in the island of St Vincent. It is not for the plant itself, therefore, but for the secret of making sugar from it, that the West Indies are indebted to the Spaniards and Portuguese; and these to the nations of the east."

Such is the reasoning of Labat, which the learned Lafitau has pronounced incontrovertible: and it is greatly strengthened by recent discoveries, the sugar cane having been found in many of the islands of the Pacific Ocean by our late illustrious navigator Captain Cook.

9 Description of the sugar cane. The sugar cane, or saccharum officinarum of botanists, is a jointed reed, commonly measuring (the flag part not included) from three feet and a half to seven feet in height, but sometimes rising to 12 feet. When ripe it is of a fine straw colour inclining to yellow, producing leaves or blades, the edges of which are finely and sharply serrated, and terminating in an arrow decorated with a panicle. The joints in one stalk are from 40 to 60 in number, and the stalks rising from one root are sometimes very numerous. The young shoot ascends from the earth like the point of an arrow: the shaft of which soon breaks, and the two first leaves, which had been included within a quadruple sheath of seminal leaves, rise to a considerable height ([illegible]). See Plate CCCCLXXXVI. M is the arrow and N the lower part with the root.

10 Soil most favourable to its growth. As the cane is a rank succulent plant, it must require a strong deep soil to bring it to perfection, perhaps indeed no soil can be too rich for this purpose. The soil which experience has found to be most favourable to the cultivation of it in the West Indies is the dark grey loam of St Christopher's, which is so light and porous as to be penetrable by the slightest application of the hoe. The under stratum is gravel from 8 to 12 inches deep. Canes planted in particular spots in this island have been known to yield 8000 pounds of Muscovado sugar from a single acre. The average produce of the island for a series of years has been 16,000 hogsheads of 16 cwt. which is one-half only of the whole cane-land, or 8500 acres. When annually cut, it gives nearly two hogsheads of 16 cwt. per acre for the whole of the land in ripe canes.

Next to the ashy loam of St Christopher's is the soil which in Jamaica is called *brick-mould*; not as resembling a brick in colour, but as containing such a due mixture of clay and sand as is supposed to render it well adapted for the use of the kiln. It is a deep, warm, and mellow, hazel earth, easily worked; and though its surface soon grows dry after rain, the under stratum retains a considerable degree of moisture in the driest weather; with this advantage too, that even in the wettest season it seldom requires trenching. Plant canes, by which is meant canes of the first growth, have been known in very fine seasons to yield two tons and a half of sugar per acre. After this may be reckoned the black mold of several varieties. The best is the deep black earth of Barbadoes, Antigua, and some other of the windward islands; but there is a species of this mold in Jamaica that is but little, if any thing inferior to it, which abounds with limestone and flint on a substratum of soapy marle. Black mold on clay is more common; but as the mold is generally shallow, and the clay stiff and retentive of water, this last sort of land requires great labour, both in ploughing and trenching, to render it profitable. When manured and properly pulverized, it becomes very productive. It is unnecessary to attempt a minute description of all the other soils which are found in these islands. There is, however, a peculiar sort of land on the north side of Jamaica, chiefly in the parish of Trelawney, that cannot be passed over unnoticed, not only on account of its scarcity but its value; few soils producing finer sugars, or such *as answer so well in the pan*; an expression signifying a greater return of refined sugar than common. The kind alluded to is generally of a red colour; the shades of which, however, vary considerably from a deep chocolate to a rich scarlet; in some places it approaches to a bright yellow, but it is everywhere remarkable, when first turned up, for a glossy or shining surface, and if wetted stains the fingers like paint.

As in every climate there is a season more favourable for vegetation than others, it is of great importance that plants for seed be committed to the ground at the commencement of this season. As the cane requires a great deal of moisture to bring it to maturity, the properest season for planting it is in the months of September and October, when the autumnal rains commence, that it may be sufficiently luxuriant to shade the ground before the dry weather sets in. Thus the root is kept moist, and the crop is ripe for the mill in the beginning of the ensuing year. Canes planted in the month of November, or later in the season, lose the advantage of the autumnal rains; and it often happens that dry weather in the beginning of the ensuing year retards their vegetation until the vernal or May rains set in, when they sprout both at the roots and the joints; so that by

([illegible]) "A field of canes, when standing, in the month of November, when it is in arrow or full blossom (says Mr Beckford in his descriptive Account of the Island of Jamaica), is one of the most beautiful productions that the pen or pencil can possibly describe. It in common rises from three to eight feet or more in height; a difference of growth that very strongly marks the difference of soil or the varieties of culture. It is when ripe of a bright and golden yellow; and where obvious to the sun, is in many parts very beautifully streaked with red; the top is of a darkish green; but the more dry it becomes, from either an excess of ripeness or a continuance of drought, of a russet yellow, with long and narrow leaves depending; from the centre of which shoots up an arrow like a silver wand from two to six feet in height; and from the summits of which grows out a plume of white feathers, which are delicately fringed with a lilac dye; and indeed is, in its appearance, not much unlike the tuft that adorns this particular and elegant tree."

by the time they are cut the field is loaded with unripe suckers instead of sugar-canes. A January plant, however, commonly turns out well; but canes planted very late in the spring, though they have the benefit of the May rains, seldom answer expectation; for they generally come in unseasonably, and throw the ensuing crops out of regular rotation. They are therefore frequently cut before they are ripe; or if the autumnal seasons set in early, are cut in wet weather, which has probably occasioned them to spring afresh; in either case the effect is the same: The juice is unconcocted, and all the sap being in motion, the root is deprived of its natural nourishment, to the great injury of the ratoon. The chief objection to a fall plant is this, that the canes become rank and top heavy, at a period when violent rains and high winds are expected, and are therefore frequently lodged before they are fit to be cut.

The sugar-cane is propagated by the top-shoots, which are cut from the tops of the old canes. The usual method of planting in the West Indies is this: The quantity of land intended to be planted, being cleared of weeds and other incumbrances, is first divided into several plats of certain dimensions, commonly from 15 to 20 acres each; the spaces between each plat or division are left wide enough for roads, for the conveniency of carting, and are called *intervals*. Each plat is then subdivided, by means of a line and wooden pegs, into small squares of about three feet and a half. Sometimes indeed the squares are a foot larger; but this circumstance makes but little difference. The negroes are then placed in a row in the first line, one to a square, and directed to dig out with their hoes the several squares, commonly to the depth of five or six inches. The mold which is dug up being formed into a bank at the lower side, the excavation or cane-hole seldom exceeds 15 inches in width at the bottom, and two feet and a half at the top. The negroes then fall back to the next line, and proceed as before. Thus the several squares between each line are formed into a trench of much the same dimensions with that which is made by the plough. An able negro will dig from 100 to 120 of these holes for his day's work of ten hours; but if the land has been previously ploughed and lain fallow, the same negro will dig nearly double the number in the same time (c).

The cane-holes or trench being now completed, whether by the plough or by the hoe, and the cuttings selected for planting, which are commonly the tops of the canes that have been ground for sugar (each cutting containing five or six gems), two of them are sufficient for a cane hole of the dimensions described. These, being placed longitudinally in the bottom of the hole, are covered with mold about two inches deep; the rest of the bank being intended for future use. In 12 or 14 days the young sprouts begin to appear; and as soon as they rise a few inches above the ground, they are, or ought to be, carefully cleared of weeds, and furnished with an addition of mold from the banks. This is usually performed by the hand. At the end of four or five months the banks are wholly levelled, and the spaces between the rows carefully hoe-ploughed. Frequent cleanings, while the canes are young, are indeed so essentially necessary, that no other merit in an overseer can compensate for the want of attention in this particular. A careful manager will remove at the same time all the lateral shoots or suckers that spring up after the canes begin to joint, as they seldom come to maturity, and draw nourishment from the original plants.

Sugar.

"In the cultivation of other lands, in Jamaica especially (says Mr Edwards, the elegant historian of the West Indies, whose superior excellence has induced us frequently to refer to him in the course of this article), the plough has been introduced of late years, and in some few cases to great advantage; but it is not every soil or situation that will admit the use of the plough; some lands being much too stony, and others too steep; and I am sorry I have occasion to remark, that a practice commonly prevails in Jamaica, on properties where this auxiliary is used, which would exhaust the finest lands in the world. It is that of ploughing, then cross-ploughing, round-ridging, and harrowing the same lands from year to year, or at least every other year, without affording manure: accordingly it is found that this method is utterly destructive of the ratoon or second growth, and altogether ruinous. It is indeed astonishing that any planter of common reading or observation should be passive under so pernicious a system. Some gentlemen, however, of late manage better: their practice is to break up stiff and clayey land, by one or two ploughings, early in the spring, and give it a summer's fallow. In the autumn following, being then mellow and more easily worked, it is holed and planted by manual labour after the old method, which has been already described. But in truth, the only advantageous system of ploughing in the West Indies is to confine it to the simple operation of holing, which may certainly be performed with much greater facility and dispatch by the plough than by the hoe; and the relief which, in the case of stiff and dry soils, is thus given to the negroes, exceeds all estimation, in the mind of a humane and provident owner. On this subject I speak from practical knowledge. At a plantation of my own, the greatest part of the land which is annually planted is neatly and sufficiently laid into cane-holes, by the labour of one able man, three boys, and eight oxen, with the common single-wheeled plough. The ploughshare indeed is somewhat wider than usual; but this is the only difference, and the method of ploughing is the simplest possible. By returning the plough back along the furrow, the turf is alternately thrown to the right and to the left, forming a trench seven inches deep, about two feet and a half wide at the top, and one foot wide at the bottom. A space of 18 or 20 inches is left between each trench, on which the mold being thrown by the share, the banks are properly formed, and the holing is complete. Thus the land is not exhausted by being too much exposed to the sun; and in this manner a field of 20 acres is holed with one plough, and with great ease, in 13 days. The plants are afterwards placed in the trench as in the common method, where manual labour alone is employed.

14
The plough might be used with advantage.

Edwards's History of the West Indies, vol. ii.

In most parts of the West Indies it is usual to hole and plant a certain proportion of the cane-land, commonly one-third in annual rotation. Canes of the first year's growth are called *plant canes*, as has been already observed. The sprouts that spring from the roots of the canes that have been

15
Canes named according to the age of their roots.

(c) As the negroes work at this business very unequally, according to their different degrees of bodily strength, it is sometimes the practice to put two negroes to a single square; but if the land has not had the previous assistance of the plough, it commonly requires the labour of 50 able negroes for 13 days to hole 20 acres. In Jamaica, some gentlemen, to ease their own slaves, have this laborious part of the planting-business performed by job-work. The usual price for holing and planting is L. 6 currency *per* acre (equal to L. 4, 7 s. Sterling). The cost of falling and clearing heavy wood-land is commonly as much more.

Sugar. been previously cut for sugar are called *ratoons*; the first yearly returns from their roots are called *first ratoons*; the second year's growth *second ratoons*.

16 Manures employed. Mr Edwards informs us, that the manure generally used is a compost formed, 1st, Of the vegetable ashes, drawn from the fires of the boiling and still houses. 2dly, Feculencies discharged from the still-house, mixed up with rubbish of buildings, white-lime, &c. 3dly, Refuse, or field-trash (i. e.), the decayed leaves and stems of the canes; so called in contradistinction to cane-trash, reserved for fuel. 4thly, Dung, obtained from the horse and mule stables, and from moveable pens, or small inclosures made by posts and rails, occasionally shifted upon the lands intended to be planted, and into which the cattle are turned at night. 5thly, Good mold, collected from gullies and other waste places, and thrown into the cattle pens.

17 The sugar-cane destroyed by monkeys, The sugar-cane is liable to be destroyed by monkeys, rats, and insects. The upland plantations suffer greatly from monkeys; these creatures, which now abound in the mountainous parts of St Christopher's, were first brought thither by the French, when they possessed half that island; they come down from the rocks in silent parties by night, and having posted centinels to give the alarm if any thing approaches, they destroy incredible quantities of the cane, by their gambols as well as their greediness. It is in vain to set traps for these creatures, however baited; and the only way to protect the plantation, and destroy them, is to set a numerous watch, well armed with fowling-pieces, and furnished with dogs. The negroes will perform this service cheerfully, for they are very fond of monkeys as food. The celebrated Father Labat says, they are very delicious, but the white inhabitants of St Kitt's never eat them.

Grainger's History of the sugar-cane

18 Rats, The low-land plantations suffer as much by rats as those on the mountains do from monkeys; but the rats, no more than the monkeys, are natives of the place; they came with the shipping from Europe, and breed in the ground under loose rocks and bushes: the field negroes eat them greedily, and they are said to be publicly sold in the markets at Jamaica. To free the plantations from these vermin, the breed of wild cats should be encouraged, and snakes suffered to multiply unmolested; they may also be poisoned with arsenic, and the rasped root of the cassava made into pellets, and plentifully scattered over the grounds. This practice, however, is dangerous; for as the rats when thus poisoned become exceeding thirsty, they run in droves to the neighbouring streams, which they poison as they drink, and the cattle grazing on the banks of these polluted waters have frequently perished by drinking after them: It is safer therefore to make the pellets of flour, kneaded with the juice of the night shade, the scent of which will drive them away though they will not eat it. There is an East Indian animal called *mungoes*, which bears a natural antipathy to rats; if this animal was introduced into our sugar islands, it would probably extirpate the whole race of these noxious vermin. The *formica omnivora* of Linnæus, the carnivorous ant, which is called in Jamaica the *raffle's ant*, would soon clear a sugar plantation of rats.

19 And insects. The sugar-cane is also subject to a disease which no foresight can obviate, and for which human wisdom has hitherto in vain attempted to find a remedy. This disease is called the *blast*, and is occasined by the *aphis* of Linnæus. When this happens, the fine, broad, green blades become sickly, dry, and withered; soon after they appear stained in spots; and if these spots are carefully examined, they will be found to contain innumerable eggs of an insect like a bug, which are soon quickened, and cover the plants with the vermin: the juice of the canes thus affected becomes sour, and no future shoot issues from the joints. Ants also concur with the bugs to spoil the plantation, and against these evils it is hard to find a remedy.

20 Time at which the crop ripens The crops of sugar-canes do not ripen precisely at the same period in all the colonies. In the Danish, Spanish, and Dutch settlements, they begin in January, and continue till October. This method doth not imply any fixed season for the maturity of the sugar-cane. The plant, however, like others, must have its progress; and it hath been justly observed to be in flower in the months of November and December. It must necessarily follow, from the custom these nations have adopted of continuing to gather their crops for 10 months without intermission, that they cut some canes which are not ripe enough, and others that are too ripe, and then the fruit hath not the requisite qualities. The time of gathering them should be at a fixed season, and probably the months of March and April are the fittest for it; because all the sweet fruits are ripe at that time, while the sour ones do not arrive to a state of maturity till the months of July and August.

Raynal's History of the East and West Indies, vol. iv.

The English cut their canes in March and April; but they are not induced to do this on account of their ripeness. The drought that prevails in their islands renders the rains which fall in September necessary to their planting; and as the canes are 18 months in growing, this period always brings them to the precise point of maturity (D).

21 A season of festivity. "The time of crop in the sugar islands (says Mr Edwards) is the season of gladness and festivity to man and beast. So palatable, salutary, and nourishing, is the juice of the cane, that every individual of the animal creation, drinking freely of it, derives health and vigour from its use. The meagre and sickly among the negroes exhibit a surprising alteration in a few weeks after the mill is set in action. The labouring horses, oxen, and mules, though almost constantly at work during this season, yet, being indulged with plenty of the green tops of this noble plant, and some of the scummings from the boiling-house, improve more than at any other period of the year. Even the pigs and poultry fatten on the refuse. In short, on a well-regulated plantation, under a humane and benevolent director, there is such an appearance during crop-time of plenty and busy cheerfulness, as to soften, in a great measure, the hardships of slavery, and induce a spectator to hope, when the miseries of life are represented as insupportable, that they are sometimes exaggerated through the medium of fancy."

Edwards vol ii. p. 226.

The plants being cut, the branches at the top are given to the cattle for food; the top-shoot, which is full of eyes, is

(D) The account given in the text concerning the time when the sugar-canes are collected, we have taken from the Abbé Raynal's History of the Trade and Settlements of the East and West Indies; but Mr Cazaud observes, that in February, March, and April, all the canes, whatever be their age, are as ripe as the nature of the soil ever allows them to be. He says farther, that the dryness of the weather, and not the age of the canes, which increases from January to April, is the cause that in January 400 gallons of juice commonly yield 48 gallons of sugar and molasses, one with another; in February from 56 to 64; in March from 64 to 72; in April sometimes 80; after which period the sugar ferments, and even burns, when the refiner is not very expert at his business

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is preſerved for planting. The canes are cut into pieces about a yard long, tied up in bundles, and carried in carts to the mill, where they are bruiſed, and the juice is extracted from them. The mill conſiſts principally of three upright iron-plated rollers or cylinders, from 30 to 40 inches in length, and from 20 to 25 inches in diameter; and the middle one, to which the moving power is applied, turns the other two by means of cogs. Between theſe rollers, the canes (being previouſly cut ſhort, and tied into bundles) are twice compreſſed; for having paſſed through the firſt and ſecond rollers, they are turned round the middle one by a circular piece of frame-work or ſcreen, called in Jamaica the *Dumb-returner*, and forced back through the ſecond and third; an operation which ſqueezes them completely dry, and ſometimes even reduces them to powder. The cane juice is received in a leaden bed, and thence conveyed into a veſſel called the *receiver*. The refuſe, or macerated rind of the cane (which is called *cane-traſh*, in contradiſtinction to *field-traſh*), ſerves for fuel to boil the liquor.

The juice as it flows from the mill, taken at a medium, contains eight parts of pure water, one part of ſugar, and one part conſiſting of coarſe oil and mucilagious gum, with a portion of eſſential oil.

As this juice has a ſtrong diſpoſition to fermentation, it muſt be boiled as ſoon as poſſible. There are ſome water-mills that will grind with great eaſe canes ſufficient for 30 hogſheads of ſugar in a week. It is neceſſary to have boiling veſſels, or clarifiers, that will correſpond in dimenſions to the quantity of juice flowing from the receiver. Theſe clarifiers are commonly three in number, and are ſometimes capable of containing 1000 gallons each; but it is more uſual to ſee them of 300 or 400 gallons each. Beſides the clarifiers which are uſed for the firſt boiling, there are generally four coppers or boilers. The clarifiers are placed in the middle or at one end of the boiling-houſe. If at one end, the boiler called the *teache* is placed at the other, and ſeveral boilers (generally three) are ranged between them. The teache is ordinarily from 70 to 100 gallons, and the boilers between the clarifiers and teache diminiſh in ſize from the firſt to the laſt. Where the clarifiers are in the middle, there is uſually a ſet of three boilers of each ſide, which conſtitute in effect a double boiling-houſe. On very large eſtates this arrangement is found uſeful and neceſſary. The objection to ſo great a number is the expence of fuel; to obviate which, in ſome degree, the three boilers on each ſide of the clarifiers are commonly hung to one fire.

The juice runs from the receiver along a wooden gutter lined with lead into the boiling-houſe, where it is received into one of the clarifiers. When the clarifier is filled, a fire is lighted, and a quantity of Briſtol quicklime in powder, which is called *temper*, is poured into the veſſel. The uſe of the lime is to unite with the ſuperabundant acid, which, for the ſucceſs of the proceſs, it is neceſſary to get rid of. The quantity ſufficient to ſeparate the acid muſt vary according to the ſtrength of the quicklime and the quality of the liquor. Some planters allow a pint of lime to every 100 gallons of liquor; but Mr Edwards thinks that little more than half the quantity is a better medium proportion, and even then, that it ought to be diſſolved in boiling water, that as little of it as poſſible may be precipitated. The heat is ſuffered gradually to increaſe till it approaches within a few degrees of the heat of boiling water, that the impurities may be thoroughly ſeparated. But if the liquor were ſuffered to boil with violence, the impurities would again incorporate with it. It is known to be ſufficiently heated when the ſcum begins to riſe in bliſters, which break into white froth, and appear generally in about 40 minutes. The fire is then ſuddenly extinguiſhed by means of a damper, which excludes the external air, and the liquor is allowed to remain about an hour undiſturbed, during which period the impurities are collected in ſcum on the ſurface. The juice is then drained off either by a ſyphon or a cock; the ſcum being of a tenacious gummy nature, does not flow out with the liquor, but remains behind in the clarifier. The liquid juice is conveyed from the clarifier by a gutter into the evaporating boiler, commonly termed the *grand copper*; and if it has been obtained from good canes it generally appears tranſparent.

26 And four coppers.

In the evaporating boiler, which ſhould be large enough to receive the contents of the clarifier, the liquor is allowed to boil; and as the ſcum riſes it is taken off. The ſcumming and evaporation are continued till the liquor becomes finer and thicker, and ſo far diminiſhed in bulk that it may be eaſily contained in the ſecond copper. When put into the ſecond copper, it is nearly of the colour of Madeira wine; the boiling and ſcumming are continued, and if the impurities be conſiderable, a quantity of lime-water is added. This proceſs is carried on till the liquor be ſufficiently diminiſhed in quantity to be contained in the third copper. After being purified a third time, it is put into the fourth copper, which is called the *teache*, where it is boiled and evaporated till it is judged ſufficiently pure to be removed from the fire. In judging of the purity of the liquor, many of the negroes (ſays Mr Edwards) gueſs ſolely by the eye (which by long habit they do with great accuracy), judging by the appearance of the grain on the back of the ladle: but the practice moſt in uſe is to judge by what is called the *touch*; i. e. taking up with the thumb a ſmall portion of the hot liquor from the ladle; and, as the heat diminiſhes, drawing with the fore-finger the liquid into a thread. This thread will ſuddenly break, and ſhrink from the thumb to the ſuſpended finger, in different lengths, according as the liquor is more or leſs boiled. The proper boiling height for ſtrong muſcovado ſugar is generally determined by a thread of a quarter of an inch long. It is evident, that certainty in this experiment can be attained only by long habit, and that no verbal precepts will furniſh any degree of ſkill in a matter depending wholly on conſtant practice.

27 After being clarified it is cooled, granulated, and freed from its melaſſes.

The juice being thus purified by paſſing through the clarifier and four coppers, it is poured into coolers, which are uſually ſix in number. The removal from the teache to the cooler is called *ſtriking*. The cooler is a ſhallow wooden veſſel 7 feet long, from 5 to 6 wide, about 11 inches deep, and capable of containing a hogſhead of ſugar. As the liquor cools, the ſugar grains, that is, collects into an irregular maſs of imperfect cryſtals, ſeparating itſelf from the melaſſes. It is then removed from the cooler, and conveyed to the curing-houſe, where the melaſſes drain from it. For receiving them there is a large ciſtern, the ſloping ſides of which are lined with boards. Directly above the ciſtern a frame of joiſt-work without boarding is placed, on which empty hogſheads without heads are ranged. The bottoms of theſe hogſheads are pierced with 8 or 10 holes, in each of which the ſtalk of a plantain leaf is fixed ſo as to project 6 or 8 inches below the joiſts, and riſe a little above the top of the hogſhead. The hogſheads being filled with the contents of the cooler, conſiſting of ſugar and melaſſes, the melaſſes being liquid, drain through the ſpungy ſtalk, and drop into the ciſtern. After the melaſſes are drained off, the ſugar becomes pretty dry and fair, and is then called *muſcovado* or *raw ſugar*.

We have deſcribed the proceſs for extracting ſugar, which is generally adopted in the Britiſh Weſt India iſlands, according to the lateſt improvements; and have been anxious to preſent it to our readers in the ſimpleſt and moſt perſpicuous form, that it might be intelligible to every perſon; and have

Sugar.

have therefore avoided to mention the observations and proposed amendments of those who have written on this subject. Had we done so, we should have swelled the present article to too great a size, without accomplishing the purpose which we have in view; for our intention is not to instruct the planters, but to give a distinct account of the most approved methods which the planters have generally adopted. But though we judge it useless to trouble our readers with all the little varieties in the process which different persons employ, we flatter ourselves it will not be disagreeable to learn by what methods the French make their sugar purer and whiter than ours. A quantity of sugar from the cooler is put into conical pans or earthen pots, called by the French *formes*, having a small perforation at the apex, which is kept closed. Each cone, reversed on its apex, is supported in another earthen vessel. The syrup is stirred together, and then left to crystallize. At the end of 15 or 16 hours, the hole in the point of each cone is opened, that the impure syrup may run out. The base of these sugar loaves is then taken out, and white pulverized sugar substituted in its stead; which being well pressed down, the whole is covered with clay moistened with water. This water filters through the mass, carrying the syrup with it which was mixed with the sugar, but which by this management flows into a pot substituted in the place of the first. This second fluid is called *fine syrup*. Care is taken to moisten and keep the clay to a proper degree of softness as it becomes dry. The sugar loaves are afterwards taken out, and dried in a stove for eight or ten days; after which they are pulverized, packed, and exported to Europe, where they are still farther purified. The reason assigned why this process is not universally adopted in the British sugar islands is this, that the water which dilutes and carries away the molasses dissolves and carries with it so much of the sugar, that the difference in quality does not pay for the difference in quantity. The French planters probably think otherwise, upwards of 400 of the plantations of St Domingo having the necessary apparatus for claying and actually carrying on the system.

29 Method of purifying used by the French.

Chaptal's Chemistry, vol. iii.

30 The art of refining sugar first communicated by a Venetian.

The art of refining sugar was first made known to the Europeans by a Venetian, who is said to have received 100,000 crowns for the invention. This discovery was made before the new world was explored; but whether it was an invention of the person who first communicated it, or whether it was conveyed from China, where it had been known for a considerable time before, cannot now perhaps be accurately ascertained. We find no mention made of the refining of sugar in Britain till the year 1659, though it probably was practised several years before. For in the Portuguese island of St Thomas in 1624 there were 74 sugar ingenios, each having upwards of 200 slaves. The quantity of raw sugar imported into England in 1778 amounted to 1,403,995 cwts.; the quantity imported into Scotland in the same year was 117,285 cwts.; the whole quantity imported into Great Britain in 1787 was 1,926,741 cwts.

Anderson's [illegible]

[illegible] with lime-water [illegible] exposed to heat.

The sugar which undergoes the operation of refining in Europe is either raw sugar, sometimes called *muscovado* or *cassonado*, which is raw sugar in a purer state. The raw sugar generally contains a certain quantity of melasses as well as earthy and feculent substances. The cassonado, by the operation of earthing, is freed from its melasses. As the intention of refining these sugars is to give them a higher degree of whiteness and solidity, it is necessary for them to undergo other processes. The first of these is called *clarification*. It consists in dissolving the sugar in a certain proportion of lime-water, adding a proper quantity of bullock's blood, and exposing it to heat in order to remove the impurities which still remain. The heat is increased very gradually till it approach that of boiling water. By the assistance of the heat, the animal matter which was thrown in coagulates, at the same time that it attracts all the solid feculent and earthy matter, and raises it to the surface in the appearance of a thick foam of a brownish colour. As the feculencies are never entirely removed by a first process, a second is necessary. The solution is therefore cooled to a certain degree by adding some water; then a fresh quantity of blood, but less considerable than at first, is poured in. The fire is renewed, and care is taken to increase the heat gently as before. The animal substance seizes on the impurities which remain, collects them on the surface, and they are then skimmed off. The same operation is repeated a third and even a fourth time, but no addition is made to the liquor except water. If the different processes have been properly conducted, the solution will be freed from every impurity, and appear transparent. It is then conveyed by a gutter into an oblong basket about 16 inches deep, lined with a woollen cloth; and after filtering through this cloth, it is received in a cistern or copper which is placed below.

31 Then freed from its remaining impurities by evaporation.

The solution being thus clarified, it undergoes a second general operation called *evaporation*. Fire is applied to the copper into which the solution was received, and the liquid is boiled till it has acquired the proper degree of consistency. A judgment is formed of this by taking up a small portion of the liquid and drawing it into a thread. When, after this trial, it is found sufficiently viscous, the fire is extinguished, and the liquid is poured into coolers. It is then stirred violently by an instrument called an *oar*, from the resemblance it bears to the oar of a boat. This is done in order to diminish the viscosity, and promote what is called the *granulation*, that is, the forming of it into grains or imperfect crystals. When the liquid is properly mixed and cooled, it is then poured into moulds of the form of a sugar loaf. These moulds are ranged in rows. The small ends, which are lowest, are placed in pots; and they have each of them apertures stopped up with linen for filtering the syrup, which runs from the moulds into the pots. The liquor is then taken out slowly in ladlefuls from the coolers, and poured into the moulds. When the moulds are filled, and the contents still in a fluid state, it is necessary to stir them, that no part may adhere to the moulds, and that the small crystals which are just formed may be equally diffused thro' the whole mass. When the sugar is completely crystallized, the linen is taken away from the apertures in the moulds, and the syrup, or that part which did not crystallize, descends into the pots in which the moulds are placed. After this purgation the moulds are removed and fixed in other pots, and a stratum of fine white clay diluted with water is laid on the upper part of the loaf. The water descending thro' the sugar by its own weight, mixes with the syrup which still remains in the body of the loaf, and washes it away. When the clay dries, it is taken off, and another covering of moist clay put in its place; and if it be not then sufficiently washed, a third covering of clay is applied. After the loaves have stood some days in the moulds, and have acquired a considerable degree of firmness and solidity, they are taken out, and carried to a stove, where they are gradually heated to the 50° of Reaumur (64° of Fahrenheit), in order to dissipate any moisture which may be still confined in them. After remaining in the stove eight days, they are taken out; and after cutting off all discolouring specks, and the head if still wet, they are wrapped in blue paper, and are ready for sale. The several syrups collected during the different parts of the process, treated in the same manner which we have just described, afford sugars of inferior quality; and the last portion, which no longer affords any sugar, is sold by the name of *melasses*.

32 Afterwards poured into moulds, where the syrup is drained from it.

33 Lastly exposed to a certain degree of heat.

The

The beauty of refined ſugar, when formed into loaves, conſiſts in whiteneſs, joined to a ſmallneſs of grain; in being dry, hard, and ſomewhat tranſparent. The proceſs which we have deſcribed above refers to ſugar once refined; but ſome more labour is neceſſary to produce double refined ſugar. The principal difference in the operation is this, the latter is clarified by white of eggs inſtead of blood, and freſh water in place of lime-water.

Sugar candy is the true eſſence of the cane formed into large cryſtals by a ſlow proceſs. When the ſyrup is well clarified, it is boiled a little, but not ſo much as is done for the proof mentioned in the proceſs for making common ſugar. It is then placed in old moulds, having their lower ends ſtopped with linen, and croſſed at little diſtances with ſmall twigs to retain the ſugar as it cryſtallizes. The moulds are then laid in a cool place. In proportion as the ſyrup cools cryſtals are formed. In about nine or ten days the moulds are carried to the ſtove, and placed in a pot; but the linen is not removed entirely, ſo that the ſyrup falls down ſlowly in drops. When the ſyrup has dropped away, and the cryſtals of the ſugar-candy are become dry, the moulds are taken from the ſtove and broken in pieces, to diſengage the ſugar, which adheres ſtrongly to the ſides of the moulds. If the ſyrup has been coloured with cochineal, the cryſtals take a ſlight taint of red; if indigo has been mixed, they aſſume a bluiſh colour. If it be deſired to have the candy perfumed, the eſſence of flowers or amber may be dropped into the moulds along with the ſyrup.

Having now given ſome account of the method uſually employed for refining ſugar, it will not be improper to ſay a few things concerning its nature and its uſes.

Sugar is ſoluble in water, and in a ſmall degree in alcohol. When united with a ſmall portion of water, it becomes fuſible; from which quality the art of preſerving is indebted for many of its preparations. It is phoſphoric and combuſtible; when expoſed to fire emitting a blue flame if the combuſtion be ſlow, and a white flame if the combuſtion be rapid. By diſtillation it produces a quantity of phlegm, acid, oil, gas, and charcoal. Bergman, in treating ſugar with the nitrous acid, obtained a new acid now known by the name of the *oxalic acid:* but he has omitted to mention the principles of which ſugar is compoſed. Lavoiſier, however, has ſupplied this omiſſion; and after many experiments has aſſigned three principles in ſugar, hydrogene, oxygene, and carbone. If the juice expreſſed from the ſugar-cane be left to itſelf, it paſſes into the acetous fermentation; and during the decompoſition of the ſugar, which is continued for three or four months, a great quantity of glutinous matter is ſeparated. This matter when diſtilled gives a portion of ammoniac. If the juice be expoſed to the ſpirituous fermentation, a wine is obtained analogous to cyder. If this wine, after being kept in bottles a year, be diſtilled, we obtain a portion of *eau de vie.*

The uſes to which ſugar are applied are indeed numerous and important: It can be made ſo ſolid as in the art of preſerving to receive the moſt agreeable colours and the greateſt variety of forms. It can be made ſo fluid as to mix with any ſoluble ſubſtance.—It preſerves the juice and ſubſtance of fruits in all countries and in all ſeaſons. It affords a delicious ſeaſoning to many kinds of food. It is uſeful in pharmacy, for it unites with medicines, and removes their diſagreeable flavour: it is the baſis of all ſyrups. M. Macquer has ſhown in a very ſatisfactory manner how uſeful ſugar would be if employed in fermenting wines. Sugar has alſo been found a remedy for the ſcurvy, and a valuable article of food in caſes of neceſſity. M. Imbert de Lennes, firſt ſurgeon to the late Duke of Orleans, publiſh- the following ſtory in the *Gazette de Santé*, which confirms this aſſertion. A veſſel laden with ſugar bound from the Weſt Indies was becalmed in its paſſage for ſeveral days, during which the ſtock of proviſions was exhauſted. Some of the crew were dying of the ſcurvy, and the reſt were threatened with a ſtill more terrible death. In this emergency recourſe was had to the ſugar. The conſequence was, the ſymptoms of the ſcurvy went off, the crew found it a wholeſome and ſubſtantial aliment, and returned in good health to France.

Sugar.

38 Affords the greateſt quantity of nouriſhment of any kind of food.

"Sugar (ſays Dr Ruſh) affords the greateſt quantity of nouriſhment in a given quantity of matter of any ſubſtance in nature; of courſe it may be preſerved in leſs room in our houſes, and may be conſumed in leſs time, than more bulky and leſs nouriſhing aliment. It has this peculiar advantage over moſt kinds of aliment, that it is not liable to have its nutritious qualities affected by time or the weather; hence it is preferred by the Indians in their excurſions from home. They mix a certain quantity of maple ſugar, with an equal quantity of Indian corn, dried and powdered, in its milky ſtate. This mixture is packed in little baſkets, which are frequently wetted in travelling, without injuring the ſugar. A few ſpoonfuls of it mixed with half a pint of ſpring water afford them a pleaſant and ſtrengthening meal. From the degrees of ſtrength and nouriſhment which are conveyed into animal bodies by a ſmall bulk of ſugar, it might probably be given to horſes with great advantage, when they are uſed in places or under circumſtances which make it difficult or expenſive to ſupport them with more bulky or weighty aliment. A pound of ſugar with graſs or hay has ſupported the ſtrength and ſpirits of an horſe during a whole day's labour in one of the Weſt-India Iſlands. A larger quantity given alone has fattened horſes and cattle, during the war before laſt in Hiſpaniola, for a period of ſeveral months, in which the exportation of ſugar, and the importation of grain, were prevented by the want of ſhips.

Tranſactions of the American Philoſophical Society, vol. iii.

39 An excellent antidote againſt worms,

"The plentiful uſe of ſugar in diet is one of the beſt preventives that has ever been diſcovered of the diſeaſes which are produced by worms. Nature ſeems to have implanted a love for this aliment in all children, as if it were on purpoſe to defend them from thoſe diſeaſes. Dr Ruſh knew a gentleman in Philadelphia, who early adopted this opinion, and who, by indulging a large family of children in the uſe of ſugar, has preſerved them all from the diſeaſes uſually occaſioned by worms.

40 And probably againſt the plague and other malignant fevers.

"Sir John Pringle has remarked, that the plague has never been known in any country where ſugar compoſes a material part of the diet of the inhabitants. Dr Ruſh thinks it probable that the frequency of malignant fevers of all kinds has been leſſened by this diet, and that its more general uſe would defend that claſs of people who are moſt ſubject to malignant fevers from being ſo often affected by them.

"In the numerous and frequent diſorders of the breaſt, which occur in all countries where the body is expoſed to a variable temperature of weather, ſugar affords the baſis of many agreeable remedies. It is uſeful in weakneſſes, and acrid defluxions upon other parts of the body. Many facts might be adduced in favour of this aſſertion. Dr Ruſh mentions only one, which, from the venerable name of the perſon whoſe caſe furniſhed it, cannot fail of commanding attention and credit. Upon my inquiring of Dr Franklin, at the requeſt of a friend (ſays our reſpectable author), about a year before he died, whether he had found any relief from the pain of the ſtone from the blackberry jam, of which he took large quantities, he told me that he had, but that he believed the medicinal part of the jam reſided wholly in the ſugar; and as a reaſon for thinking ſo, he added, that he often found the ſame relief by taking about half a pint of a ſyrup,

41 He given relief from the pain of the ſtone.

2

Sugar. syrup, prepared by boiling a little brown sugar in water, just before he went to bed, that he did from a dose of opium. It has been supposed by some of the early physicians of our country, that the sugar obtained from the maple-tree is more medicinal than that obtained from the West India sugar-cane; but this opinion I believe is without foundation. It is preferable in its qualities to the West-India sugar only from its superior cleanliness.

"Cases may occur in which sugar may be required in medicine, or in diet, by persons who refuse to be benefited, even indirectly by the labour of slaves. In such cases the innocent maple sugar will always be preferred. It has been said, that sugar injures the teeth; but this opinion now has so few advocates, that it does not deserve a serious refutation."

42 Not hurtful to the teeth.

In the account which we have given above of the method of cultivating and manufacturing sugar, we have had in our eye the plantations in the West Indies, where slaves alone are employed; but we feel a peculiar pleasure in having it in our power to add a short description of the method used in the East Indies, because there sugar is manufactured by free men, on a plan which is much more economical than what is followed in the West Indies. The account which we mean to give is an extract from the report of the committee of Privy-council for trade on the subject of the African slave-trade, drawn up by Mr Botham. We shall give it in the author's own words.

43 Sugar manufactured in the East Indies by freemen,

"Having been for two years in the English and French West-Indian islands, and since conducted sugar estates in the East-Indies; before the abolition of the slave-trade was agitated in parliament, it may be desirable to know that sugar of a superior quality and inferior price to that in our islands is produced in the East-Indies; that the culture of the cane, the manufacture of the sugar and arrack, is, with these material advantages, carried on by free people. China, Bengal, the coast of Malabar, all produce quantities of sugar and spirits; but as the most considerable growth of the cane is carried on near Batavia, I shall explain the improved manner in which sugar estates are there conducted. The proprietor of the estate is generally a wealthy Dutchman, who has erected on it substantial mills, boiling and curing houses. He rents this estate to a Chinese, who resides on it as a superintendant; and this renter (supposing the estate to consist of 300 or more acres) relets it to freemen in parcels of 50 or 60 on these conditions: "That they shall plant it in canes, and receive so much *per* pecul of 133¼ pounds for every pecul of sugar that the canes shall produce."

44 Of a superior quality and at a lower price.

45 How sugar estates are managed at Batavia.

When crop time comes on, the superintendant collects a sufficient number of persons from the adjacent towns or villages, and takes off his crop as follows. To any set of tradesmen who bring their carts and buffaloes he agrees to give such a price *per* pecul to cut all his crop of canes, carry them to the mill and grind them. A second to boil them *per* pecul. A third to clay them and basket them for market *per* pecul. So that by this method of conducting a sugar estate the renter knows to a certainty what the produce of it will cost him *per* pecul. He has not any permanent or unnecessary expence; for when the crop is taken off, the taskmen return to their several pursuits in the towns and villages they came from; and there only remains the cane planters who are preparing the next year's crop. This like all other complex arts, by being divided into several branches, renders the labour cheaper and the work more perfectly done.

Only clayed sugars are made at Batavia; these are in quality equal to the best sort from the West Indies, and are sold so low from the sugar estates as eighteen shillings sterling *per* pecul of 133¼ libs. This is not the selling price to the trader at Batavia, as the government there is arbitrary, and sugar subject to duties imposed at will. The Shabander exacts a dollar *per* pecul on all sugar exported. The price of common labour is from 9d to 10d *per* day. By the method of carrying on the sugar estates, the taskmen gain considerably more than this not only from working extraordinary hours, but from being considered artists in their several branches. They do not make spirits on the sugar estates. The melasses is sent for sale to Batavia, where one distillery may purchase the produce of an hundred estates. Here is a vast saving and reduction of the price of spirits; not as in the West Indies, a distillery, for each estate; many centre in one, and arrack is sold at Batavia from 21 to 25 rix-dollars *per* leaguer of 160 gallons; say 8 d *per* gallon.

46 Description of the maple

The Sugar Maple, (the *acer saccharinum* of Linnæus), as well as the sugar-cane, produces a great quantity of sugar. This tree grows in great numbers in the western counties of all the middle states of the American union. Those which grow in New York and Pennsylvania yield the sugar in a greater quantity than those which grow on the waters of Ohio.—These trees are generally found mixed with the beech, hemlock, white and water ash, the cucumber-tree, linden, aspen, butter nut, and wild cherry trees. They sometimes appear in groves covering five or six acres in a body, but they are more commonly interspersed with some or all of the forest trees which have been mentioned. From 30 to 50 trees are generally found upon an acre of ground. They grow only in the richest soils, and frequently in stony ground. Springs of the purest water abound in their neighbourhood. They are, when fully grown, as tall as the white and black oaks, and from two to three feet in diameter. They put forth a beautiful white blossom in the spring before they show a single leaf. The colour of the blossom distinguishes them from the acer rubrum, or the common maple, which affords a blossom of a red colour. The wood of the sugar maple-tree is extremely inflammable, and is preferred upon that account by hunters and surveyors for fire-wood. Its small branches are so much impregnated with sugar as to afford support to the cattle, horses, and sheep of the first settlers, during the winter, before they are able to cultivate forage for that purpose. Its ashes afford a great quantity of potash, exceeded by few, or perhaps by none, of the trees that grow in the woods of the United States. The tree is supposed to arrive at its full growth in the woods in twenty years.

Trans. of the American Philosophical Society,

It is not injured by tapping; on the contrary, the oftener it is tapped, the more syrup is obtained from it. In this respect it follows a law of animal secretion. A single tree had not only survived, but flourished after forty-two tappings in the same number of years. The effects of a yearly discharge of sap from the tree, in improving and increasing the sap, are demonstrated from the superior excellence of those trees which have been perforated in an hundred places, by a small wood-pecker which feeds upon the sap. The trees, after having been wounded in this way, distil the remains of their juice on the ground, and afterwards acquire a black colour. The sap of these trees is much sweeter to the taste than that which is obtained from trees which have not been previously wounded, and it affords more sugar.

4[illegible] The oftener the tree is tapped the more syrup is obtained from it.

From twenty-three gallons and one quart of sap, procured in twenty-four hours from only two of these dark coloured trees, Arthur Noble, Esq; of the state of New York, obtained four pounds and thirteen ounces of good grained sugar.

What quantity will produce certain quantity of sugar.

A tree of an ordinary size yields in a good season from twenty to thirty gallons of sap, from which are made from five to six pounds of sugar. To this there are sometimes remarkable exceptions. Samuel Lowe, Esq; a justice of peace

peace in Montgomery county, in the ſtate of New York, informed Arthur Noble, Eſq; that he had made twenty pounds and one ounce of ſugar between the 14th and 23d of April, in the year 1789, from a ſingle tree that had been tapped for ſeveral ſucceſſive years before.

From the influence which culture has upon foreſt and other trees, it has been ſuppoſed, that by tranſplanting the ſugar maple-tree into a garden, or by deſtroying ſuch other trees as ſhelter it from the rays of the ſun, the quantity of the ſap might be increaſed, and its quality much improved. A farmer in Northampton county, in the ſtate of Pennſylvania, planted a number of theſe trees above twenty years ago in his meadow, from three gallons of the ſap of which he obtains every year a pound of ſugar. It was obſerved formerly, that it required five or ſix gallons of the ſap of the trees which grow in the woods to produce the ſame quantity of ſugar.

The ſap diſtils from the wood of the tree. Trees which have been cut down in the winter for the ſupport of the domeſtic animals of the new ſettlers, yield a conſiderable quantity of ſap as ſoon as their trunks and limbs feel the rays of the ſun in the ſpring of the year. It is in conſequence of the ſap of theſe trees being equally diffuſed through every part of them, that they live three years after they are girdled, that is, after a circular inciſion is made through the bark into the ſubſtance of the tree for the purpoſe of deſtroying it. It is remarkable that graſs thrives better under this tree in a meadow, than in ſituations expoſed to the conſtant action of the ſun. The ſeaſon for tapping the trees is in February, March, and April, according to the weather which occurs in theſe months.

Warm days and froſty nights are moſt favourable to a plentiful diſcharge of ſap. The quantity obtained in a day from a tree is from five gallons to a pint, according to the greater or leſs heat of the air. Mr Lowe informed Arthur Noble, Eſq; that he obtained near three and twenty gallons of ſap in one day (April 14. 1789.) from the ſingle tree which was before mentioned. Such inſtances of a profuſion of ſap in ſingle trees are however not very common.

There is always a ſuſpenſion of the diſcharge of ſap in the night if a froſt ſucceed a warm day. The perforation in the tree is made with an axe or an auger. The latter is preferred from experience of its advantages. The auger is introduced about three quarters of an inch, and in an aſcending direction (that the ſap may not be frozen in a ſlow current in the mornings or evenings), and is afterwards deepened gradually to the extent of two inches. A ſpout is introduced about half an inch into the hole made by this auger, and projects from three to twelve inches from the tree. The ſpout is generally made of the ſumach or elder, which uſually grows in the neighbourhood of the ſugar trees. The tree is firſt tapped on the ſouth ſide; when the diſcharge of its ſap begins to leſſen, an opening is made on the north ſide, from which an increaſed diſcharge takes place. The ſap flows from four to ſix weeks, according to the temperature of the weather. Troughs large enough to contain three or four gallons made of white pine, or white aſh, or of dried water aſh, aſpen, linden, poplar, or common maple, are placed under the ſpout to receive the ſap, which is carried every day to a large receiver, made of either of the trees before mentioned. From this receiver it is conveyed, after being ſtrained, to the boiler.

We underſtand that there are three modes of reducing the ſap to ſugar; by evaporation, by freezing, and by boiling; of which the latter is moſt general, as being the moſt expeditious. We are farther aſſured, that the profit of the maple tree is not confined to its ſugar. It affords moſt agreeable melaſſes, and an excellent vinegar. The ſap which is ſuitable for theſe purpoſes is obtained after the ſap which affords the ſugar has ceaſed to flow, ſo that the manufactories of theſe different products of the maple-tree, by ſucceeding, do not interfere with each other. The melaſſes may be made to compoſe the baſis of a pleaſant ſummer beer. The ſap of the maple is moreover capable of affording a ſpirit; but we hope this precious juice will never be proſtituted to this ignoble purpoſe. Should the uſe of ſugar in diet become more general in this country (ſays Dr Ruſh), it may tend to leſſen the inclination or ſuppoſed neceſſity for ſpirits, for I have obſerved a reliſh for ſugar in diet to be ſeldom accompanied by a love for ſtrong drink.

54 Sugar procured from many other vegetables.

There are ſeveral other vegetables raiſed in our own country which afford ſugar; as beet-roots, ſkirrets, parſneps, potatoes, celeri, red-cabbage ſtalks, the young ſhoots of Indian wheat. The ſugar is moſt readily obtained from theſe, by making a tincture of the ſubject in rectified ſpirit of wine; which, when ſaturated by heat, will depoſit the ſugar upon ſtanding in the cold.

Sugar of Milk. *See Sugar of Milk.*

Acid of Sugar. See Chemistry-*Index*.

SUGILLATION, in medicine, an extravaſation of blood in the coats of the eye, which at firſt appears of a reddiſh colour, and afterwards livid or black. If the diſorder is great, bleeding and purging are proper, as are alſo diſcutients.

SUICIDE, the crime of ſelf-murder, or the perſon who commits it.

We have often wiſhed to ſee a hiſtory of crimes drawn up by a man of ability and reſearch. In this hiſtory we would propoſe that the author ſhould deſcribe the crimes peculiar to different nations in the different ſtages of ſociety, and the changes which they undergo in the progreſs of civilization. After having arranged the hiſtorical facts, he might, by comparing them with the religion and the knowledge of the people, deduce ſome important general concluſions, which would lead to a diſcovery of the cauſe of crimes, and of the remedy moſt proper to be applied. Some crimes are peculiar to certain ſtages of ſociety, ſome to certain nations, &c.

1 Suicide among the Jews.

Suicide is one of thoſe crimes which we are led to believe not common among ſavage nations. The firſt inſtances of it recorded in the Jewiſh hiſtory are thoſe of Saul and Ahitophel; for we do not think the death of Samſon a proper example. We have no reaſon to ſuppoſe that it became common among the Jews till their wars with the Romans, when multitudes ſlaughtered themſelves that they might not fall alive into the hands of their enemies. But at this period the Jews were a moſt deſperate and abandoned race of men, had corrupted the religion of their fathers, and rejected that pure ſyſtem which their promiſed Meſſiah came to Jeruſalem to announce.

2 Among the Greeks.

When it became remarkable among the Greeks, we have not been able to diſcover; but it was forbidden by Pythagoras, as we learn from Athenæus, by Socrates and Ariſtotle, and by the Theban and Athenian laws. In the earlieſt ages of the Roman republic it was ſeldom committed; but when luxury and the Epicurean and Stoical philoſophy had corrupted the ſimplicity and virtue of the Roman character, then they began to ſeek ſhelter in ſuicide from their misfortunes or the effects of their own vices.

3 The Bramins and Gentoos.

The religious principles of the bramins of India led them to admire ſuicide on particular occaſions as honourable. Accuſtomed to abſtinence, mortification, and the contempt of death, they conſidered it as a mark of weakneſs of mind to ſubmit to the infirmities of old age. We are informed that the modern Gentoos, who ſtill in moſt things conform to the cuſtoms of their anceſtors, when old and infirm, are frequently brought to the banks of rivers, particularly to

thoſe

Suicide. thoſe of the Ganges, that they may die in its ſacred ſtreams, which they believe can waſh away the guilt of their ſins. But the maxims of the Bramins, which have encouraged this practice, we are aſſured by Mr Holwell, are a corruption of the doctrines of the Shaſtah, which poſitively forbid ſuicide under the ſevereſt puniſhment. The practice which religion or affection has eſtabliſhed among the Gentoos for women at the death of their huſbands to burn themſelves alive on the funeral pile, we do not think ought to be conſidered as ſuicide, as we are not anxious to extend the meaning of the word; for were we to extend it thus far, it would be as proper to apply it to thoſe who chooſe rather to die in battle than make their eſcape at the expence of their honour. Thus we ſhould condemn as ſuicides the brave Spartans who died at Thermopylæ in defence of their country: we ſhould alſo be obliged to apply the ſame diſgraceful epithet to all thoſe well-meaning but weak-minded Chriſtians in this iſland, who in the laſt century choſe rather to die as martyrs than comply with commands which were not morally wrong. According to the Gentoo laws, "it is proper for a woman after her huſband's death to burn herſelf in the fire with his corpſe. Every woman who thus burns ſhall remain in paradiſe with her huſband three crore and fifty lacks of years. If ſhe cannot, ſhe muſt in that caſe preſerve an inviolable chaſtity. If ſhe remain chaſte, ſhe goes to paradiſe; and if ſhe do not preſerve her chaſtity, ſhe goes to hell."

4 Among the Americans. Robertſon's America.

A cuſtom ſimilar to this prevailed among many nations on the continent of America. When a chief died, a certain number of his wives, of his favourites, and of his ſlaves, were put to death, and interred together with him, that he might appear with the ſame dignity in his future ſtation, and be waited upon by the ſame attendants. This perſuaſion is ſo deeply rooted, that many of their retainers offer themſelves as victims; and the ſame cuſtom prevails in many of the negro nations in Africa.

5 The Japaneſe, and

If we can believe the hiſtorians of Japan, voluntary death is common in that empire. The devotees of the idol Amida drown themſelves in his preſence, attended by their relations and friends, and ſeveral of the prieſts, who all conſider the devoted perſon as a ſaint who is gone to everlaſting happineſs. Such being the ſuppoſed honours appropriated to a voluntary death, it is not ſurpriſing that the Japaneſe anxiouſly cheriſh a contempt of life. Accordingly it is a part of the education of their children "to repeat poems in which the virtues of their anceſtors are celebrated, an utter contempt of life is inculcated, and ſuicide is ſet up as the moſt heroic of actions."

Raynal's Hiſtory of the Eaſt and Weſt Indies, vol. i.

6 Scythians,

A notion ſeems alſo to have prevailed among the ancient Scythian tribes, that it was puſillanimous and ignoble for a man whoſe ſtrength was waſted with diſeaſe or infirmity, ſo as to be uſeleſs to the community, to continue to live. It was reckoned an heroic action voluntarily to ſeek that death which he had not the good fortune to meet in the field of battle. Perverſion of moral feeling does not ſpring up, we hope, ſpontaneouſly in any nation, but is produced by ſome peculiarities of ſituation. A wandering people like the Scythians, who roamed about from place to place, might often find it impoſſible to attend the ſick, or to ſupply from their precarious ſtore the wants of the aged and infirm. The aged and infirm themſelves, no longer able to ſupport the character of warriors, would find themſelves unhappy. In this way the practice of putting to death ſuch perſons as were uſeleſs to the community might originate, and afterwards be inculcated as honourable; but he who put an end to his infirmities by his own hand, obtained a character ſtill more illuſtrious.

The tribes of Scandinavia, which worſhipped Odin the "father of ſlaughter," were taught, that dying in the field of battle was the moſt glorious event that could befal them. This was a maxim ſuited to a warlike nation. In order to 7 eſtabliſh it more firmly in the mind, all were excluded from Odin's feaſt of heroes who died a natural death. In Aſgardia ſtood the hall of Odin; where, ſeated on a throne, he received the ſouls of his departed heroes. This place was called *Valhalla*, ſignifying "the hall of thoſe who died by violence." Natural death being thus deemed inglorious, and puniſhed with excluſion from Valhala the paradiſe of Odin, he who could not enjoy death in the field of battle was led to ſeek it by his own hands when ſickneſs or old age began to aſſail him. In ſuch a nation ſuicide muſt have been very common.

As ſuicide prevailed much in the decline of the Roman empire, when luxury, licentiouſneſs, profligacy, and falſe philoſophy, pervaded the world, ſo it continued to prevail even after Chriſtianity was eſtabliſhed. The Romans, when they became converts to Chriſtianity, did not renounce their ancient prejudices and falſe opinions, but blended them with the new religion which they embraced. The Gothic nations alſo, who ſubverted the Roman empire, while they received the Chriſtian religion, adhered to many of their former opinions and manners. Among other criminal practices which were retained by the Romans and their conquerors, that of ſuicide was one; but the principles from which it proceeded were explained, ſo as to appear more agreeable to the new ſyſtem which they had eſpouſed. It was committed, either to ſecure from the danger of apoſtacy, to procure the honour of martyrdom, or to preſerve the crown of virginity.

When we deſcend to modern times, we lament to find ſo many inſtances of ſuicide among the moſt poliſhed nations, who have the beſt opportunities of knowing the atrocity of that unnatural crime. The Engliſh have long been reproached by foreigners for the frequent commiſſion of it; and the "gloomy month of November" has been ſtigmatized as the ſeaſon when it is moſt common. But this diſgraceful imputation, we think, may be juſtly attributed, not to the greater frequency of the crime in England than in other places, but to the cuſtom of publiſhing in the newſpapers every inſtance of ſuicide which is known. Mr Moore, who lately publiſhed a full inquiry into this ſubject, was at great pains to obtain accurate information concerning the perpetration of this crime in different countries. Mercier, who wrote in 1782, ſays, that the annual number of ſuicides in Paris was then about 150. He does not tell us how he came by the information; but we have the authority of the Abbé Fontana for aſſerting, that more perſons put an end to their lives in Paris than in London. The Abbé had this information from the lieutenant of the police. Mr Moore was informed by one of the principal magiſtrates of Geneva, that in that city, which contains about 25,000 inhabitants, the average number of ſuicides is about *eight*. The average number of ſuicides, from what cauſe ſoever, for the laſt 28 years, has been 32 each year for London, Southwark, and Weſtminſter. In Edinburgh, which contains 80,000 inhabitants, we are convinced the average number of ſuicides does not exceed *four*. Mr Moore found, from the accounts with which he was favoured by the ſeveral coroners of the county of Kent, that for the laſt 18 years the number has been upwards of 32 each year. Kent is ſuppoſed to contain 200,000 inhabitants, and London 800,000. It is eaſy therefore to ſee, that in the metropolis many inſtances of ſuicide muſt occur which are never the ſubject of legal inquiry, and conſequently never made known to the world. Whereas in the country towns and villages of Kent it is ſcarcely poſſible to conceal ſuch an action as ſelf-murder from

from the knowledge of the whole neighbourhood. The calculation therefore reſpecting Kent we may receive as true, while we muſt increaſe the average number in London very conſiderably. Mr Moore computes the average number of ſuicides in England every year at a thouſand; but the principles on which he founds this opinion are ſo imperfect and vague, that we do not think it can be depended on as coming near the truth.

It might lead to ſome intereſting concluſions to compare together, not only the number of ſuicides in different countries, but alſo the rank and principles, the ſex and age, of thoſe unhappy perſons by whom it has been committed. Mercier ſays, that at Paris it was the lower ranks who were moſt commonly guilty of it; that it was moſtly committed in garrets or hired lodgings; and that it proceeded from poverty and oppreſſion. A great many, he ſays, wrote letters to the magiſtrates before their death. Mr Moore's correſpondent from Geneva informed him, that from the year 1777 to 1787 more than 100 ſuicides were committed in Geneva; that two-thirds of theſe unfortunate perſons were men; that few of the clerical order have been known to commit it; and that it is not ſo much the end of an immoral, irreligious, diſſipated life, as the effect of melancholy and poverty. By the information obtained from the coroners of Kent, it appears, that of the 32, three-fourths have deſtroyed themſelves by hanging; that the proportion of males to females has been about two-thirds of the former; that no one ſeaſon of the year is more diſtinguiſhed for this crime than another; and that ſuicide is upon the increaſe. Our accounts reſpecting the city of London are very imperfect; but we think ourſelves intitled to conclude, that ſuicide is more common among the great and wealthy than among the lower ranks, and that it is uſually the effect of gaming and diſſipation.

Thoſe who have inquired into the cauſes of ſuicide in Britain have enumerated many phyſical as well as moral cauſes. They have aſcribed it to the variableneſs of our climate, to the great uſe of animal food, to ſtrong ſpirituous liquors, to tea, and to the ſulphureous exhalations of the pit-coal uſed as fuel, which are ſaid to produce a depreſſion of ſpirits and nervous affections. Of our climate, we have no cauſe to complain, nor have we any reaſon to impute any of our vices to its influence. There are many climates much more unfavourable where ſuicide is ſcarcely known. That an exceſſive quantity of groſs animal food, or of ſtrong liquors, or of tea, will powerfully affect the human conſtitution, we will not deny: but before we conſider theſe as cauſes, it muſt firſt be determined, whether thoſe who are guilty of ſelf-murder be much addicted to them; and if they are, whether there be not other cauſes much more violent in their nature which have operated on their mind; for we ought not raſhly to attribute vicious effects to any of thoſe things which ſeem to have been created on purpoſe for the comfort or convenience of man. We are rather ſurpriſed to find that coal is mentioned even as a diſtant cauſe of ſuicide; for it is one of the bleſſings of our iſland: and a good coal fire we have always found rather conducive to good ſpirits than injurious to them.

Among the moral cauſes which are ſuppoſed to co-operate in producing ſuicide in Britain, the freedom of our conſtitution and laws is reckoned one. That rational liberty ſhould have any tendency to encourage crimes of any kind, a Chriſtian philoſopher can never allow; for ſuch an opinion is totally diſcountenanced by enlightened views of nature. Mercier has aſcribed the frequency of ſuicide in Paris to the oppreſſion of the late government. Now it appears ſomewhat extraordinary, that ſuicide in one country ſhould be occaſioned by liberty, and in another by the want of it. One of theſe opinions muſt be falſe, and it is ſurely not difficult to diſtinguiſh which. 13 And moral cauſes.

Humanity would in moſt caſes diſpoſe us to to conclude, that ſuicide is the effect of inſanity, were there not ſo many inſtances of cool deliberate ſelf-murder. That ſuicide is an unnatural crime, which none but a madman would commit, compaſſion indeed may ſuppoſe: but the murder of a wife, a father, or a child, are alſo unnatural; yet compaſſion does not teach us in all caſes to aſcribe ſuch a crime to madneſs. Paſſion may often ariſe to ſuch a height of outrage as to be ſcarcely diſtinguiſhable from madneſs in its ſymptoms and its effects; yet we always make a diſtinction between that madneſs which ariſes from diſeaſe and that which is owing to a violent perturbation of mind. If a perſon be capable of managing his wordly affairs, of making a will, and of diſpoſing of his property, immediately before his death, or after he formed the reſolution of dying by his own hands, ſuch a man is not to be conſidered as inſane. 14 Not owing always to inſanity;

But though a regard for truth prevents us from aſcribing ſuicide in all caſes to inſanity, we muſt aſcribe it either to inſanity or to vicious paſſion. Theſe two diviſions, we imagine, will comprehend every ſpecies of it, whether ariſing from melancholy, *tædium vitæ* or *ennui*, diſappointment in ſchemes of ambition or love, pride, gaming, or a deſire to avoid the ſhame of a public execution; paſſions which are often increaſed by falſe views of God, of man, and of a future ſtate, ariſing from deiſm and infidelity. If theſe be the cauſes of ſuicide in modern time, what a diſgraceful contraſt do they form to thoſe principles which actuated many of the ancient philoſophers, the Gentoos, the Japaneſe, and the worſhippers of Odin? When they committed ſuicide, they committed it from principle, from a belief of its lawfulneſs, and the hope of being rewarded for what they judged an honourable ſacrifice. But in modern times, we are ſorry to ſay, when it is not the effect of madneſs, it is the effect of vice: and when it is the effect of vice, it proves that the vicious paſſions are then indulged to the higheſt degree; for there is no crime which a man can commit that is ſo ſtrong a ſympton of the violence of particular paſſions. It is from not attending to this circumſtance, that it has been found ſo difficult to refute the arguments in favour of ſuicide. If the criminality of ſuicide be confined merely to the violent action, many apologies may be made for it; but if it be conſidered ſolely as the effect of vice, as the ſtrongeſt ſymptom of ungoverned paſſion, he who undertakes its defence muſt undertake the defence of what all men will loudly condemn (A). 15 But often alſo to vicious paſſion.

It is unneceſſary then to enter particularly into the arguments

(A) Several of the heathens entertained a very juſt ſenſe of the atrocity of ſuicide. Quintus Curtius introduces Darius with the following ſpeech, when he had loſt his empire: " I wait (ſays the unfortunate monarch) the iſſue of my fate: you wonder, perhaps, that I do not terminate my own life; but I chooſe rather to die by the crime of another than by my own.

We cannot refuſe ourſelves the pleaſure of preſenting to our readers the following beautiful paſſage upon this ſubject from Fitzoſborne's letters*: " I'am perſuaded (ſays this elegant writer) this diſguſt of life is frequently indulged out of a principle of mere vanity. It is eſteemed as a mark of uncommon refinement, and as placing a man above the ordinary level

* Letter iv.

Suicide.

16 Unworthy [illegible]

ments of those writers who have undertaken the inglorious office of advocates for the crime of suicide. Their talents might surely have been employed more usefully to the world, and more honourably to themselves, than in pleading for a practice which, if it were permitted by every man to whom the passions may make it lawful, would totally destroy some of the noblest virtues, fortitude, patience, and resignation; nay, would destroy society itself, and teach us to despise the opinion that this world is a state of preparation for another. "I came into life without my own consent, and may I not quit it at pleasure?" say the advocates for suicide. If, because we came into life without our own consent, we ought to quit it at pleasure, why may we not spend our life also as we please? Why may we not rob and murder, and commit every kind of crime, if *mere inclination* is to be the rule of action? Thus upon the principles of suicide the basest villain and murderer may reason, and every man may find a sufficient apology for any crime which he is tempted to commit. Or this absurdity may be otherwise answered: As we came into life without our own consent, we must have come with the consent of some other being; and logic says, that with the consent of that Being only can we lawfully quit it.

17 Its great criminality and imprudence.

It is sufficient shortly to say, that suicide is contrary to the strongest principle of the human constitution, self-preservation; that it is rebellion against God; that it is cruelty to the feelings and reputation, and often takes away the subsistence of a wife, a child, or a father; that it proves a want of fortitude to brave misfortunes; that it delivers only from imagined to plunge into real evils. We may add, that almost every instance of suicide of which we have heard was rash, imprudent, and premature, interrupted a useful life, or prevented a more honourable death. Had Cato's pride permitted him to yield himself to the clemency of Cæsar, his character and his influence might have contributed to retard the slavery of his country, which his death tended to hasten. Had Brutus and Cassius not executed the fatal resolution which they had formed, of dying by their own hands in case of misfortune, the battle of Philippi might have had a very different issue. Had Hannibal surrendered himself to the Romans, instead of swallowing poison, he would have gained more glory in braving their tortures than he won in the battle of Cannæ; for to suffer innocently and heroically is the greatest exertion of human fortitude.

18 How punished [illegible]

As suicide was deemed a crime by the most illustrious and virtuous of the Greek and Roman philosophers, it was considered as a crime by the laws, and treated with ignominy. By the law of Thebes suicides were to have no honours paid to their memory †. The Athenian law ordained the hand which committed the deed to be cut off, and buried apart from the rest of the body. The body was not buried with the usual solemnities, but was ignominiously thrown into some pit. In Ceos and Massilia (the ancient *Marseilles*), it was considered as a crime against the state; and it was therefore necessary for those who wished to destroy themselves to obtain permission from the magistrates. Plutarch acquaints us, that an unaccountable passion for suicide seized the Milesian virgins; from indulging which they could not be prevented by the tears and entreaties of parents and friends: but what persuasion and entreaty could not effect was accomplished by very different means. A decree was issued, "that the body of every young woman who hanged herself should be dragged naked through the streets by the same rope with which she had committed the deed." This wise edict put a complete stop to the extraordinary frenzy, and suicide was no longer committed by the virgins of Miletus.

† [illegible]

19 [illegible] Romans.

In the early part of the Roman history there seems to have been seldom occasion for enacting any law against suicide. The only instance recorded occurs in the reign of Tarquinius Priscus. The soldiers who were appointed to make drains and common sewers, thinking themselves disgraced by such servile offices, put themselves to death in great numbers. The king ordered the bodies of all the self-murderers to be exposed on crosses, and this put an effectual stop to the practice. It is doubtful whether there was any standing law against suicide during the existence of the republic; but during the reign of the emperors it was thought proper to lay it under certain regulations, though not absolutely to condemn it as a crime. In Justinian's Digests there is a law, by which it was enacted, "that if persons accused, or who had been found guilty, of any crime, should make away with themselves, their effects should be confiscated ‡."

‡ Lib. x[illegible] Tit. x[illegible] c. 3.

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level of his species, to seem superior to the vulgar feelings of happiness. True good sense, however, most certainly consists not in despising, but in managing our stock of life to the best advantage, as a cheerful acquiescence in the measures of Providence is one of the strongest symptoms of a well constituted mind. Self-weariness is a circumstance that ever attends folly; and to condemn our being is the greatest, and indeed the peculiar infirmity, of human nature. It is a noble sentiment which Tully puts into the mouth of Cato, in his Treatise upon old Age; *Non lubet mihi* (says that venerable Roman) *deplorare vitam, quod multi, et ii docti, sæpe fecerunt; neque me vixisse pœnitet: quoniam ita vixi, ut non frustra me natum existimem.*

"It is in the power, indeed, of but a very small portion of mankind to act the same glorious part that afforded such high satisfaction to this distinguished patriot; but the number is yet far more inconsiderable of those who cannot, in any station, secure themselves a sufficient fund of complacency to render life justly valuable. Who is it that is placed out of the reach of the highest of all gratifications, those of the generous affections, and that cannot provide for his own happiness, by contributing something to the welfare of others? As this disease of the mind generally breaks out with most violence in those who are supposed to be endowed with a greater delicacy of taste and reason than is the usual allotment of their fellow creatures, one may ask them, whether there is any satiety in the pursuits of useful knowledge? or, if one can ever be weary of benefiting mankind? Will not the fine arts supply a lasting feast to the mind? or, can there be wanting a pleasurable enjoyment, so long as there remains even one advantageous truth to be discovered or confirmed? To complain that life has no joys, while there is a single creature whom we can relieve by our bounty, assist by our counsels, or enliven by our presence, is, to lament the loss of that which we possess, and is just as rational as to die for thirst with the cup in our hands. But the misfortune is, when a man is settled into a habit of receiving all his pleasures from the mere selfish indulgences, he wears out of his mind the relish of every nobler enjoyment, at the same time that his powers of the sensual kind are growing more languid by each repetition. It is no wonder, therefore, he should fill up the measure of his gratifications long before he has completed the circle of his duration; and either wretchedly sit down the remainder of his days in discontent, or rashly throw them up in despair."

confiſcated." But this puniſhment only took place when confiſcation of goods happened to be the penalty appointed by the law for the crime of which the ſelf-murderer was accuſed or found guilty, and was not inflicted for ſuicide committed in any other circumſtances.

When the Chriſtian church had extended its juriſdiction in the Roman empire, it was decreed in the ſixth century, that no commemoration ſhould be made in the euchariſt for ſuch as deſtroyed themſelves; neither ſhould their bodies be carried out to burial with pſalms, nor have the uſual ſervice ſaid over them. This eccleſiaſtical law continued till the reformation, when it was admitted into the ſtatute code of England by the authority of parliament. As an additional puniſhment, however, confiſcation of land and goods ſeems to have been adopted from the Danes, as we learn from Bracton ‡. At preſent the puniſhment conſiſts in confiſcating all the perſonal property of a *felo de ſe* for the uſe of the crown, and in excluding his body from interment in conſecrated ground. The warrant of the coroner requires that the body ſhould be buried in ſome public highway, and a ſtake driven through it to increaſe the ignominy.

To inquire into the prevalence and cauſes of crimes, in order to diſcover the moſt judicious methods of preventing them, is the duty of the patriot and the Chriſtian. Suicide, we find, is a common and an increaſing evil: but it is a difficult matter to find an effectual remedy; for what motives can be held out ſufficient to influence that man's mind who is deaf to the voice of nature ſpeaking within him, and to the voice of nature's God declaring that he is ſtationed at a poſt which it is his duty to maintain? His reputation and property are indeed within the reach of the laws, his body may be treated with ignominy, and his property confiſcated; but this puniſhment will not be a preventive, even if it could be always inflicted; and that it is ſeldom inflicted, though the laws have decreed it, is well known. The humanity of the preſent age diſpoſes us to ſympathiſe with the relations of the deceaſed, inſtead of demanding that the ſentence of the law ſhould be executed. It is a generally received opinion, and a juſt one, that puniſhments decreed by human laws ſhould be directed only againſt ſuch crimes as are injurious to ſociety; but when it is hence inferred, that ſuicide ought not to be ſubject to the cognizance of human laws, every rule of logic is violated. There is no man, however mean in ſtation and in talents, whoſe life may not, on ſome occaſions, be uſeful to the community at large; and to conclude, that a perſon who fancies himſelf uſeleſs may therefore lawfully put a period to his life, is as falſe reaſoning as it would be to conclude, that by killing a poor man, who lives on the public, we ſhould perform an action not only innocent but meritorious, as we ſhould thereby free ſociety from one of its burdens.

SUIDAS, a Greek writer, according to ſome, flouriſhed in the 11th century, under the reign of the Emperor Alexius Comnenus; according to others, before the 10th century. He wrote in Greek an Hiſtorical and Geographical Dictionary or Lexicon; a work which, though not always ſtrictly accurate, is neverthele ſs of great importance, as it contains many things taken from the ancients that are nowhere elſe to be found. The beſt edition of Suidas is that of Kuiſter, in Greek and Latin, with notes, printed in 3 vols fol. which has been much improved by Toup.

Lapis SUILLUS. See *Swine-Stone*.

SUIT, is uſed in different ſenſes; as, 1. Suit of court, or ſuit-ſervice, which is an attendance the tenant owes to his lord's court. 2. Suit-covenant, where a perſon has covenanted to do ſervice in the court of the lord. 3. Suit-cuſtom, which is where one and his anceſtors have owed ſuit time out of mind. 4. It is uſed for a petition to the king or any perſon of dignity, where a lord diſtrains his tenant for ſuit, and none is due. In this caſe, the party may have an attachment againſt him to appear in the king's court.

Suit, in law, the ſame with action. The Romans introduced pretty early ſet forms for actions and ſuits into their law, after the example of the Greeks; and made it a rule, that each injury ſhould be redreſſed by its proper remedy only. "*Actiones*, (ſay the Pandects) *compoſitæ ſunt quibus inter ſe homines diſceptarent, quas actiones ne populus prout vellet inſtitueret, certas ſolemneſque eſſe voluerunt.*" The forms of theſe actions were originally preſerved in the books of the pontifical college as choice and ineſtimable ſecrets, till one Cneius Flavius, the ſecretary of Appius Claudius, ſtole a copy and publiſhed them to the people. The concealment was ridiculous: but the eſtabliſhment of ſome ſtandard was undoubtedly neceſſary to fix the true ſtate of a queſtion of right; leſt, in a long and arbitrary proceſs, it might be ſhifted continually, and be at length no longer diſcernible. Or, as Cicero expreſſes it, "*ſunt jura, ſunt formulæ, de omnibus rebus conſtitutæ, ne quis aut in genere injuriæ, aut in ratione actionis, errare poſſit. Expreſſe enim ſunt ex uniuſcujuſque damno, dolore, incommodo, calamitate, injuria, publicæ à prætore formulæ, ad quas privata lis accommodatur.*" And in the ſame manner Bracton, ſpeaking of the original writs upon which all our actions are founded, declares them to be fixed and immutable, unleſs by authority of parliament. And all the modern legiſlators of Europe have found it expedient, from the ſame reaſons, to fall into the ſame or a ſimilar method. In England, the ſeveral ſuits, or remedial inſtruments of juſtice, are, from the ſubject of them, diſtinguiſhed into three kinds; actions *perſonal*, *real*, and *mixed*.

Perſonal actions are ſuch whereby a man claims a debt, or perſonal duty, or damages in lieu thereof; and likewiſe whereby a man claims a ſatisfaction in damages for ſome injury done to his perſon or property. The former are ſaid to be founded upon contracts, the latter upon *torts* or wrongs: and they are the ſame which the civil law calls "*actiones in perſonam, quæ adverſus eum intenduntur qui ex contractu vel delicto obligatus eſt aliquid dare vel concedere.*" Of the former nature are all actions upon debt or promiſes; of the latter are all actions of treſpaſſes, nuiſances, aſſaults, defamatory words, and the like.

Real actions (or, as they are called in the Mirror, *feodal actions*), which concern real property only, are ſuch whereby the plaintiff, here called the *demandant*, claims title to have any lands or tenements, rents, commons, or other hereditaments, in fee-ſimple, fee-tail, or for term of life. By theſe actions formerly all diſputes concerning real eſtates were decided; but they are now pretty generally laid aſide in practice, upon account of the great nicety required in their management, and the inconvenient length of their proceſs; a much more expeditious method of trying titles being ſince introduced, by other actions perſonal and mixed.

Mixed actions are ſuits partaking of the mixture of the other two, wherein ſome real property is demanded, and alſo perſonal damages for a wrong ſuſtained. As for inſtance, an action of waſte: which is brought by him who hath the inheritance, in remainder or reverſion, againſt the tenant for life, who hath committed waſte therein, to recover not only the land waſted, which would make it merely a real action; but alſo treble damages, in purſuance of the ſtatute of Glouceſter, which is a perſonal recompenſe; and ſo both, being joined together, denominate it a *mixed action*.

The ordinary parts of a suit are these: 1. The original *writ*. 2. The *process*. 3. The *pleadings*. 4. The *issue* or demurrer. 5. The *trial*. 6. The *judgment*, and its incidents. 7. The proceedings in nature of *appeals*. 8. The *execution*. See Blackstone.

SULLY. See Bethune.

SULPHAT, in the new chemical nomenclature, denotes a compound of the sulphuric acid with some other substance.

SULPHUR, a well known substance, which is yellow, tasteless, hard, brittle, and when rubbed becomes electric. Its specific gravity is from 1,9 to 2,35. According to Bergman, it gently evaporates at 170, melts at 185, and flames at 302 of Fahrenheit. It burns with a blue flame, and a disagreeable suffocating smell: in close vessels it sublimes without decomposition, or only a decomposition proportionable to the quantity of air they contain; when melted it becomes red, but recovers its colour on cooling. It is insoluble in water, though by long trituration it is said water will take up some of it, but it is rather diffused than dissolved in it; neither can spirit of wine unite to it, except when both are in a vaporous state, and then 72 parts of spirit of wine take up 1 of sulphur; it is soluble in hot oils, and also in fixed alkalis, both in the dry and liquid way; it is decomposed by boiling in concentrated nitrous acid, partly decomposed and partly dissolved by the vitriolic and oxygenated muriatic acid. See CHEMISTRY-*Index*.

Sulphur was formerly supposed to consist of sulphuric acid and phlogiston, in the proportion of 60 parts of the former to 40 of the latter; but by the new system which is now generally adopted, sulphur is reckoned a simple substance, and the sulphuric acid a compound of sulphur and oxygene or vital air. This conclusion is founded on the following facts: 1. Sulphur does not burn unless vital air have access to it. 2. During combustion it absorbs vital air from the atmosphere. 3. The sulphuric produced by the combustion of sulphur is equal in weight to the sulphur employed and the quantity of air that has been consumed.

Sulphur is found sometimes pure, and sometimes in combination with other substances. Of pure sulphur there are seven varieties. 1. Transparent sulphur, in eight-sided crystals, with two truncated pyramids. It is generally deposited by water on the surface of calcareous spar. Cadiz sulphur is of this kind. 2. Transparent sulphur in irregular fragments. Such is the sulphur of Switzerland. 3. Whitish pulverulent sulphur, deposited in siliceous geodes. In Franche Compté there are flints full of sulphur. 4. Pulverulent sulphur deposited on the surface of mineral waters, such as those of Aix-la-Chapelle. 5. Crystalline sulphur that has been sublimed, found in the neighbourhood of volcanoes. 6. Pulverulent sulphur sublimed from volcanoes, found in abundance at Solfatara in the vicinity of Naples. 7. Sulphur in stalactites, formed by volcanic fires.

Sulphur is also found united with different substances, as with metals, when it is called *pyrites*: a short account of which may be seen under the article PYRITES. Sometimes it is combined with calcareous earth, as in fetid calcareous stones and swine-stone. It has lately been discovered, that sulphur is formed by a natural process in animals and vegetables beginning to putrefy. It is found on stable-walls and in privies. It is also extracted from vegetables, from dock-root, cochlearia, &c. M. Deyeux obtained it from the white of eggs. It has been also procured from horsedung.

The sulphur used in Great Britain is generally brought in a pure state from volcanic countries, where it abounds in an inexhaustible quantity. It is well known, however, that some of the metallic ores in this country abound with it; but from the common mode of purifying them, the sulphur is dissipated and lost. Dr Watson has shown, in a paper on lead-ore in the Philosophical Transactions, that not less than [illegible] tons are annually dissipated in the various lead-mines of England.

It is extracted from pyrites in the following manner in Saxony and Bohemia. The pyrites is put in small pieces into earthen tubes: one of the tubes is placed on a furnace, and the other passes into a square vessel of cast iron containing water. The sulphur is disunited by the heat from the pyrites, and passes into the vessel; but it is then very impure. It is afterwards melted in an iron ladle, when the earthy and metallic particles are deposited by their weight, and the sulphur being light rises to the top. It is then poured off into a copper boiler, where it is farther purified, and afterwards poured into cylindrical moulds of wood, from which it receives the shape in which it is usually sold.

When melted sulphur is gently heated, it flies off in a yellow powder, which is called *flowers of sulphur*. The operation is performed in this manner: Common sulphur in powder is put into an earthen cucurbit, to the top of which a number of earthen pots inserted in one another is fixed, known by the name of *aludels*. The cucurbit is then heated till the sulphur become liquid: it then rises and attaches itself to the sides of the aludels.

Sulphur combined with an alkali is called *hepar sulphuris*, *liver of sulphur*, because it resembles in colour the liver of animals. In the French nomenclature it is called *sulphure*, and by those British chemists who have adopted the new system *sulphuret*.

Water decomposes the sulphuret. The sulphur is precipitated by acids, when a particular gas is extricated commonly called *hepatic gas*, or, what is more expressive of its composition, *sulphurated hydrogenous gas*. The fetor of this gas is insufferable, and is fatal to animals. It communicates a green colour to syrup of violets, and burns with a light-blue flame. It acts on metals and metallic oxides, especially those of lead and bismuth, which it soon blackens. It is decomposed by vital air; and accordingly, when it comes into contact with atmospheric air, a portion of the sulphur is separated. For this reason sulphureous waters do not contain genuine liver of sulphur.

The mineral acids act differently on sulphur. If the sulphuric acid be boiled on sulphur, the acid acquires an amber colour, and a sulphureous smell; the sulphur melts and swims like oil. When cooled, it concretes into globules of a greenish hue; but a small portion of the sulphur is dissolved in the acid, which may be precipitated by an alkali. The flaming red nitrous acid acts powerfully on sulphur. When poured upon melted sulphur, it occasions detonation and inflammation. The common muriatic acid produces no effect upon it; but the oxygenated muriatic acid acts upon it with force.

Sulphur unites readily with all metallic substances, excepting gold, platina, and zinc; at least we have not found the means of uniting it with these directly, and without some intermediate substance. The degrees of affinity with which sulphur combines with those metals to which it may be readily united are different; for it not only unites more easily and abundantly with some than with others, but it also quits those with which it has a less affinity, to unite with others to which it has a stronger affinity.

The affinities of sulphur, according to Mr Geoffroy's table, are, fixed alkali, iron, copper, lead, silver, regulus of antimony, mercury, and gold; and, according to Mr Gellert's table, they are, iron, copper, tin, lead, silver, bismuth,

regulus

regulus of antimony, mercury, arsenic, and cobalt: gold and zinc are marked in this table as being incapable of uniting with sulphur.

The compounds formed by sulphur with different metals are different; but all of them possess a metallic lustre, without any ductility: these combinations of sulphur and of metals are very frequently found in a natural state. Almost all the metals which we dig from the earth are naturally found combined with sulphur, forming most of the ores and metallic minerals.

It is a curious phenomenon, that nitre mixed with sulphur burns rapidly, even in close vessels; this is easily explained by the new system. Nitre, when heat is applied to it, yields a great quantity of vital air; and sulphur is a combustible body, or, which is the same thing, has a strong attraction for vital air. As vital air is thus supplied, which is the only principle necessary to combustion, communication with the atmospheric air is unnecessary. The sulphur will burn till the whole vital air which the nitre furnishes be consumed. The products obtained by this process are different according to the proportions of nitre and sulphur which are employed. If eight parts of sulphur and one of nitre be set on fire in a close vessel, sulphuric acid is produced; and this is the method by which oil of vitriol or strong sulphuric acid was formerly made in Great Britain. The vessels in which the operation was performed were large glass balloons, with very large necks, each containing 400 or 500 pints. But it was attended with great expence, on account of the high price and brittleness of the balloons. A few years ago a cheaper method has been attempted with success in France. The sulphur is burned on a kind of grid-irons, in large apartments lined with lead. As the acid condenses it is conveyed by gutters into a reservoir, and afterwards concentrated. It must be observed, that the sulphuric acid thus obtained is always combined with a little sulphur and sulphat of pot ash, a small quantity of aluminous sulphat and sulphat of lead; but these substances are in so small a proportion, that for common use it is not necessary to separate them. If necessary, however, it may easily be done by distilling the acid to dryness.

Gunpowder, the terrible effects of which are owing to its strong tendency to combustion, is a mixture of sulphur, nitre, and charcoal. (See GUNPOWDER). But there is another mixture of which sulphur is an ingredient still more violent in its effects: This is called *fulminating powder*, and is composed of three parts of nitre, two parts of the carbonate of pot-ash, and one of powdered sulphur. These being closely united together by trituration in a hot marble mortar, when exposed to a slight degree of heat, will melt, and produce a violent detonation like the report of a cannon. A dram of this mixture is sufficient for the experiment.

Sulphur is of great use in chemistry, in medicine, and the arts. Sulphur is useful in making some fusions, precipitations, and separations of metals and minerals; but is particularly useful, as being the substance from which the sulphuric acid is obtained. Hepar sulphuris is employed in chemistry for making several solutions.

Sulphur is employed in medicine both internally and externally. It is given either in flowers or in lozenges, made up with sugar, or joined to magnesia, crystals of tartar, manna, cassia, lenitive electuary, &c. Two or three drams generally prove laxative; and it is given in such doses in cases of piles, of uterine, and other hœmorrhagies; because it does not stimulate nor heat during its operation, nor leave a disposition to costiveness, as rhubarb, aloes, and other hot resinous purges do. Sulphur was formerly much recommended in coughs and diseases of the breast, but of late its virtues as a pectoral have been much doubted. When applied externally, it is mixed with some unctuous substance, as hogs lard, butter, &c. and is rubbed on such parts of the body as are affected with eruptions.

Some physicians and chemists, considering that sulphur is insoluble in water, and capable of resisting the action of most menstruums, have affirmed, that it can produce no effect when taken internally, single and unaltered; but this assertion seems to be without foundation; for it is certain, that the sweat and perspiration of those who take sulphur internally have a smell evidently sulphureous. Besides, sulphur is much more soluble than is generally believed. It is attacked by all oily and saponaceous substances, and consequently by almost all animal liquors.

We cannot easily form a very distinct and clear idea of the manner in which sulphur acts internally upon our bodies; but, from observations made upon its effects, it appears to be dividing, stimulating, and somewhat heating: it principally acts upon the perspirable parts of the body, the chief of which are the skin and lungs; and from this property it is particularly useful in some diseases of these parts.

Sulphur is also a powerful repellent, as appears from its curing several kinds of itch, merely by external application, in form of ointments and pomatums. Several mineral waters, which are drunk or used as baths for some diseases, owe their good qualities to sulphur contained in them.

Sulphur is also used in several arts. By means of it fine impressions of engraved stones are taken. Matches are formed of it; and its utility as an ingredient in the preparation of gunpowder and fireworks is well known. Lastly, it is used for whitening wool, silk, and many other matters exposed to its vapour during its combustion; the colours and redness of which could not be destroyed by any other substance, but are quickly effaced by this acid vapour.

Sulphur-Wort, in botany. See PEUCEDANUM.

SULPHURIC-ACID, the name adopted by the French chemists for the vitriolic acid. It is formed by a combination of sulphur with vital air, as described under the article SULPHUR. When sulphur is burned with a low degree of heat, it burns with a blue flame, and diffuses a suffocating vapour, which, when collected, is called *sulphureous acid*. When sulphur is exposed to strong heat it burns rapidly, and emits a lively white flame, and has no smell; the residue is called *sulphuric acid*. The sulphureous is a weaker acid than the sulphuric, owing to its containing a less quantity of oxygene.

SULPICIA, an ancient Roman poetess, who lived under the reign of Domitian, and has been so much admired as to be termed the *Roman Sappho*. We have nothing, however, left of her writings but a satire, or rather the fragment of one, against Domitian, who published a decree for the banishment of philosophers from Rome: which satire is to be found in Scaliger's *Appendix Virgiliana*. She is mentioned by Martial and Sidonius Apollinaris; and is said to have addressed a poem on conjugal love to her husband Calenus, a Roman knight.

SULPICIUS (Severus), an ecclesiastical writer who flourished about the beginning of the 5th century, and was contemporary with Rufinus and St Jerome. He was the disciple of St Martin of Tours, whose life he has written; and the friend of Paulinus bishop of Nola, with whom he held an intimate correspondence. The principal of his works is his *Historia Sacra*, from the creation of the world to the consulate of Stilicho and Aurelian, about the year 400; in which his style is elegant beyond the age he lived in.

SULTAN, or SOLDAN, a title or appellation given to the emperor of the Turks.

Vattier will have the word Turkish, and to signify *king of*

Sulzer. *of kings*; adding, that it was first given to the Turkish princes Angrolipex and Mogrel, about the year 1055: others will have it originally Persian, alleging, in proof hereof, an ancient manual of Cosroe: others derive it from *soldanus, quasi solus dominus*: others from the Hebrew שלט *schalat* or *sholath*, "to rule, reign."

It had its rise under Mahmoud, son of Sebecteghin, the first emperor of the dynasty of the Gaznevides, towards the close of the fourth century of the era of the Hegira: when that prince going to Segestan to reduce Kalaf governor of that province, who affected the sovereignty, Kalaf was no sooner advertised of his coming than he went out to meet him, delivered the keys of his fortress, and owned him his *sultan*, that is, his lord or commander. The title pleased Mahmoud so well, that he assumed it ever afterwards; and from him it passed to his descendants, and to other Mahometan princes. It is chiefly confined to the Turkish and Persian monarchs.

SULZER (M.), a celebrated philosopher, was born at Winterthur, in the canton of Zurich, October 16. 1720. He was the youngest of 25 children. His early education did not promise much, tho' it was by no means neglected. He had little inclination for what is called in the schools the study of *humanity*, and made but a small progress in the learned languages, which were to prepare him for the study of theology, for which profession his parents designed him. At the age of 16, when he went to the academical school of Zurich, he had not the smallest notion of the sciences, or of elegant literature, and consequently no taste for study. The first incident that developed a hidden germ of philosophical genius, was his meeting with Wolfe's Metaphysics: this was the birth of his taste for science; but he wanted a guide. The clergyman with whom he lodged was an ignorant man; and the academical prelections were, as yet, above the reach of his comprehension. On the other hand, a sedentary life was not the thing he liked, nor to which he had been accustomed; and, moreover, a sociable turn of mind led him often into company, where he lost much time in frivolous amusements, yet without corrupting his morals. Who, that observed him at this period, says Mr Formey in his *Eulogium*, would have thought that Sulzer would one day be numbered among the most knowing and wise men of his time? The learned Gesner was the instrument of Providence that rendered Sulzer's inclination to study triumphant over his passion for amusement and company. Animated by the counsels and example of this worthy and learned man, he applied himself to philosophy and mathematics with great ardour, and resumed the pursuit of Grecian literature and the Oriental languages. The contemplation of nature became his noble and favourite passion. An ecclesiastical settlement in a rural scene, that exhibited happy objects and occasions for this delightful study, began to render his days happy and useful; and he published, in 1741, *Moral Contemplations of the Works of Nature*; and the year following an *Account* of a journey he had made through the Alps; which showed, at the same time, his knowledge of natural history, and the taste and sensibility with which he surveyed the beauties of nature, and the grandeur and goodness of its Author. He afterwards became private tutor to a young gentleman at Magdeburg. This procured him the acquaintance of Messrs Maupertuis, Euler, and Sack, which opened to his merit the path of preferment, and advanced him successively to the place of mathematical professor in the King's College at Berlin, in 1747, and to that of member of the Royal Academy in 1750.

In this last quality he distinguished himself in a very eminent manner, enriched the class of speculative philosophy with a great number of excellent memoirs, and was justly considered as one of the first rate metaphysicians in Germany. But his genius was not confined to this branch of science. His *Universal Theory of the Fine Arts* is a valuable production. A profound knowledge of the arts and sciences, and a perfect acquaintance with true taste, are eminently displayed in this work, and will secure to its author a permanent and distinguished rank in the republic of letters. The first volume of this excellent work was published in 1771, and the second in 1774. We shall not here give a catalogue of the writings of M. Sulzer; but we cannot help mentioning his *Remarks on the Philosophical Essays* of the late Mr Hume, as a work of real merit, which does justice to the acuteness, while it often detects the sophistry, of the British Bayle. The moral character of M. Sulzer was amiable and virtuous: sociability and beneficence were its characteristical lines; and his virtues were animated by that sacred philosophy that forms the Christian, ennobles man, and is the only source of that heart-felt serenity and sedate fortitude which support humanity, when every other object of confidence fails. His dying moments were calm, humble, and sublime; and when he expired, the placid and composed air of his countenance made his mourning friends doubt, for some time, whether it was death or sleep that had suspended his conversation. He had no enemy; and his friends were numerous, affectionate, and worthy of the tender returns he made them.

The king of Prussia distinguished him by repeated marks of munificence and favour. We learn, however, that his royal protector had never seen him before the end of the year 1777, though he had been member of the academy from the year 1750. The audience, indeed, though late vouchsafed, was honourable to M. Sulzer, with whom the monarch conversed for a long time with the greatest affability and condescension.

Sulzer, Sum.

SUM, signifies the quantity that arises from the addition of two or more magnitudes, numbers, or quantities together.

SUMACH, in botany. See RHUS.

SUMATRA, an island of Asia, the most western of the Sunda Islands, and constituting on that side the boundary of the Eastern Archipelago. Its general direction is nearly north-west and south-east. The equator divides it into almost equal parts, the one extremity being in 5. 33. N. and the other in 5. 56. S. Lat. Acheen Head, at the north extremity of the island, is in longitude 95. 34. east. It lies exposed on the south-west side to the Indian Ocean; the north point stretches into the bay of Bengal; to the north-east it is divided from the peninsula of Malacca by the straits of that name; to the east by the straits of Banca, from the island of that name; to the south-east by the commencement of what are called the *Chinese Seas*; and on the south by the straits of Sunda, which separate it from the island of Java. It is about 900 miles in length, but from 100 to 150 only in breadth. No account had been given of this island by any Englishman till the year 1778, when Mr Charles Miller (son of the late botanical gardener) published an account of the manners of a particular district, in the 68th volume of the Philosophical Transactions. These were the Battas, a people who live in the interior parts, called the *Cassia Country*. They differ from all the other inhabitants in language, manners, and customs. They eat the prisoners whom they take in war, and hang up their skulls as trophies in their houses. He observes, however, that human flesh is eaten by them *in terrorem*, and not as common food, though they prefer it to all others, and speak with peculiar raptures of the soles of the feet and palms of the hands. They expressed much surprise that the white people did not kill, much less eat, their prisoners. From this

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ra. this country the greatest part of the cassia that is sent to Europe is procured. It abounds also with the camphire trees, which constitute the common timber in use; and in these trees the camphire is found native, in a concrete form. It is remarkable, that in this state it is sold to the Chinese at the price of 250 l. or 300 l. *per* cwt. but these dexterous artists contrive to furnish the Europeans with it at about a quarter of that price. In 1783, Mr Marsden, who had been secretary to the president and council of Fort Marlborough, published a History of Sumatra, with very copious particulars of the island. He represents it as surpassed by few in the beautiful indulgences of nature. A chain of high mountains runs through its whole extent; the ranges in many parts being double and treble; their altitude, though great, is not sufficient to occasion their being covered with snow during any part of the year. Between these ridges are extensive plains, considerably elevated above the surface of the maritime lands. In these the air is cool; and from this advantage they are esteemed the most eligible portion of the country, are the best inhabited, and the most cleared from woods, which elsewhere, in general, throughout Sumatra, cover both hills and valleys with an eternal shade. Here too are found many large and beautiful lakes, that facilitate much the communication between the different parts. The heat of the air is far from being so intense as might be expected from a country occupying the middle of the Torrid Zone; and it is more temperate than many regions within the Tropics; the thermometer at the most sultry hour, about two in the afternoon, generally fluctuating between 82 and 85 degrees. Mr Marsden divides the inhabitants into Malays, Achenese, Battas, Lampoons, and Rejangs; and he takes the latter as his standard of description, with respect to the persons, manners, and customs, of the inhabitants. They are rather below the middle stature; their bulk in proportion; their limbs for the most part slight, but well shaped, and particularly small at the wrists and ancles; and, upon the whole, they are gracefully formed. Their hair is strong, and of a shining black. The men are beardless, great pains being taken to render them so when boys, by rubbing their chins with a kind of quicklime. Their complexion is properly yellow, wanting the red tinge that constitutes a copper or tawny colour. They are in general lighter than the Mestees, or half breed, of the rest of India; those of the superior class, who are not exposed to the rays of the sun, and particularly their women of rank, approaching to a degree of fairness. If beauty consisted in this one quality, some of them would surpass our brunettes in Europe. The major part of the females are ugly, many of them even to disgust; yet among them are some whose appearance is strikingly beautiful, whatever composition of person, features, and complexion, that sentiment may be the result of. Some of the inhabitants of the hilly parts are observed to have the swelled neck or goitre; but they attempt no remedy for it, as these wens are consistent with the highest health. The rites of marriage among the Sumatrans consist simply in joining the hands of the parties, and pronouncing them man and wife without much ceremony, excepting the entertainment which is given upon the occasion by the father of the girl. The customs of the Sumatrans permit their having as many wives as they can purchase, or afford to maintain; but it is extremely rare that an instance occurs of their having more than one, and that only among a few of the chiefs. This continence they owe, in some measure, to their poverty. The dictates of frugality are more powerful with them than the irregular calls of appetite, and make them decline an indulgence from which their law does not restrain them. Mothers carry their children, not on the arm as our nurses do, but straddling on the hip, and usually supported by a cloth which ties in a knot on the opposite shoulder. The children are nursed but little; are not confined by any swathing or bandages; and being suffered to roll about the floor, soon learn to walk and shift for themselves. When cradles are used, they swing suspended from the ceilings of the rooms. Sumatra.

The Sumatrans are so fond of cock-fighting, that a father on his death-bed has been known to desire his son to take the first opportunity of matching a cock for a sum equal to his whole property, under a blind conviction of its being invulnerable. When a cock is killed, or runs, the other must have sufficient spirit and vigour left to peck at him three times on his being held up to him for that purpose, or it becomes a drawn battle; and sometimes an experienced cocker will place the head of his vanquished bird in such an uncouth situation as to terrify the other, and render him unable to give this proof of victory.

The wild beasts of Sumatra are tigers, elephants, rhinoceroses, bears, and monkeys. The tigers prove to the inhabitants both in their journeys and even their domestic occupations most destructive enemies. The number of people annually slain by these rapacious tyrants of the woods is almost incredible. Whole villages have been depopulated by them; yet from a superstitious prejudice it is with difficulty they are prevailed upon, by a large reward which the India Company offers, to use methods of destroying them, till they have sustained some particular injury in their own family or kindred. The size and strength of the species which prevails on this island is prodigious. They are said to break with a stroke of their fore paw the leg of a horse or a buffalo; and the largest prey they kill is without difficulty dragged by them into the woods. This they usually perform on the second night, being supposed on the first to gratify themselves with sucking the blood only. Time is by this delay afforded to prepare for their destruction, either by shooting them, or placing a vessel of water strongly impregnated with arsenic near the carcase, which is fastened to a tree to prevent its being carried off. The tiger having satiated himself with the flesh, is prompted to assuage his thirst with the tempting liquor at hand, and perishes in the indulgence. Their chief subsistence is most probably the unfortunate monkeys with which the woods abound. They are described as alluring them to their fate by a fascinating power, similar to what has been supposed of the snake; and, says Mr Marsden, "I am not incredulous enough to treat the idea with contempt, having myself observed, that when an alligator or a crocodile, in a river, comes under an overhanging branch of a tree, the monkeys, in a state of alarm and distraction, crowd to the extremity, and, chattering and trembling, approach nearer and nearer to the amphibious monster that waits to devour them as they drop, which their fright and number render almost unavoidable." These alligators likewise occasion the loss of many inhabitants, frequently destroying the people as they bathe in the river, according to their regular custom, and which the perpetual evidence of the risk attending it cannot deter them from. A superstitious idea of their sanctity also preserves them from molestation, although, with a hook of sufficient strength, they may be taken without much difficulty. The other animals of Sumatra are buffaloes, a small kind of horses, goats, hogs, deer, bullocks, and hog-deer. This last is an animal somewhat larger than a rabbit, the head resembling that of a hog, and its shanks and feet like those of the deer. The bezoar-stone found on this animal has been valued at 10 times its weight in gold; it is of a dark brown colour, smooth on the outside; and the coat being taken off, it appears still darker, with strings running underneath the coat; it will swim on the top of the water. If it be infu-

Sumatra.

fed in any liquid, it makes it extremely bitter: the virtues usually attributed to this stone are clearing the stomach, creating an appetite, and sweetening the blood.

Of birds they have a greater variety than of beasts. The coo-ow, or Sumatran pheasant, is a bird of uncommon beauty. They have storks of prodigious size, parrots, dung-hill fowls, ducks, the largest cocks in the world, wood-pigeons, doves, and a great variety of small birds, different from ours, and distinguished by the beauty of their colours. Of their reptiles, they have lizards, flying-lizards, and cameleons. The island swarms with insects, and their varieties are no less extraordinary than their numbers. Rice is the only grain that grows in the country; they have sugar-canes, beans, peas, radishes, yams, potatoes, pumkins, and several kinds of pot-herbs unknown to Europe: and here are to be found most of the fruits to be met with in other parts of the East Indies, in the greatest perfection. Indigo, Brasil-wood, two species of the bread-fruit tree, pepper, benjamin, coffee, and cotton, are likewise the produce of this island, as well as cassia and camphire mentioned above. Here also is the cabbage-tree and silk cotton tree; and the forest contains a great variety of valuable species of wood, as ebony, pine, sandal, eagle or aloes, teck, manchineel, and iron-wood, and also the banyan tree. Gold, tin, iron, copper, and lead, are found in the country; and the former is supposed to be as plentiful here as in Peru or Mexico. The finest gold and gold-dust are found in the country of *Limong*, immediately contiguous to the presidency of *Fort Marlborough*, to which the merchants repair annually for the purchase of opium, and such other articles as they may be in want off, and give for them gold of so pure a nature as to contain little or no alloy. The native indolence of the *Malay* disposition prevents them from collecting more than is sufficient to supply the few and simple wants of a race of men as yet unenlightened by civilization and science, and ignorant of the full extent of the advantages of the country inhabited by them. The roads leading to this golden country are almost impervious; affording only a scanty path to a single traveller, where whole nights must be passed in the open air, exposed to the malignant influence of a hostile climate, in a country infested by the most ferocious wild beasts. These are circumstances that have hitherto checked curiosity; but perseverance and studied precaution will surmount the obstacles they furnish, and such discoveries might be made as would amply compensate for the difficulties leading to them. The gold merchants who come from the neighbouring and less rich countries, give us such accounts of the facility of procuring gold as border nearly on the marvellous, and would be altogether incredible, if great quantities of that metal produced by them did not in some degree evince the certainty of their accounts.

Asiat. Researches, vol. i.

This great abundance of gold in Sumatra induces Mr Marsden to suppose that island to be the Ophir of Solomon; a conjecture which, in his opinion, derives no small force from the word *Ophir*, being really a *Malay* substantive, of a compound sense, signifying a mountain containing gold. The natives, he confesses, have no oral tradition on the subject; and we have elsewhere made it probable, that Ophir was situated in a different quarter of the world (see OPHIR). Besides the metals and different species of wood which we have mentioned Sumatra produces sulphur, arsenic, salt-petre, and bees-wax, with edible birds-nests, which are there commodities of great importance (see *Birds-Nests*.)

The English and Dutch have factories on this island; the principal one of the former being Fort Marlborough, on the south west coast. The original natives of Sumatra are Pagans; but it is to be observed, that when the Sumatrans, or any of the natives of the eastern islands, learn to read the Arabic character, and submit to circumcision, they are said to become Maleys; the term *Malay* being understood to mean *Mussulman*. See ACHEEN.

Summary | Sumpter.

SUMMARY, in matters of literature. See ABRIDGEMENT.

SUMMER, the name of one of the seasons of the year, being one of the quarters when the year is divided into four quarters, or one half when the year is divided only into two, summer and winter. In the former case, summer is the quarter during which, in northern climates, the sun is passing through the three signs Cancer, Leo, Virgo, or from the time of the greatest declination, till the sun come to the equinoctial again, or have no declination: which is from about the 21st of June till about the 22d of September. In the latter case, summer contains the six warmer months, while the sun is on one side of the equinoctial; and winter the other six months, when the sun is on the other side of it. It is said that a frosty winter produces a dry summer, and a mild winter a wet summer.

Summer-Islands. See BERMUDAS.

Summer Red-Bird. See MUSCICAPA.

SUMMIT, the top or vertex of any body or figure, as of a triangle, cone, pyramid, &c.

SUMMONS, in law, a citing or calling a person to any court, to answer a complaint or to give his evidence.

SUMMONS, in war. To summon a place, is to send a drum or trumpet to command the governor to surrender, and to declare that if the place be taken by storm, all must submit to the mercy of the conqueror. See CAPITULATION and CHAMADE.

SUMMUM BONUM, in ethics, the chief good.

SUMP, in metallurgy, a round pit of stone, lined with clay within, for the receiving the metal on its first fusion from the ore.

SUMP, in the British salt works, where sea-water is boiled into salt, is the name of a sort of pond, which is made at some distance from the saltern on the sea shore, between full sea and low water mark. From this pond a pipe is laid, through which, when the sea is in, the water runs into a well adjoining to the saltern; and from this well it is pumped into troughs, through which it is carried to the cisterns, in order to be ready to supply the pans. See SALT.

SUMPH, in mining, denotes a pit sunk down in the bottom of the mine, to cut or prove the lode still deeper than before; and in order to slope and dig it away if necessary, and also to drive on the lode in depth. The sumph principally serves as a bason or reservoir, to collect the water of a mine together, that it may be cleaned out by an engine or machine.

SUMPTER-HORSE, is a horse that carries provisions and necessaries for a journey.

SUMPTUARY LAWS (*Leges Sumptuariæ*), are laws made to restrain excess in apparel, costly furniture, eating, &c.

Most ages and nations have had their sumptuary laws; and some retain them still, as the Venetians, &c. But it is observed, that no laws are worse executed than sumptuary laws. Political writers have been much divided in opinion with respect to the utility of these laws to a state. Montesquieu observes, that luxury is necessary in monarchies, as in France, but ruinous to democracies, as in Holland. With regard to England, whose government is compounded of both species, it may still be a dubious question, says judge Blackstone, how far private luxury is a public evil; and as such cognizable by public laws.

The sumptuary laws of that ancient Locrian legislator Zaleucus are famous: by these it was ordained, that no woman should go attended with more than one maid in the

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the ftreet except fhe were drunk: that fhe fhould not go out of the city in the night, unlefs fhe went to commit fornication: that fhe fhould not wear any gold or embroidered apparel, unlefs fhe propofed to be a common ftrumpet; and that men fhould not wear rings or tiffues except when they went a whoring, &c.

Among the Romans, the fumptuary laws were very numerous: By the *Lex Orchia*, the number of guefts at feafts was limited, though without any limitation of the charges: by the Fannian law, made 22 years afterwards, it was enacted, that more than 10 *affes* fhould not be fpent at any ordinary feaft: for the folemn feafts, as the Saturnalia, &c. an hundred affes were allowed; ten of which, Gellius informs us, was the price of a fheep, and a hundred of an ox. By the Didian law, which was preferred 18 years after, it was decreed, that the former fumptuary laws fhould be in force, not only in Rome, but throughout all Italy; and that for every tranfgreffion, not only the mafter of the feaft, but all the guefts too, fhould be liable to the penalty.

The Englifh have had their fhare of fumptuary laws, chiefly made in the reigns of Edw. III. Edw. IV. and Henry VIII. againft fhoes with long points, fhort doublets, and long coats; though all repealed by ftatute 1 Jac. I. c. 25. As to excefs in diet, there remains ftill one law unrepealed. Under King Henry IV. Camden tells us, pride was got fo much into the foot, that it was proclaimed, that no man fhould wear fhoes above fix inches broad at the toes. And their other garments were fo fhort, that it was enacted, 25 Edw. IV. that no perfon, under the condition of a lord, fhould, from that time, wear any mantle or gown, unlefs of fuch length, that, ftanding upright, it might cover his privy members and buttocks.

SUN, Sol, ☉, in aftronomy, the great luminary which enlightens the world, and by its prefence conftitutes day. See Astronomy-*Index*.

Mock-Sun. See Parhelion.

Sun-Fifh of the Irifh. See Squalus.

Sun-Flower, in botany. See Helianthus.

Sun-Dew, in botany. See Drosera.

SUNDA-islands, a general name for a clufter of iflands in the India Ocean, between 93° and 120° of eaft longitude, and between 8° north and 8° fouth latitude. The particular names of the iflands are *Borneo*, *Sumatra*, *Java*, *Bally*, *Banca*, &c.

SUNDAY, or the Lord's-day, a folemn feftival obferved by Chriftians on the firft day of every week, in memory of our Saviour's refurrection. See Sabbath.

In the breviary and other offices we meet with Sundays of the firft and fecond clafs. Thofe of the firft clafs are, Palm, Eafter, Advent, and Whitfunday, thofe of *Quafimodo* and *Quadragefima*. Thofe of the fecond clafs are the common Sundays. Anciently each Sunday in the year had its particular name, which was taken from the introit of the day; which cuftom has only been continued to fome few in lent; as *Reminifcere*, *Oculi*, *Lætare*, *Judica*.

Some are of opinion that the Lord's-day, mentioned in the Apocalypfe, is our Sunday; which they believe was fo early inftituted by the apoftles. Be this as it will, it is certain a regard was had to this day even in the earlieft ages of the church; as appears from the firft apology of Juftin Martyr, where he defcribes the exercife of the day not much unlike to ours.

But it was Conftantine the Great who firft made a law for the proper obfervation of Sunday; and who, according to Eufebius, appointed it fhould be regularly celebrated throughout the Roman empire. Before him, and even in his time, they obferved the Jewifh Sabbath as well as Sunday; both to fatisfy the law of Mofes and to imitate the apoftles, who ufed to meet together on the firft day.

By Conftantine's laws, made in 321, it was decreed, that for the future the Sunday fhould be kept a day of reft in all cities and towns; but he allowed the country people to follow their work. In 538, the council of Orleans prohibited country labour; but becaufe there were ftill many Jews in Gaul, and the people fell into many fuperftitious ufages in the celebration of the new Sabbath, like thofe of the Jews among that of the old, the council declares, that to hold it unlawful to travel with horfes, cattle, and carriages, to prepare food, or to do any thing neceffary to the cleanlinefs and decency of houfes or perfons, favours more of Judaifm than of Chriftianity. See Sabbath-*Breaking*.

Sunday-Schools. See *Sunday*-Schools.

SUOVETAURILIA, an ancient Roman facrifice, fo called becaufe it confifted of a pig (*fus*), a fheep or rather ram (*ovis*), and a bull (*taurus*). They were all males, to denote the mafculine courage of the Roman people. It was likewife called *folitaurilia*, becaufe the animals offered up were always *folida*, whole or uncut.

SUPERCARGO, a perfon employed by merchants to go a voyage, and overfee their cargo or lading, and difpofe of it to the beft advantage.

SUPERCILIUM, in anatomy, the eye-brow. See Anatomy, n° 142.

SUPEREROGATION, in theology, what a man does beyond his duty, or more than he is commanded to do. The Romanifts ftand up ftrenuoufly for works of fupererogation, and maintain that the obfervance of evangelical councils is fuch. By means hereof, a ftock of merit is laid up, which the church has the difpofal of, and which fhe diftributes in indulgences to fuch as need.

This abfurd doctrine was firft invented towards the clofe of the 12th century, and modified and embellifhed by St Thomas in the 13th: according to which, it was pretended that there actually exifted an immenfe treafure of merit, compofed of the pious deeds and virtuous actions which the faints had performed beyond what was neceffary for their own falvation, and which were therefore applicable to the benefit of others; that the guardian and difpenfer of this precious treafure was the Roman pontiff; and that of confequence he was empowered to affign to fuch as he thought proper a portion of this inexhauftible fource of merit, fuitable to their refpective guilt, and fufficient to deliver them from the punifhment due to their crimes

The reformed church do not allow of any work of fupererogation; but hold with the apoftles, that when we have done our beft, we are but unprofitable fervants.

SUPERFETATION, in medicine, a fecond or after-conception, happening when the mother, already pregnant, conceives of a latter coition; fo that fhe bears at once two fœtufes of unequal age and bulk, and is delivered of them at different times. We meet with inftances of fuperfetations in Hippocrates, Ariftotle, Du Laurens, &c.: but they are faid to be much more frequent in hares and fwine.

SUPERFICIES, or Surface, in geometry, the outfide or exterior face of any body. This is confidered as having the two dimenfions of length and breadth only [illegible] no thicknefs; and therefore it makes no part of the fubftance or folid content or matter of the body.

The terms, or bounds, or extremities, of a fuperficies, are lines; and fuperficies may be confidered as generated by the motions of lines. Superficies are either rectilinear, curvilinear, plane, concave, or convex. A rectilinear fuperficies is that which is bounded by right lines. Curvilinear fuperficies

Superficies ‖ Superstition.

cies is bounded by curve lines. Plane superficies is that which has no inequality in it, nor risings, nor sinkings, but lies evenly and straight throughout, so that a right line may wholly coincide with it in all parts and directions. Convex superficies is that which is curved and rises outwards. Concave superficies is curved and sinks inward. See GEOMETRY.

SUPERFINE, in the manufactories, a term used to express the superlative fineness of a stuff: thus a cloth, a camblet, &c. are said to be superfine when made of the finest wool, &c. or when they are the finest that can be made.

SUPERFLUOUS INTERVAL, in music, is one that exceeds a true diatonic interval by a semitone minor. See INTERVAL.

SUPERINTENDANT, denotes an ecclesiastical superior in several reformed churches where episcopacy is not admitted: particularly among the Lutherans in Germany, and the Calvinists in some other places.

The superintendant is similar to a bishop; only his power is somewhat more restrained than that of our diocesan bishops. He is the chief pastor, and has the direction of all the inferior pastors within his district or diocese. In Germany they had formerly superintendants general, who were superior to the ordinary superintendants. These, in reality, were archbishops; but the dignity is sunk into disuse; and at present none but the superintendant of Wirtemberg assumes the quality of superintendant general.

SUPERIOR, a person raised above another in rank, office, or talents

SUPERIOR, in Scots law. See LAW, N° clxiv. 3. clxv. 2. & clxvi.

SUPERLATIVE, in grammar, one of the three degrees of comparison, being that inflection of adjective nouns that serves to augment and heighten their signification, and shows the quality of the thing denoted to be in the highest degree. See GRAMMAR.

SUPERNUMERARY, something over and above a fixed number. In several of the offices are supernumerary clerks, to be ready on extraordinary occasions.

SUPERPARTICULAR PROPORTION, or *Ratio*, is that in which the greater term exceeds the less by unit or 1. As the ratio of 1 to 2, or 2 to 3, or 3 to 4, &c.

SUPERPARTIENT PROPORTION, or *Ratio*, is when the greater term contains the less term once, and leaves some number greater than 1 remaining. As the ratio

of 3 to 5, which is equal to that of 1 to $1\frac{2}{3}$;
of 7 to 12, which is equal to that of 1 to $1\frac{5}{7}$, &c.

SUPERSEDEAS, in law, a writ issued in divers cases, importing in general a command to stay or forbear some ordinary proceedings in law, which in appearance ought to be done or pursued, were it not for the cause whereon this writ is granted.

Thus a man regularly is to have a surety of peace against him of whom he will swear he is afraid; and the justice required hereunto cannot deny it him: yet, if the party be formerly bound to the peace, either in chancery or elsewhere, this writ lies to stay the justice from doing that which otherwise he ought not to deny.

SUPERSTITION, a word that has been used so indefinitely, that it is difficult to determine its precise meaning. From its resemblance in sound to the Latin word *superstes*, "a survivor," it is evidently derived from it, and different attempts have been made to trace their connection in signification. Balbus, in the dialogue *De Natura Deorum* of Cicero, says, that they who prayed and sacrificed whole days that their children might *survive* them, were called superstitious. Lactantius censures this etymology, and says they were not called superstitious who wished that their children might survive them (for this we all wish), but because they who survived their parents worshipped their images. Others again say, that superstition is derived from *superstes*, because it consisted in considering the dead as if they were alive. But these etymologies are solely conjectural; and we consider conjectures as absurd in philology as we do in science; they may mislead, but are seldom of any benefit. The usual meaning affixed to the word *superstition*, both in the Latin and English languages, is so different from *superstes*, that its change of meaning must be owing to some accident which it is in vain to inquire after. If we had not known that the word *paganus* "a pagan" was derived from *pagus* "a village," because the heathens in a certain period of the Christian history lived in villages, the whims and fancies of etymologists would not have thrown much light on the subject.

Without labouring, from the aid of etymology, to define superstition, which is a word of a very extensive signification, we will consider to what objects it is applied; and then, by observing what is common to them all, we shall be enabled to fix with some degree of precision the meaning of the term. We apply it to the idolatry of the heathens; we apply it also to the Jews, who made the will of God of no effect by their traditions, and substituted ceremonies in place of the religion of their fathers. We say also that Christians are guilty of superstition; the Roman Catholics, who believe in transubstantiation and in the efficacy of prayers to saints; and those Protestants who esteem baptism and the Lord's supper, and the punctual performance of other ceremonies, without regard to morality, as sufficient to ensure salvation. Those persons also are reckoned superstitious who believe, without any evidence, that prophecies are still uttered by the divine inspiration, and that miracles are still performed. The word is also extended to those who believe in witchcraft, magic, and apparitions, or that the divine will is declared by omens or augury; that the fortune of individuals can be affected by things indifferent, by things deemed lucky or unlucky, or that diseases can be cured by words, charms, and incantations.

Through all the particulars which we have enumerated, there runs one general idea, the belief of what is false and contrary to reason. From this, however, we must not suppose that whatever is false and contrary to reason may be denominated superstition. We think that it is false and irrational to suppose that there ever lived on earth a race of men who walked on one leg, and had their eyes in their breast; or that there were giants 90 feet high: yet we do not call the philosopher who believes these chimeras superstitious, but credulous. Superstition has always a reference to God, to religion, or to beings superior to man. We do not however distinguish all false and irrational opinions in religion by the name of superstition. We do not, for instance, apply this name to the opinions which some of the ancients entertained, that God is the soul of the world, and that men are only portions of him separated for a time, or that the soul after death lives successively in different bodies. If we examine the subject with more attention, we shall discover that the foundation of superstition is ignorance of the moral attributes of God; for we never say a man is superstitious for entertaining erroneous opinions of the natural attributes of God. Some of the Socinians have denied the prescience of God; and a French philosopher has not only rejected the belief that He is a spirit, but has presumed to say that he is composed of a species of crystals. The first of these opinions discovers very imperfect ideas of God, and the second is the height of impiety and absurdity; yet the

Socinians have not been accuſed of ſuperſtition, nor can this French philoſopher be ſuſpected of it. We do not call every falſe opinion concerning the unity or moral attributes of God by the name of ſuperſtition, as, for inſtance, the opinion which ſome ſceptics have ſupported, that God is not good; for, as was mentioned before, ſuperſtition always involves the idea of credulity. It does not conſiſt in falſely denying that God poſſeſſes any particular moral attributes, but in believing more than what is true concerning them; in forming mean, unworthy ideas of them; in ſuppoſing that he is guided by blind paſſion like mankind, and enjoins upon his creatures commandments which are irrational and abſurd.

As ſuperſtition ariſes from ignorance and credulity in the underſtanding, ſo it has alſo a ſeat in the paſſions. Fear has been commonly conſidered as the paſſion of the human mind from which it chiefly derives its origin; and there is no doubt that more ſuperſtition has ariſen from fear united with ignorance and credulity than from any other paſſion. Yet it would certainly be improper to exclude all other paſſions. We cannot account for the ſuperſtition of the Egyptians, without ſuppoſing that much of it aroſe from gratitude. They worſhipped the Nile, becauſe it diſtributed fertility and abundance over the land of Egypt; and they worſhipped ſome animals, merely becauſe they prevented the increaſe of other animals which were noxious. Thus they adored the ibis, becauſe it deſtroyed the eggs of the crocodile.

Having thus endeavoured to analyze the ideas comprehended under the word ſuperſtition, we may ſum them up in a few words. It reſpects God and beings ſuperior to man, and extends to our religious opinions, worſhip, and practices; and may be defined *abſurd opinions and actions ariſing from mean and defective ideas of the moral attributes of God.* Let us apply this definition to the different ſpecies of ſuperſtition already mentioned.

But before entering upon this application, it may be proper to obſerve, that ſuperſtition involves the idea of a blameable inattention to reaſon, or a credulity ariſing from an indolence of underſtanding. We generally make a diſtinction between the imperfect opinions which a ſavage, from the neceſſary effects of his ſituation, forms of the attributes of God, and thoſe which civilized nations entertain. We ſay the ſavage is ignorant, and we aſcribe his ignorance to his ſituation; but we call the Roman Catholic ſuperſtitious, and we blame him for not having thoſe juſt ideas of God which he might have obtained by opening his Bible, or by the exerciſe of his underſtanding in the favourable ſituation in which he is placed. Superſtition then does not originate ſo much from the natural weakneſs of the human underſtanding, as from a miſapplication or a neglect of it (A).

We cannot therefore with any propriety apply the name *ſuperſtition* to polytheiſm in general; for what all the ancient philoſophers, after much ſtudy and reflection, concluded to be true, could never proceed from credulity and inattention, but from their ſituation. We ſpeak very properly, however, when we call idolatry by the name of ſuperſtition; becauſe there is no man ſo devoid of underſtanding as not to be capable of diſcovering, that a piece of metal, or wood, or ſtone, can neither hear nor anſwer petitions. *Superſtition* was a name which the ancient philoſophers gave to thoſe who entertained mean opinions of the gods, or did fooliſh things to obtain their favour. According to Theophraſtus, the ſuperſtitious man is one who, having waſhed his hands, and ſprinkled himſelf all round, leaves the temple with a laurel leaf in his mouth, with which he walks about the whole day. Or, if a weaſel ſhould croſs the road, he will not advance a ſtep till he has thrown three ſtones over the road. If he finds a ſerpent in his houſe, he rears a place of devotion on the ſpot. He purifies his houſe often, will not ſit upon a grave, nor touch a dead perſon. He is anxious about the interpretation of his dreams, will not offer a ſacrifice unleſs his wife go along with him, or, if ſhe is engaged, he takes the nurſe and the little children. He purifies himſelf with onions; and when he ſees a mad or an epileptic perſon, he ſpits in their boſom. Such was the character of ſuperſtition in the days of Theophraſtus. All theſe whimſical ceremonies were done to prevent miſchief, and to avert the wrath of the gods; and therefore perfectly correſpond with the definition given above.

It is only neceſſary to conſider a little the ſuperſtitious opinions and practices among Jews and Chriſtians, to be ſenſible that they have all ariſen from mean and abſurd ideas of the moral attributes of God; for they have generally entertained noble opinions of his natural attributes. The Jews conſidered God as a partial Being, who had a predilection for their nation in preference to all others, and preferred external homage and ceremony to moral purity. If the Roman Catholics think conſiſtently, they muſt eſteem God as a Being who can be prevailed upon by the importunity of one dead man to aſſiſt another, or as a Being whoſe patience would be fatigued with hearing prayers conſtantly. Hence their practice of praying to ſaints. They in effect believe, however they may deceive themſelves, that God is unjuſt, or they could not believe tranſubſtantiation; for it ſuppoſes that God can give commands directly contrary to thoſe principles of belief with which he has endued the human mind. They conſider a ſtrict adherence to a variety of ceremonies, to forms, to pomp, and ſhow, as eſſential to the worſhip of God: this is treating God as a vainglorious Being. They thought it their duty to extirpate heretics: this was ſuppoſing God a cruel and revengeful Being. Even among Proteſtants, we are ſorry to ſay, a great deal of ſuperſtition remains: we have not yet learned to conſider God as a ſpirit, who is to be worſhiped in ſpirit and in truth, as a pure moral benevolent Being; and hence ariſes all the ſuperſtitious practices which prevail among us.

Beſides thoſe ſuperſtitious opinions and practices which entirely reſpect our duty to God, there are others which may be termed *vulgar ſuperſtitions.* Theſe alſo ariſe from imperfect and mean ideas of the moral attributes of God. To believe vulgar prophecies, which are always the effuſions of madneſs or knavery, is to ſuppoſe that God, who has drawn a veil over futurity, and only delivers prophecies, to accompliſh ſome great moral purpoſe, ſometimes gives them for no purpoſe at all, or to gratify idle curioſity, or to diſcloſe ſuch a knowledge of what is to happen as is inconſiſtent with the free agency of man and the moral adminiſtration of the world. Nor is it leſs ſuperſtitious to believe in vulgar miracles. To believe in them, is to believe that God ſuſpends the laws of nature for the moſt trivial purpoſes, or to countenance fraud and worldly ambition: it is to receive the moſt extraordinary facts upon the moſt unſatisfactory evidence. The belief of witchcraft, of apparitions, and the ſecond ſight, may be reſolved into the ſame principle. To ſuppoſe that God would communicate the power of doing miſchief, and of controuling his laws, to any being merely for gratifying their own paſſions, is unworthy of God. The belief of apparitions is equally inconſiſtent with the goodneſs of God (ſee SPECTRE). The ſame objection riſes againſt the ſecond ſight as againſt the belief of vulgar prophecies, and may alſo be extended to omens, to aſtrology, to things lucky and unlucky, to fortune-telling, &c. As to the different devices and charms for preventing and curing diſorders, they reſemble in every reſpect falſe miracles.

(A) We do not pretend to ſay that this is the ſenſe in which ſuperſtition is always uſed, becauſe it is often uſed improperly.

Superſtition.

A judicious hiſtory of ſuperſtition would be a curious and entertaining work, and would exhibit the human character in a remarkable point of view. Superſtition is moſt prevalent among men of weak and uncultivated minds; it is more frequent in the female ſex than among men; and abounds more in the rude than in the refined ſtages of ſociety. The general features of it have been the ſame in all ages; but it aſſumes certain peculiarities according to the diverſity of character of different nations. It gained admiſſion into the ſcience of medicine at an early period. He who was endowed with ſuperior genius and knowledge was reckoned a magician. D. Bartolo was ſeized by the inquiſition at Rome in the laſt century, becauſe he unexpectedly cured a nobleman of the gout. Diſeaſes were imputed to faſcination, and hundreds of poor wretches were dragged to the ſtake for being acceſſary to them. Mercatus, phyſician to Philip II. of Spain, a writer of uncommon accuracy and invention, appears ſtrongly inclined to deny the exiſtence of faſcinatory diſeaſes: but he is conſtrained to acknowledge them for two reaſons; *firſt*, becauſe the inquiſition had decided in favour of their reality; *secondly*, becauſe he had ſeen a very beautiful woman break a ſteel mirror to pieces, and blaſt ſome trees by a ſingle glance of her eyes.

Mancheſter Tranſactions, vol. ii.

As the opinions concerning the cauſe of diſeaſes were ſuperſtitious, thoſe concerning the method of curing them were not leſs ſo. In the Odyſſey we read of a cure performed by a ſong. Joſephus relates, that he ſaw a certain Jew, named *Eleazar*, draw the devil out of an old woman's noſtrils by the application of Solomon's ſeal to her noſe in preſence of the Emperor Veſpaſian. Many different kinds of applications were uſed for expelling the devil. Flagellation ſometimes ſucceeded admirably; purgatives and antiſpaſmodics were other modes of diſcharging him. Dr Mynſight cured ſeveral bewitched perſons with a plaſter of aſſafœtida. How the aſſafœtida was ſo efficacious, was much diſputed. Some thought the devil might conſider ſo vile an application as an inſult, and run off in a paſſion; but others very ſagely obſerved, that as devils are ſuppoſed to have eyes and ears, it is probable they may have noſes too.

Nor was it only in medicine theſe ſuperſtitious opinions were entertained; they prevailed alſo in natural philoſophy. The pernicious effects in mines, which we now know are occaſioned by noxious air, were confidently imputed to the demons of the mine. Even Van Helmont, Bodinus, Strozza, and Luther, attributed thunder and meteors to the devil. Chemiſts were employed for centuries in ſearch of the philoſopher's ſtone, with which they were to do miracles. It was a common queſtion among philoſophers in the laſt century, whether the imagination could move external objects? A queſtion generally decided in the affirmative.

Though ſuperſtition be generally the mark of a weak mind, ſuch is the infirmity of human nature, that we find many inſtances of it among men of the moſt ſublime genius and moſt enlightened minds. Socrates believed that he was guided by a demon. Lord Bacon believed in witchcraft; and relates that he was cured of warts by rubbing them with a piece of lard with the ſkin on, and then nailing it with the fat towards the ſun on the poſt of a chamber window facing the ſun. Henry IV. one of the moſt illuſtrious of monarchs, was very uneaſy before his aſſaſſination on account of ſome prophecies*. Sully declares, that one of the conſiderations that kept him faithful to his maſter in the moſt unpromiſing ſtate of his affairs, was a prediction of La Broſſe, that Henry would make his fortune†. The aſtrologer Morin directed Cardinal Richelieu's motions in ſome of his journeys‡. The enlightened Cudworth defended prophecies in general, and called thoſe who oppoſed the belief of witchcraft by the name of *atheiſts*; and the predictions of Rice Evans have been ſupported in the preſent century by the celebrated names of *Warburton* and *Jortin*. Dr Hoffman, the father of the Modern Theory and Practice of Medicine, in a diſſertation publiſhed in the large edition of his works in 1747, ſays, that the devil can raiſe ſtorms, produce inſects, and act upon the animal ſpirits and imagination; and, in fine, that he is an *excellent optician and natural philoſopher* on account of his long experience. Dr Johnſon, the leviathan of literature, is ſuppoſed to have believed the ſecond ſight.

* Memoirs of Sully.

† Ibid.

‡ Bayle, Art. Morin.

With reſpect to the effects of ſuperſtition on the human mind, they are indeed deplorable. It chains down the underſtanding, and ſinks it into the moſt abject and ſordid ſtate, and keeps it under the dominion of fear, and ſometimes of cruelty. Where once it takes poſſeſſion, it has a tendency to become extreme, and generally becomes ſo intolerable, that men of reflection and learning conſpire its deſtruction. The Chriſtian religion gave a violent ſhock to the heathen ſuperſtition; the reformation in a great meaſure demoliſhed the ſuperſtition of the church of Rome; and the ſuperſtition which remained among Proteſtants after their ſeparation from that church has been gradually yielding to the influence of enlightened reaſon, or to the bold and daring attacks of infidelity and deiſm. We behold the proſpect of its ruins with pleaſure, and thank the deiſts for their zeal; but it is from the firm hope that the religion of Jeſus will ariſe in all its beauty and ſimple majeſty, and be admired and reſpected as it deſerves: for mean and contemptible as ſuperſtition certainly is, we would rather ſee men do what they reckon their duty from ſuperſtitious principles, than ſee anarchy and vice prevail, even though attended with all the knowledge and liberality of ſentiment which deiſm and infidelity can inſpire.

SUPERVISOR, a ſurveyor or overſeer.

SUPINATION, in anatomy, the action of a ſupinator muſcle, or the motion whereby it turns the hand ſo as that the palm is lifted up towards heaven.

SUPINE, in Latin grammar, part of the conjugation of a verb, being a verbal ſubſtantive of the ſingular number and the fourth declenſion.

There are two kinds of ſupines: One, called the *firſt ſupine*, ending in *um* of the accuſative caſe, which is always of an active ſignification, and follows a verb of motion; as *abiit deambulatum*. The other, called the *laſt ſupine*, and ending in *u* of the ablative caſe, is of a paſſive ſignification, and is governed by ſubſtantives or adjectives; as, *facile dictu*, &c.

They have their name, ſays Probus, and after him Voſſius, *quod ad inſtar ſupinorum & otioſorum hominum omnia habent confuſa*: or, according to Priſcian, *quod naſcantur a participiis paſſivis, quæ ſupina appelata ſunt, quia in infimo loco ſita, totam conjugationis molem ſuſcipiant.*

SUPPER, the evening repaſt.—Suppers that are heavy ſhould be avoided, becauſe the ſtomach is more oppreſſed with the ſame quantity of food in an horizontal poſture than in an erect one, and becauſe digeſtion goes on more ſlowly when we ſleep than when we are awake. They ſhould be eaten long enough before bed-time, that they may be nearly digeſted before going to ſleep; and then a draught of pure water will dilute that which remains in the ſtomach.

Supper of the Lord, otherwiſe called the *Euchariſt*, is a ſacrament ordained by Chriſt in his church, of which the outward part is bread and wine, and the inward part or thing ſignified the body and blood of Chriſt, which the majority of Chriſtians believe to be in ſome ſenſe or other taken and received by the faithful communicants. See Sacrament. Def.

There is no ordinance of the goſpel which has been the ſubject of more violent controverſies between different churches, and even between different divines of the ſame

church,

church, than this facrament; and though all confefs that one purpofe of its inftitution was to be a bond of love and union among Chriftians, it has, by the perverfenefs of mankind, been too often converted into an occafion of hatred. The outward and vifible fign, and the inward and fpiritual grace, have equally afforded matter of difputation to angry controvertifts. Many members of the church of Rome condemn the Greek church and the Proteftants for ufing leavened bread in the Lord's Supper, contrary to the example fet them by our Saviour; whilft the Greek church in general, and fome Proteftant focieties in particular unite with the church of Rome in cenfuring all churches which mix not the wine with water, as deviating improperly from primitive practice. See EUCHARIST.

That it was unleavened bread which our Lord bleffed and brake and gave to his difciples as his body, cannot be queftioned; for at the time of the paffover, when this ordinance was inftituted, there was no leavened bread to be found in Jerufalem*. For the mixed cup, the evidence is not fo decifive. It is indeed true, as we have obferved under the article EUCHARIST, that the primitive Chriftians ufed wine diluted with water; and if we may believe Maimonides†, it was the general cuftom of the Jews, as well at the paffover as at their ordinary meals, to add a little water to their wine on account of its great ftrength; but that this was *always* done, or that it was done by our *Saviour in particular*, there is no clear evidence. Origen indeed affirms‡, that our Lord adminiftered in wine unmixed; and he was not a man to hazard fuch an affirmation, had there been in his days any certain tradition, or fo much as a general opinion, to the contrary. On this account we have often heard with wonder the neceffity of the mixed cup infifted on by thofe who without hefitation make ufe of leavened bread; for if it be effential to the facrament that the very fame elements be employed by us that were employed by our Saviour, the neceffity of unleavened bread is certainly equal to that of wine diluted by water.

But the mixed cup is faid to be emblematical of the blood and water which flowed from the fide of our Lord when pierced by the fpear of the Roman foldier, while the abfence of leaven is emblematical of no particular circumftance in His paffion. This argument for the mixture is as old as the era of St Cyprian, and has fince been frequently urged with triumph by thofe who furely perceived not its weaknefs. The flowing of the blood and water from our Saviour's fide was the confequence either of the fpear's having pierced the *pericardium*, or more probably of an *afcites* or *hydrothorax*, occafioned by his cruel and lingering death (fee MEDICINE, n° 342, 343.) But whatever was the caufe of it, how can the mixing of wine with water in the facrament be emblematical of the flowing of blood and water feparately? Such a mixture furely bears a more ftriking refemblance to the reunion of the *ferum* and *craffamentum*, after they had been feparated by whatever caufe. See BLOOD.

We urge not thefe objections to the mixed cup from any diflike that we have to the practice. It is unqueftionably harmlefs and primitive; and we wifh that greater regard were paid to primitive practices than the generality of Chriftians feem to think they can claim: but let the advocates for antiquity be confiftent; let them either reftore, together with the mixed cup, the ufe of unleavened bread, or acknowledge that neither the one nor the other is effential to the facrament. This laft acknowledgment muft indeed be made, if they would not involve themfelves in difficulties from which they cannot be extricated. If either the mixed cup or unleavened bread be abfolutely neceffary to the validity of the facrament, why not wine made from the grapes of Judea? why not that particular kind of wine which was ufed by our Saviour? and where is that wine to be found?

3 Frivolous.

But the controverfies refpecting the outward part or fign of the Lord's Supper are of little importance when compared with thofe which have been agitated refpecting the inward part or thing fignified; and of thefe we haften to give as comprehenfive a view as the limits prefcribed to fuch articles will admit.

4 About the thing fignified.

Our Bleffed Lord, in the fame night that he was betrayed, "took bread, and bleffed it, and brake it, and gave it to the difciples, and faid, Take, eat: this is my body. And he took the cup, and gave thanks, and gave it to them, faying, Drink ye all of it; for this is my blood of the new teftament, which is fhed for many for the remiffion of fins." Such was the inftitution of the Lord's Supper as it is recorded in the gofpel by St Matthew; and we have the fame account of it, in almoft the very fame words, by three other infpired writers, St Paul, St Mark, and St Luke. That it was the bread which Chrift bleffed and brake that is here called his body, and the wine over which he gave thanks that he ftyles his blood of the new teftament, will admit of no reafonable doubt (A); but in what fenfe they became fo, has been the fubject of many controverfies.

5 Doctrine of the church of Rome.

The church of Rome, which holds, that after confecration, Jefus Chrift, God and man, is really, truly, and fubftantially, contained under the outward appearances of the bread and wine, informs us, that about the middle of the mafs, when the prieft, taking into his hand, firft the bread and then the wine, pronounces over each feparately the facred words of confecration, the fubftance of thefe elements is immediately changed by the almighty power of God into the body and blood of Chrift; fo that though all the outward appearances of the bread and wine, and all their fen-

(A) Some over-zealous Proteftants have indeed affirmed, that it was not the confecrated bread and wine, but thofe elements, *together with the whole action* of taking them into his hands, bleffing them, breaking the bread, and diftributing the bread and wine to the difciples, that Chrift calls his body and blood. This novel and fingular opinion refts upon no better foundation than a very childifh criticifm. Our Saviour, after bleffing and breaking the bread, gave it to the difciples, faying, in the original, Λαβετε, φαγετε· τουτο εστι το σωμα μου. Now, fay our critics, τουτο in the neuter gender, can never agree with the antecedent αρτος in the mafculine, but muft refer to all the circumftances of the action taken together, and confidered as one complex neuter noun. But this noun, whether complex or fimple, certainly denotes what could be *eaten*; and to fuppofe that our bleffed Lord defired his apoftles to eat *actions*, is as repugnant to human reafon as any doctrine of the church of Rome. The truth is, that the word τουτο which is more properly a definite article than a demonftrative pronoun (fee GRAMMAR, Chap. II.), refers directly to the thing, whatever it was, which our Saviour held in his hand and gave to the difciples; and the claufe, when completed, is τουτο [ον] εστι το σωμα μου; this *being*, this *fubftance, is my body*. There was no neceffity for characterifing that fubftance by any analogy to fex, in order that it might be diftinguifhed from every other fubftance; for the apoftles could not but fee it in the hand of their Mafter.

Supper. ſenſible qualities remain. This more than miraculous change is called TRANSUBSTANTIATION; and is founded on the philoſophy of Ariſtotle, which reſolves all bodies into *matter* and *form* (ſee METAPHYSICS, nº 142—150.); for it is only the *matter* or imperceptible ſubſtance which ſupports the *forms* or ſenſible qualities of bread and wine, that is changed into the *ſubſtance* or matter of the body and blood of Chriſt, ſo that this divine matter, coming into the place of the former earthly matter, ſupports the ſame identical *forms* which it ſupported. Hence we are told, "that Jeſus Chriſt, now preſent inſtead of the bread and wine, exhibits himſelf to us under thoſe very ſame outward *forms* or appearances which the bread and wine had before the change."

Could this doctrine be true, it would be abundantly myſterious; but to add to the myſtery, we are farther informed, that under each kind is contained Jeſus Chriſt whole and entire, his body and blood, his ſoul and divinity; ſo that when a man eats what has the appearance of a wafer, he really and truly eats the body and blood, the ſoul and divinity, of Jeſus Chriſt; and when he afterwards drinks what has the appearance of wine, he drinks the very ſame body and blood, ſoul and divinity, which not a minute perhaps before he had wholly and entirely eaten! The ingenious author from whoſe work we have taken this account of the Romiſh doctrine concerning the real preſence, may perhaps reject our inference that the orthodox members of his church muſt believe the *ſoul* and *divinity* of Chriſt to be *eaten* and *drunk* in the Lord's Supper; but he cannot deny that, according to his ſtatement of the Catholic faith, the ſoul and divinity are both received whole and entire into the ſtomach of each communicant. He ſays indeed, that "communion conſiſts in receiving Jeſus Chriſt whole and entire, his ſacred body, his precious blood, his bleſſed ſoul, and his adorable divinity, into our *ſouls*;" but that which was formerly bread and wine unqueſtionably goes into the *ſtomachs* of the communicants; and ſince, according to him, it is now the body and blood of Chriſt, the ſoul and divinity muſt go thither with it, for theſe four cannot be ſeparated. This our author himſelf grants. "The Scripture (ſays he) poſitively declares, that *Chriſt riſing again from the dead, dieth no more; death ſhall no more have dominion over him* (Rom. vi. 9.) Conſequently his body, his blood, and his ſoul, ſhall never more be ſeparated from one another; and as the union of his divine and human natures can never more be broken, ſo neither can theſe, his two natures, united in his divine perſon, be ever ſeparated. From this it neceſſarily follows, that wherever the body of Chriſt is, there alſo his blood, his ſoul, and his divinity, muſt of neceſſity be in like manner."

Now, whether we ſuppoſe, with our author, that the ſoul and divinity of Chriſt directly carry his body and blood with them into the human ſoul, or, truſting in ſome degree to the evidence of ſenſe, believe that the body and blood carry the ſoul and divinity with them directly into the ſtomach of each communicant—is it credible, is it poſſible, that the high and lofty One, who inhabiteth eternity, and whom the oracles of truth aſſure us that even the heaven of heavens cannot contain, ſhould be *ſubſtantially* received *whole* and *entire* into a finite ſpirit like the human ſoul, or into a body ſo limited as the human ſtomach? Our author ſays it is; declaring that, "by the bleſſed *preſence* of Jeſus Chriſt, *whole and entire within us*, are communicated to our ſouls all the heavenly graces which are the effects of the holy communion: ſuch as the ſanctification of the ſoul by an increaſe of juſtifying grace; the rendering of it more pure, more holy, more beautiful, more agreeable, in the eyes of God; the cleanſing of the ſoul from all thoſe venial ſins and imperfections of which we repent, and preſerving us from falling into mortal ſins; the uniting of us in a moſt intimate manner with Jeſus Chriſt, who comes to us in this holy ſacrament on purpoſe to dwell in our ſouls and abide with us; and the giving us a pledge and earneſt of a glorious immortality, to the enjoyment of which it brings us at laſt, if we perſevere to the end in the grace of God."

The conſequence of the doctrine of tranſubſtantiation is the *ſacrifice of the maſs*, by which, it is ſaid, God's acceptance of Chriſt's ſacrifice on the croſs is obtained for the actual benefit of thoſe perſons in particular for whom the maſs is offered. In the work ſo often quoted, we are told, that "Jeſus Chriſt our redeemer, who is both our high-prieſt and our victim, who, in order to perfect the work of our redemption, and reconcile man with his offended Creator, offered himſelf once in a bloody manner upon the croſs, in order to communicate and apply to the ſouls of individuals thoſe graces, which, by his death, he merited for mankind in general, continues to offer himſelf daily upon the altar in an unbloody manner, by the miniſtry of his prieſts, in the *maſs*. The ſacrifice of the croſs and that of the maſs are both one and the ſame ſacrifice, becauſe in both the victim is the ſame and the high prieſt the ſame, viz. Jeſus Chriſt. The only difference is in the *manner* of offering. On the croſs he offered himſelf in a bloody manner and actually died; whereas on the altar he is offered up to God in an unbloody manner, not *actually* dead, but under the *appearance* of death;" ſo that the communicants not only eat the man Jeſus Chriſt, but even eat him alive (B)!

It is known to all our readers that this doctrine of tranſubſtantiation was one cauſe of the breach between the church of Rome and thoſe various ſocieties which call themſelves reformed churches. The real and ſubſtantial change of the bread and wine into the body and blood of our Lord is rejected by every reformer as a change contradictory and impoſſible, and fraught with the moſt impious conſequences; and volumes have been written to expoſe the weakneſs of thoſe arguments which have ſo often been vainly urged in its ſupport. It has been ſhown to imply numberleſs abſurdities, ſuch as, that the ſame thing can be in a million of different places, *whole* and *entire*, at the

(B) This whole account of the Romiſh doctrine reſpecting the ſacrament of the Lord's Supper is taken from a work in two ſmall volumes, called *The Sincere Chriſtian inſtructed in the Faith of Chriſt, from the Written Word.* Its author is a man of learning, and great perſonal worth; and as he fills a high ſtation in the church of Rome, we cannot doubt but that he has given a fair view of the doctrine of that church reſpecting this and every other article of which he treats. We are ſorry however that his zeal ſhould have impelled him, in a *popular* work, to write in the manner that he has done of the ſalvation of thoſe who are not members of his church, or who cannot embrace all his opinions; for if his doctrine on this ſubject be implicitly received by thoſe "over whom he has the rule, and for whoſe ſouls he is appointed to watch," they muſt neceſſarily look upon the majority of their fellow-citizens as reprobates doomed to eternal perdition. Let this be our apology for treating ſome of thoſe opinions, which he thinks ſo abſolutely

neceſſary

er. the fame inftant of time; that it is near 1800 years old, and yet may be not more than one minute; that *forms* or fenfible qualities are real things independent of their fubject and the fentient beings who perceive them; that the infinite and eternal God, who created and fuftains the univerfe, is himfelf wholly and fubftantially comprehended by the human foul; and that the half, or fourth, or tenth part of the body of Chrift, is equal to the whole of that body. That thefe are neceffary confequences of tranfubftantiation has been fo completely proved in various works (C) to which every reader may have accefs, that it is needlefs for us to repeat arguments fo hackneyed; but there are two objections to that doctrine, which, as we do not remember to have met with them elfewhere, and as they appear to us abfolutely conclufive, it may be worth while to ftate in this place.

The advocates for the real prefence in the Lord's Supper contend, that every word relating to that ordinance is to be taken in the ftricteft and moft literal fenfe, and they affect to triumph over the Proteftants, becaufe their notions of the facrament cannot be fupported without having recourfe to figure and metaphor. This however is a very vain triumph; for we hefitate not to affirm, that fuppofing tranfubftantiation poffible, and even capable of proof, there is not in the whole New Teftament a fingle word or a fingle phrafe which, if interpreted *literally*, gives the flighteft countenance to that wonderful doctrine. The reader will remember, that tranfubftantiation, as we have ftated it from a dignitary of the Romifh church, and as it is in fact ftated by the council of Trent (D), confifts in a change of the *matter*, *imperceptible fubftance*, or *fubftratum* of the bread and wine into the *matter*, *imperceptible fubftance*, or *fubftratum* of Chrift's body and blood; for all parties agree that the fenfible qualities of the bread and wine remain, and, according to the Romanift, are after confecration either fupported by the *matter* of Chrift's body and blood, or hung upon nothing. But the phrafe τουτο εστι το σωμα μου if taken in the literal fenfe, cannot poffibly denote the confequence of fuch a change as this; for every perfon at all acquainted with the Greek language, efpecially the language of the Peripatetic fchool, knows that το σωμα μου fignifies, not the *matter* or *fubftratum* of my body divefted of its fenfible qualities; but the body of me in its natural ftate, confifting of *matter* and *qualities*, or *matter* and *form united*. Unlefs therefore the *fenfible qualities*, as well as the *matter* of the bread and wine, give place to the fenfible *qualities* as well as the *matter* of our Saviour's body and blood, and unlefs he appear glorified on the altar as he appeared on the mount at his transfiguration, the words το σωμα μου muft be interpreted figuratively. Had the apoftles underftood their Mafter's words in the fenfe in which they are underftood by the church of Rome, they would have rendered them into Greek, not τουτο εστι το σωμα μου, "this is my *body*," but τουτο εστι ἡ ὑλη του σωματος μου, "this is the *matter* of my body." In like manner, when St John relates || that Jefus faid, "Whofo eateth my flefh and drinketh my blood, hath eternal life, and I will raife him up at the laft day," had he underftood his adorable Mafter to fpeak of his flefh and blood in the Eucharift in the fenfe in which they are taught to be there by the church of Rome, he would have reprefented him as faying, not Ὁ τρωγων μου την σαρκα, και πινων μου το αἱμα, but Ὁ τρωγων την ὑλην μου της σαρκος, και πινων την ὑλην μου του αἱματος, "whofo eateth the *matter* of my flefh, and drinketh the *matter* of my blood, hath eternal life, and I will raife him up at the laft day."

Supper.

|| Chap. vi. verfe 54.

But further, fuppofing this fingular converfion poffible in itfelf, it cannot be rendered credible, however ftated in any language that ever was or ever will be fpoken by man. 8
At firft fight it may appear paradoxical to affirm, that a poffible fact cannot be fo related as to obtain credit; but that tranfubftantiation, if poffible, is fuch a fact, will be apparent on the flighteft confideration.

And incapable of proof.

The relation that fubfifts between things and words is arbitrary; fo that what is termed *body* in Englifh, is σωμα in Greek, and *corpus* in Latin; and the fame thing might with equal propriety (had the authors of thefe languages fo pleafed) have been expreffed in the firft by *foul*, in the fecond by ψυχη, and in the third by *anima*. (See LANGUAGE, n° 3, &c.) The confequences of this are, that there is no univerfal language fpoken; that the natives of one country underftand not the fpeech of thofe of another; and that different men fpeaking the fame language are perpetually liable to miftake each other's meaning. Between the *fubftrata* of bodies and their *fenfible qualities* there is a relation founded in nature, fo that the fenfible qualities which indicate the fubftance to which they belong, to be *gold*, for inftance, in one country, indicate the fame thing in every other country, and have done fo from the beginning of time. The fenfible appearances of bodies therefore are an univerfal language, the language of the Author of Nature, by which he declares to his creature man, that though the ὑλη πρωτη, or primary matter of all bodies, may be the fame kind of fubftance; yet the ὑλη προσεχης of one body, or the internal combination of its primary parts, differs from that of another;

rary ip-

neceffary to falvation, with lefs ceremony than perhaps we fhould have done, had he lefs pofitively pronounced our damnation for not having it in our power to embrace them. He is not indeed much lefs fevere on the moft virtuous heathens, though they never faw the New Teftament, or heard the doctrines of his church preached. But perhaps this feverity may be occafioned by the following queftion of Cicero: "Cum fruges, *Cererem*; vinum, *Liberum* dicimus, genere nos quidem fermonis utimur ufitato: fed ECQUEM TAM AMENTEM effe putas, qui illud, quo vefcatur, deum credat effe?" *De Natura Deorum*, Lib. 3. Cap. 16.

(C) Among other works on this fubject, we may confidently recommend to the reader a fmall tract publifhed by Dr Abernethy Drummond, about twenty years ago, in the form of *A Dialogue between Philalethes and Benevolus*. In that treatife, together with a defence of it, which were both printed for Balfour and Drummond, Edinburgh, the abfurd confequences which we have mentioned are, by arguments unanfwerable, proved to flow from the doctrine of tranfubftantiation; and the artful fophiftry, by which a very acute genius endeavoured to keep thefe confequences out of fight, is detected and expofed on acknowledged principles of the foundeft metaphyfics.

(D) The canon of that council which eftablifhes tranfubftantiation is thus tranflated by the author of *The Sincere Chriftian Inftructed*: "If any man fhall fay, that in the bleffed facrament of the Eucharift the fubftance of the bread and wine remains along with the body and blood of our Lord Jefus Chrift, and fhall deny that wonderful and fingular converfion of the whole fubftance of the bread into the body, and of the whole fubftance of the wine into the blood, the appearances of the bread and wine only remaining, which converfion the Catholic Church calls *tranfubftantiation*, let him be anathema."

that; that gold, for instance, has a different *fubftratum* or internal fubftance from iron, lead, or filver; that the internal organization or fubftance of the body of an ox is different from that of a horfe; and that the *internal fubftance* or *fubftratum* which fupports the appearances of bread and wine is different from that which fupports the fenfible qualities of flefh and blood (fee METAPHYSICS, Part I. Chap. I. and Part II. Chap. I. and II.). Suppofing therefore the doctrine of tranfubftantiation to be poffible and even true, it would ftill be impoffible, by any ftatement of it in human language, or by any argument urged in its fupport, to render that doctrine an object of rational belief; for if it be faid that the words [illegible] were fpoken by a divine perfon, who could neither be deceived himfelf nor intend to deceive us, it may be replied, that the fenfible appearances of bread and wine, which are confeffed to remain, are likewife the language of a divine perfon, even of the Creator and Governor of heaven and earth; that this language addreffed to the fight, the tafte, the touch, and the fmell, is equally intelligible to all nations; that fince the creation of the world its meaning has never been miftaken by the fcholar or the clown, the fage or the favage, except in this fingle inftance of our Lord's flefh and blood exhibiting the fenfible appearances of bread and wine; and that it is therefore infinitely more probable that the members of the church of Rome fhould miftake the meaning of the words [illegible] which, though fpoken by Chrift, are part of the language of men, and liable to all its ambiguities, than that all mankind fhould miftake the language of God himfelf, which is liable to no ambiguities, and which was never in any other inftance mifunderftood by a fingle individual. Should tranfubftantiation therefore be really true, its truth can never be proved or rendered probable, but by an immediate operation of the fpirit of God on the mind of man; and he who is confcious of no fuch operation on his own mind, may reft affured that the Father of mercies, who knows whereof he is made, will never bring upon him, for his incredulity in this inftance, any of the anathemas denounced by the church of Rome upon thofe who place implicit confidence in the univerfal language of Him who created them, in oppofition to her figurative and contradictory interpretations of the written word. Of the tranfubftantiation of the elements a vifible miracle would afford no proof. Had the water been changed into wine at the marriage in Cana of Galilee, for the exprefs purpofe of bearing teftimony to this fingular converfion, what would have been the confequence on the minds of thofe who witneffed that miracle? Nothing, we think, but fcepticifm or a diftruft of their own faculties; for they would have had the very fame evidence that *no* fubftantial change was wrought on the elements, as that the water was *actually* turned into wine.

Though the reformed churches unanimoufly reject the doctrine of tranfubftantiation, and of courfe the facrifice of the mafs, its infeparable confequence, they are far from being agreed among themfelves refpecting the nature of the Lord's Supper; and the notions of this ordinance entertained by fome of them appear to us as untenable as any part of the doctrine of the church of Rome. The Lutherans believe, that the body and blood of Chrift are really and fubftantially prefent with the bread and wine; that the body is really and truly eaten, and the blood really and truly drunk, by the communicants; and that whatever motion or action the bread has, the body has the fame§. According to them, therefore, the fame fenfible appearances are exhibited by two fubftances united in fome inexplicable manner, which is neither a perfonal union, nor incorporation, nor the inclofure of the body within the bread; nor

9 Doctrine of the Lutherans incredible.

§ [illegible]

does it laft longer than while the facrament is celebrating. This union is generally called CONSUBSTANTIATION; but they reject the term, contenting themfelves with afferting the real prefence, without prefuming to define the mode by which the body and blood of Chrift are united to the facramental elements.

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It would be fuperfluous to wafte time in replying to this doctrine. Every reader fees that it implies the poffibility of the fame thing's being whole and entire in a million of places at one and the fame inftant of time, which has been fo often urged as an unanfwerable objection to the Romifh doctrine; and it is fraught with this additional abfurdity peculiar to itfelf, that two bodily fubftances may at once occupy the fame place, which is directly contrary to our notions of folidity. It may be obferved too, that whatever be the real fenfe of our Saviour's words, he fays exprefsly, "This is my body"—this thing which I give you, and which you fee and feel; whereas, had he meant what Luther and his followers teach, he would furely have faid, "*With* this bread receive my body, *with* this cup receive my blood."

10 Of the early Calvinifts.

The notions of fome of the early Calvinifts refpecting the Lord's Supper are very myfterious, and expreffed in language of which we are not fure that we underftand the meaning. In the year 1561 an attempt was made in France to bring the Catholics and Proteftants to an uniformity of doctrine on this great topic of controverfy; and deputies were appointed by both parties to meet at *Poiffy*, and debate the queftion in a friendly manner. The principal managers on the fide of the Catholics were the cardinals of *Lorraine* and *Tournon*; thofe on the fide of the Proteftants were ***Beza*** and ***Peter Martyr***. After feveral meetings, difputes, and violent feparations, the Proteftant deputies declared their faith in the following words: "We confefs, that Jefus Chrift, in the Supper, does truly give and exhibit to us the fubftance of his body and blood by the efficacy of his Holy Spirit; and that we do receive and eat fpiritually, and by faith, *that very body which was offered and immolated for us*, fo as to be bone of his bone and flefh of his flefh, to the end that we may be enlivened thereby, and receive what is conducive to our falvation. And becaufe faith, fupported by the word of God, makes thofe things prefent, which it apprehends, and by that faith we do in *deed* and *reality* receive the *true natural* body and blood of Chrift, by the power of the Holy Spirit; by this means, we confefs and acknowledge the prefence of his body and blood in the Supper." One of the Catholic delegates expreffing his diflike of this laft claufe, the Proteftant minifters gave the following explanation of their fentiments: "No diftance of place can hinder us from communicating of the body and blood of Chrift, for the Lord's Supper is a heavenly thing; and though on earth we receive with our mouths bread and wine, which are the true figns of his body and blood, yet by faith, and the efficacy of the Holy Ghoft, our minds, which are fed with this food, *are rapt up into heaven*, and enjoy the prefence of the body and blood; and that by this means it may be faid that the body is truly joined to the bread, and the blood to the wine; but after the manner of a facrament, and not at all according to place or natural pofition *."

If the reader can difcover the precife meaning of thefe paffages, his fagacity exceeds ours. That the Proteftant deputies believed, or profeffed to believe, that the *natural* body and blood of Chrift are by the faithful received in the Lord's Supper, is indeed evident; but their notions refpecting the manner of this reception are very unintelligible, if not contradictory. In the former quotation, they confefs that Chrift's body and blood are really prefent in

* Th[illegible] lib 2 See a[illegible] *John*[illegible] *Unblo*[illegible] *Sacri*[illegible] vol 1

Unin[illegible]gible

r. in the facrament; that they are made prefent by faith (we fuppofe the faith of the communicants); and that the *very body* which was offered and immolated for us is eaten *fpiritually* and by *faith*. In the latter quotation, they feem to fay that Chrift's body and blood are in heaven, at a great diftance from the true figns of them; that on earth the communicants receive only thefe figns, which are bread and wine; but that, by faith and the efficacy of the Holy Spirit, their minds, during actual communion, are rapt up into heaven, where they enjoy the prefence of the body and blood; and that by this means the body and blood are truly joined to the bread and wine through the medium of the mind of the communicant, which is at once prefent both to the fign and to the thing fignified. To this myfterious doctrine it is needlefs to urge objections. Every man who is accuftomed to think, and to ufe words with fome determinate meaning, will at once perceive that the authors of this declaration muft have had very confufed notions of the fubject, and have pleafed themfelves with found inftead of fenfe, fatisfied that they could not be wrong if they did not fymbolize with the Lutherans or the Council of Trent.

s of The churches of England and Scotland, in their eftablifhed doctrines refpecting the Lord's Supper, appear to be Calviniftical; but the compilers of the Thirty-nine Articles and of the Confeffion of Faith muft have been much more rational divines than Beza and Peter Martyr. They agree in condemning the doctrine of tranfubftantiation as contrary to common fenfe, and not founded in the word of God; they teach, that to fuch as rightly, worthily, and with faith, receive the facrament, the bread which we break is a partaking of the body of Chrift, and the cup of bleffing a partaking of the blood of Chrift; and they add, that the body and blood of Chrift are eaten and drunk, not corporally or carnally, but only after a heavenly and fpiritual manner, by which the communicants are made partakers of all the benefits of his death *. In one important circumftance thefe two churches feem to differ. The Confeffion of Faith, as we underftand it ‡, affirms, that in the Lord's Supper there is no facrifice made at all. The thirty-firft article of the church of England likewife condemns the Popifh facrifice of the mafs as a *blafphemous fable* and *dangerous deceit*; but in *the order for the adminiftration of the Lord's Supper or Holy Communion*, the celebrator "befeeches God moft mercifully to accept the alms and *oblations* of the congregation," and again "to accept *their facrifice of praife* and thankfgiving:" from which petitions many have inferred that, in the Lord's Supper, that church offers a commemorative and euchariftical facrifice. This inference feems not to be wholly without foundation. In the order for the adminiftration of the Lord's Supper, according to the form of the Book of Common Prayer fet forth by act of parliament in the fecond and third years of king Edward the Sixth, the elements were folemnly offered to God as a facrifice of praife and thankfgiving; and though the prayer containing that oblation was, at the review of the liturgy fome years afterwards, removed from the prayer of confecration, to which it was originally joined, and placed where it now ftands in the poft communion fervice; yet the very act of parliament which authorized that alteration, calls king Edward's "a very godly order, agreeable to the word of God and the primitive church, and very comfortable to all good people defiring to live in Chriftian converfation."

les ... urch and, ... nfef- ... aith, 9. ... 29.

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The Englifh church, however, has not pofitively determined any thing refpecting this great queftion; and whilft fhe condemns the doctrine of the real prefence, with all its dangerous confequences, fhe allows her members to entertain very different notions of this holy ordinance, and to publifh thefe notions to the world. Accordingly, many of her moft eminent divines (E) have maintained that, in the celebration of the Lord's Supper, the elements of bread and wine are offered to God as a facrifice commemorative of Chrift's one facrifice for the fins of the whole world; that thefe elements, though they undergo no fubftantial change, yet receive fuch a divine virtue by the defcent of the Holy Ghoft, as to convey to the worthy communicant all the benefits of Chrift's paffion; that they are therefore called his body and blood, becaufe being, after their oblation, eaten and drunk in remembrance of Him, they fupply the place of his body and blood in the feaft upon his facrifice; and that it is cuftomary with our Saviour to give to any thing the name of another of which it completely fupplies the place, as when he calls himfelf the *door* * of the fheep, becaufe there is no entrance into the church or kingdom of God but by faith in him. They obferve, that the Euchariſt's being commemorative, no more hinders it from being a proper facrifice, than the typical and figurative facrifices of the old law hindered them from being proper facrifices: for as to be a type doth not deftroy the nature and notion of a legal facrifice, fo to be reprefentative and commemorative doth not deftroy the nature of an evangelical facrifice. To prove that, in the celebration of the Lord's Supper, there is a real facrifice offered to God as well as a facrament received by the communicants, they appeal to St Paul, who fays exprefsly †, that "Chriftians have an *altar*, whereof they have no right to eat who ferve the tabernacle," and who by contrafting the cup of the Lord with the cup of devils, and the table of the Lord with the table of devils ¶, teaches plainly, that thofe cups and thofe tables had the fame fpecific nature. That the *table of devils* fpoken of by the apoftle was the Pagan altars, and the *cup of devils* the wine poured out in libations to the Pagan divinities, will admit of no difpute; and therefore, fay the advocates for the euchariftical facrifice, the table of the Lord muft be the Chriftian altar, and the cup of the Lord the wine offered to God as the reprefentative of the blood of Chrift; otherwife there would not be that *abfurdity* which the apoftle fuppofes, in the fame perfon drinking the cup of the Lord and the cup of devils, and partaking of the Lord's table and the table of devils. They obferve farther, that in all the ancient liturgies extant there is a folemn form of oblation of the facramental elements, and that all the Chriftian writers from the fecond century downwards treat of the Lord's Supper as a facrifice as well as facrificial feaft, having indeed no value in itfelf, but acceptable to God as reprefenting Chrift's one facrifice for the fins of the world. Our limits will not permit us to give even an abftract of their arguments; but the reader who fhall attentively perufe *Johnfon's unbloody Sacrifice and Altar unveiled and fupported*, will difcover that their notions are better founded than probably he fuppofes, and that they are totally irreconcileable with the doctrine of tranfubftantiation and the Popifh facrifice of the *mafs*.

13 Some Englifh divines hold the Lord's fupper to be a euchariftical facrifice.

* St John x. 7.

† Heb. xiii. 10.

¶ 1 Cor. x. 16, &c.

Other Englifh divines of great learning, with the celebrated Hoadley bifhop of Winchefter at the head of them, contend ftrenuoufly that the Lord's Supper, fo far from being

14 Others, a mere memorial;

(E) The archbifhops Laud and Wake; the bifhops Poynet, Andrews, Bull, and Patrick; the Doctors Hickes, Grabe, and Brett; Meffrs Bingham, Johnfon, Mede, Wheatly, Scandaret, Bowyer, &c.

Supper.

being a sacrifice of any kind, is nothing more than bread and wine reverently eaten and drunk, in remembrance that Christ's body was broken and his blood shed in proof of his Father's and his own love to mankind; that nothing is essential to the sacrament but this remembrance, and a serious desire to honour and obey our Saviour as our head; that the sacrament might be celebrated without uttering one prayer or thanksgiving, merely by a society of Christians, whether small or great, jointly eating bread and drinking wine with a serious remembrance of Christ's death; that St Paul enjoins a man to examine himself before he eat of that bread and drink of that cup, not to discover what have been the sins of his past life in order to repent of them, but only that he may be sure of his remembering Christ's body broken and his blood shed; that, however, it is his duty in that as in every other instance of religious worship to resolve to obey from the heart every precept of the gospel, whether moral or positive; and that to partake worthily of the Lord's Supper is acceptable to God, because it is paying obedience to one of these precepts; but that no particular benefits or privileges are annexed to it more than to any other instance of duty. Bishop Hoadley acknowledges, that when St Paul says*, "The cup of blessing which we bless, is it not the communion of the blood of Christ? The bread which we break, is it not the communion of the body of Christ?" he has been supposed by many learned men to affirm, that all the benefits of Christ's passion are in the Lord's Supper conveyed to the worthy communicant; but this (says he) is an idea which the apostle could not have in his thoughts as at all proper for his argument. The Greek word κοινωνια and the English *communion* signify only a partaking of something in common with others of the same society; and the apostle's meaning (he says) can be nothing more, than that in the Lord's Supper we do not eat bread and drink wine as at an ordinary meal, but as a memorial of the body and blood of Christ, in honour to *him* as the *head* of that body of which we are all *members*. That the word κοινωνια is not meant to denote any inward or spiritual part of the Lord's Supper, he thinks evident, because the same word is used with regard to the cup and the table of idols, where no spiritual part could be thought of, and in an argument which supposes an idol to be nothing§.

* 1 Cor. x. 16.

§ A Plain Account of the Nature and End of the Lord's Supper.

To this view of the nature and end of the Lord's Supper, it must appear no small objection, that "he who eateth and drinketh unworthily is said to be *guilty of the body and blood of the Lord, and to eat and drink a judgement to himself, not discerning the Lord's body*." No doubt it would be sinful to eat and drink a mere memorial of Christ's death without serious dispositions; but we cannot conceive how a little wandering of the thoughts, which is all the unworthiness which the author thinks there can be on such an occasion, should be a sin of so deep a dye as to be properly compared with the guilt of those who murdered the Lord of life. Other divines therefore, feeling the force of this and similar objections, steer a middle course between the mere memorialist and the advocate for a real sacrifice in the holy Eucharist, and insist that this rite, though no sacrifice itself, is yet a feast upon the one sacrifice offered by Christ and slain upon the cross. The most eminent patrons of this opinion have been Dr Cudworth, bishop Warburton, and the present bishop of Chester; and they support it by such arguments as the following: "In those ages of the world when victims made so great a part of the religion both of Jews and Gentiles, the sacrifice was always followed by a religious feasting on the thing offered; which was called the *feast upon, or after the sacrifice*, and was supposed to convey to the partakers of it the benefits of the sacrifice. Now Jesus (say they), about to offer himself a sacrifice on the cross for our redemption, did, in conformity to general practice, institute the *last supper*, under the idea of *a feast after the sacrifice*; and the circumstances attending its institution were such, they think, that the apostles could not possibly mistake his meaning. It was just before his passion, and while he was eating the paschal supper, which was a Jewish *feast upon the sacrifice*, that our blessed Lord instituted this rite; and as it was his general custom to allude, in his actions and expressions, to what passed before his eyes, or presented itself to his observation, who can doubt, when, in the very form of celebration, we see all the marks of a *sacrificial supper*, but that the divine institutor intended it should bear the same relation to his *sacrifice on the cross* which the *paschal supper* then celebrating bore to the oblation of the *paschal lamb?* If this was not his purpose, and if nothing more was intended than a general memorial of a dead benefactor, why was this instant of time preferred for the institution to all others throughout the course of his ministry, any one of which would have been equally commodious? Indeed any other time would have been more commodious for the institution of a mere memorial; for the paschal lamb and unleavened bread were certainly a sacrifice; and the words used by our Saviour, when he gave the bread and wine to the apostles, were such as must necessarily have led them to consider that bread and wine as bearing the same relation to his sacrifice that the paschal supper bore to the paschal sacrifice. At that Jewish feast, it was the custom of every father of a family to break the unleavened bread, and to give to every guest a portion, saying, "This is the bread of affliction, which our fathers did eat in the land of Egypt:" a custom which, we may be sure, that Christ, as father of his family, would religiously observe. The apostles knew well that they were not eating the identical bread which their fathers did eat in Egypt, but the feast upon the sacrifice then offered in commemoration of their redemption from Egyptian bondage; and therefore when they saw their Master after supper break the bread again and give it to each of them, with these remarkable words, "This is my body which is given for you, do this in remembrance of me," they must have concluded, that his meaning was to institute a rite which should to the end of the world bear the same relation to his sacrifice that the paschal supper bore to the sacrifice of the passover.

15 And others, a feast upon one Sacrifice once offered, &c.

This inference, from the circumstances attending the institution, bishop Warburton thinks confirmed by St Paul's mode of arguing with the Corinthians, on their impiety and absurdity in partaking both of the Lord's table and the table of devils; for "what (says he) had the eaters of the sacrifices to do with the partakers of the bread and wine in the Lord's Supper, if the Lord's Supper was not a feast of the same kind with their feasts? If the three feasts, Jewish, Pagan, and Christian, had not one common nature, how could the apostle have inferred that this intercommunity was inconsistent? *Ye* CANNOT (says he) *drink the cup of the Lord and the cup of devils; ye* CANNOT *be partakers of the Lord's table and the table of devils.* For though there might be *impiety* in the promiscuous use of Pagan and Christian rites of any kind, yet the *inconsistency* arises from their having a common nature, and consequently, as they had opposite originals, from their destroying one another's effects in the very celebration. Sacrifices, and feasts upon sacrifices, were universally considered as *federal* rites; and therefore the Lord's table and the table of devils being both *federal* rites, the same man could no more

be partaker of both, than he could at once engage to ſerve both God and the devil. This is the apoſtle's argument to the wiſe men, to whom he appeals; and we ſee that it turns altogether upon this poſtulatum, that the Chriſtian and Pagan feaſts had the ſame ſpecific nature, or were both feaſts upon ſacrifices. If this be admitted, it is eaſy to ſee why St Paul deemed thoſe who ate and drank unworthily guilty of the body and blood of the Lord; for if the Lord's Supper be a feaſt upon his ſacrifice, it muſt have been conſidered as the means of conveying to the communicants all the benefits of his death and paſſion; and the profanation of ſuch a rite, by rendering his death ineffectual, might be fitly compared and juſtly equalled to the enormous guilt of thoſe by whom his blood was ſhed." In reply to biſhop Hoadley's remarks upon the word κοινωνια, his brother biſhop obſerves, that "had the apoſtle meant what the learned writer makes him to mean, he would doubtleſs have ſaid κοινωνια ὑμων εις το σωμα, 'your communion in the body—your eating it jointly.' St Paul (continues he) knew how to expreſs himſelf properly, as appears from a paſſage in his epiſtle to the Philippians, where, profeſſedly ſpeaking of the joint participation of a bleſſing, he uſes theſe words, κοινωνια ὑμων εις το ευαγγελιον, 'your communion in the goſpel.' To the other remark, that no ſpiritual part could be thought of in the table of idols, becauſe an idol is ſaid by the apoſtle to be *nothing*, biſhop Warburton replies, "that by St Paul the Gentiles are ſaid to have ſacrificed to devils, and thoſe who ate of ſuch ſacrifices to have had communion with devils: now the *devil* (continues his Lordſhip) was in St Paul's opinion *ſomething*." But the inference which the apoſtle draws from the acknowledged truth, that the cup of bleſſing which we bleſs is the communion of the blood of Chriſt, and the bread which we break the communion of the body of Chriſt, puts his meaning, our author thinks, beyond all doubt. He ſays †, that the partaking of one bread makes the receivers of *many* to become *one body*. A juſt inference, if this rite be of the nature of a *feaſt upon the ſacrifice*; for then *the communion of the body and blood of Chriſt* unites the receivers into one body by an equal diſtribution of one common benefit. But if it be only a general commemoration of a deceaſed benefactor, it leaves the receivers as it found them, not *one body*, but *many ſeparate profeſſors* of one common faith.

Thus have we given ſuch a view as our limits would permit us to give, of the principal opinions that have been held reſpecting the nature and end of the Lord's Supper. It is an ordinance which ſeems not to be generally underſtood; though, being intended to ſhow forth the Lord's death till he come, it is ſurely of ſufficient importance to engage the attention of every ſerious Chriſtian. The moſt conſiderable Proteſtant divines who have expreſsly written upon it are, Johnſon in his *Unbloody Sacrifice*; Cudworth in his *Diſcourſe concerning the true Nature of the Lord's Supper*; Hoadley in his *Plain Account*; and Warburton in his *Rational Account*. The notions of Cudworth and Warburton are the ſame, and perhaps they differ not ſo much from thoſe of Johnſon as many readers ſeem to imagine. At any rate, the arguments by which Warburton ſupports his doctrine muſt have ſome force, ſince it is ſaid that Hoadley himſelf acknowledged they would be unanſwerable, if it could be proved that the death of Chriſt was a real ſacrifice.

SUPPLEMENT, in literature, an appendage to ſupply what is wanting in a book. Books of various kinds require ſuch an appendage; but none ſo much as a dictionary of arts and ſciences, which, from the progreſſive courſe of phyſical ſcience, cannot be completed without it.

SUPPORTED, in heraldry, a term applied to the uppermoſt quarters of a ſhield when divided into ſeveral quarters, theſe ſeeming as it were ſupported or ſuſtained by thoſe below. The chief is ſaid to be ſupported when it is of two colours, and the upper colour takes up two-thirds of it. In this caſe it is ſupported by the colour underneath.

SUPPORTERS, in heraldry, figures in an atchievement placed by the ſide of the ſhield, and ſeeming to ſupport or hold up the ſame. Supporters are chiefly figures of beaſts: figures of human creatures for the like purpoſe are called *tenants*.

SUPPOSITION, in muſic, is when one of the parts dwells on a note, while another part makes two or more leſſer notes equivalent to it, by conjoint degrees.

Suppoſition is defined by a late author the uſing of two ſucceſſive notes, of the ſame value as to time; the one whereof, being a diſcord, ſuppoſes the other a concord.

The harmony, Mr Malcolm obſerves, is always to be full on the accented parts of the bar or meaſure; but, on the unaccented, diſcords may tranſiently paſs, without any offence to the ear. This tranſient uſe of diſcords, followed by concords, make what we, after the French, call *ſuppoſition*.

Concords by ſuppoſition are thoſe where the continued baſs adds or ſuppoſes a new ſound below the fundamental baſs; whence ſuch concords always exceed the extent of the octave. Of theſe concords there are three ſorts, all which are concords of the ſeventh: the firſt, when the added ſound is a third below the fundamental ſound; ſuch is the concord of the ninth: and if the concord of the ninth is formed by the mediant, added below the ſenſible concord in the minor mode, then the concord is called the *ſuperfluous fifth*. The ſecond kind is, when the ſuppoſed ſound is a fifth below the fundamental ſound, as in the concord of the fourth or eleventh; and if the concord is ſenſible, and the tonic be ſuppoſed, this concord is called the *ſuperfluous ſeventh*. The third kind is that where the ſuppoſed ſound is below a concord of the diminiſhed ſeventh: if it is a fifth below, *i. e.* if the ſuppoſed ſound be the mediant, the concord is called the concord of the *fourth* and *ſuperfluous fifth*: if it is a ſeventh below, *i. e.* if the ſuppoſed ſound be the tonic, the concord is called the *leſſer ſixth* and *ſuperfluous ſeventh*.

SUPPOSITORY, a kind of medicated cone or ball, which is introduced into the anus for opening the belly.

It is uſually compoſed of common honey, mixed up with either ſoap or oil, and formed into pieces of the length and thickneſs of the little finger, only pyramidal. To the compoſition is ſometimes alſo added powder of ſcammony, euphorbium, colocynthis, ſalt, aloes, &c. according to the caſe of the patient.

The ſuppoſitory was invented for the convenience of ſuch as have an averſion to the taking of clyſters; or to be uſed when the diſeaſe does not allow thereof.

SUPPRESSION, in medicine, is generally uſed to ſignify a retention of urine or of the menſes.

SUPPURATION, the ſecond way wherein an inflammation terminates; being a converſion of the inſpiſſated blood and the firſt adjacent parts, as the veſſels and fat into pus or matter; which diſorder, when it has not yet found an opening, is generally called an *abſceſs*.

SUPRACOSTALES, in anatomy. See *Table of the Muſcles* in ANATOMY.

SUPRALAPSARIANS, in theology, perſons who hold that God, without any regard to the good or evil works of men, has reſolved, by an eternal decree, *ſupra lapſum*, antecedently to any knowledge of the fall of Adam, and independently of it to ſave ſome and to damn others; or, in other words, that God intended to glorify his juſtice in

in the condemnation of some, as well as his mercy in the salvation of others; and for that purpose decreed that Adam should necessarily fall, and by that fall bring himself and all his offspring into a state of everlasting condemnation.

These are also called *antelapsarians*, and are opposed to sublapsaries and infralapsaries.

According to the supralapsarians, the object of predestination is, *homo creabilis et labilis*; and, according to the sublapsarians and infralapsarians, *homo creatus et lapsus*.

SUPRASPINATUS, in anatomy. See *Table of the Muscles* in ANATOMY.

SUPREMACY, the superiority or sovereignty of the king. See SOVEREIGNTY.

SUR, or SHUR (anc. geog.), a desert of Arabia Petræa, extending between Palestine and the Arabian Gulph; into which the Israelites, after marching through the Red Sea, first came (Exod. xv. 22.) Again (Numb. xxxiii. 8.), it is said, that from the sea they went three days journey into the Wilderness of Etham; whence some conclude that Etham and Shur are the same wilderness; or only differ as a part from the whole, Shur being the general name, and Etham that part of it lying next to the place of encampment of the same name. We know so little of the geography of these places, that there is more room for disputation than for decision. As to the route which the Israelites followed in their passage through the Red Sea, Mr Bryant, we think, has given the most satisfactory account in his late work on the Plagues of Egypt.—Shur is now called *Corondel*.

SURAT, a city of Indostan, belonging to Britain, on the western coast of the peninsula, a little to the northward of Bombay, and about 16 miles up the river Tappee. It is but of modern date, and is a most remarkable instance of the power of trade to bring wealth and population to any spot where it can be brought to settle. Towards the middle of the last century this place was only the resort of a few merchants, who, under the shelter of an old insignificant castle, laid the first foundations of a city now almost as large and fully as populous as London within the walls, and containing many fine buildings of Indian architecture, which is partly Gentoo and partly Morisque. Those of the greatest note are so contrived, that the gateway is defensible against any sudden irruption of a few armed men. The private apartments lie backwards for the conveniency of the women, of whom the Moors are remarkably jealous. They are fond of having one room, in the midst of which a fountain keeps playing, and which, by its noise, lulls them to sleep, and refreshes the room by its coolness; but thus a damp is produced, which would be very dangerous to Europeans. They have also generally a saloon with fountains playing in it, which, with the variegated flower-beds, in which they are very curious, makes a beautiful prospect. During the intense heats of summer they have country retirements a little way out of town, where they reside, or go in parties to amuse themselves. The streets are irregularly laid out; but have one property which renders it agreeable to walk in them, viz. that a competent width being left at bottom, the upper stories of the houses project over one another in such a manner, that people may with ease converse from them; by which means the street is agreeably shaded, at the same time that a proper ventilation is not impeded, but rather promoted. The shops, notwithstanding the vast trade carried on in this great and populous city, have a very mean appearance, owing to the dealers keeping their goods in warehouses, and selling by samples.

No place is better supplied with provisions than the city of Surat while its communication with the country remains open. Besides the unbounded importation, by which every article is brought here in great abundance, the natural productions of the soil are excellent, though less cheap than in other parts of India, as at Bengal especially; yet in that place, though the cattle and poultry are bought originally at a very low rate, they turn out very dear by the time they are fed for the table. Here, however, all kinds of eatables may be had at a reasonable price, ready for immediate use, and as good as can be found anywhere. The wheat of Surat is famous all over India for its singular substance, whiteness, and taste; and its sallads and roots are likewise of an excellent quality. There are also many kinds of wild-fowl and other game to be had at an easy rate; but for wines and spirituous liquors they depend mostly on importation.

Surat was surrounded with a wall in a short time after it had assumed the form of a town. The fortification, however, was meant only to prevent the incursions of the Mahrattas, who had twice pillaged it; so that the place was by no means capable of standing any regular siege. Even the castle appears but a poor defence, being mounted with cannon here and there, without any order, or without any thing like an attempt towards military architecture.

In this city, before the East India company became invested with the possession of Bombay, was the presidency of their affairs on the western coast. For this purpose they had a factory established there with great privileges by the Mogul government; and even after the presidency was established at Bombay, they continued a factory here at one of the best houses in the city; which yet not being spacious enough to contain their effects, they hired another at some distance from it, and nearer the water-side, which was called the new factory. In the mean time, the city flourished, and became the centre of all the Indian trade, being much more frequented for the sake of foreign merchandize than for either the natural productions or manufactures of the country, though they also made a considerable part of its commerce. In short, there was scarce any article of merchandize but what was to be found at all times in Surat, almost as readily as in London itself. While the Mogul government was in its vigour, there was such a show of justice kept up, as induced merchants of all religions and denominations to take up their residence in the city. The Gentoos especially resorted thither, in order to avoid the oppressions of their own government. Great care indeed was taken that no very flagrant acts of oppression should be committed; so that, in what sometimes happened, appearances were at least kept up; and the oppressions of government were chiefly owing to the animosities and rivalship of the merchants themselves. As an instance of the great extent to which commerce was pushed in Surat, we shall here quote from Mr Grose, what is said by Captain Hamilton of a merchant named *Abdulgafour*, viz. "That he drove a trade equal to the East India company: for he had known him fit out in a year above 20 sail of ships, between 300 and 800 tons, none of which had less of his own stock than L. 20,000, and some of them L. 25,000. After that foreign stock was sent away, it behoved him to have as much more of an inland stock for the following year's market." On the decease of this merchant, the government seized on a million of his money; and his grandson was not only deprived of all that he possessed, but barbarously murdered through the envy and treachery of his brother merchants, and the rapacity of the governor.

The city of Surat was taken and ruined by the Portuguese in 1520; and it was not till after this misfortune that it became such a celebrated emporium. All the Indian merchants who had been accustomed to trade thither contributed to re-establish it; but it was not till near a century after that it became the general staple of Indian and European

European merchandize; when the Dutch appearing in the Indian ocean, had deprived the Portuguese of all their conquests on that coast, and almost entirely ruined their trade. The English established a factory here in 1609, the Dutch in 1616, and the French in 1665. In process of time, the Indian seas being greatly infested by pirates, a naval officer was appointed by the Mogul to keep them in awe. This officer was named *Siddee* (A) *Mussoot*, who had been chief of an Ethiopian colony settled at Rajapore. Here he had collected some vessels of considerable force, and carried on some trade, till he was dispossessed by the Mahrattas; upon which he repaired to Bombay, and afterwards to Surat, where he was appointed admiral on that station to the Mogul, with a yearly revenue of about L. 36,000 Sterling. Though he had no power, indeoendent of the marine, he seized on the castle, encroached on the town, and appropriated to himself a third part of its revenues, under pretence of arrears due in his appointed revenue. Another third was paid to the Mahrattas, to prevent their depredations upon trade in the open country; but they, not satisfied with this stipulation, watched an opportunity to plunder the town, which was kept in subjection by Siddee Mussoot till his death, which happened in 1756.

Siddee Mussoot was succeeded by his son, who soon rendered himself very disagreeable to the inhabitants. In 1758 the English factory was greatly oppressed by him, and the black merchants treated still worse; on which the latter applied to Mr Ellis the English chief at that time, desiring him to recommend it to the presidency of Bombay to take the castle by force out of the hands of the usurper. This proposal proving agreeable, Admiral Pococke, who was then with his squadron at Bombay, readily concurred in supporting the expedition. The enterprize was conducted with the usual success attending the British arms; and Captain Maitland the conductor took possession of the castle with its revenue in name of the East India company, who were confirmed in the government by grants from the Mogul.

SURCHARGE OF THE FOREST, is when a commoner puts more beasts in the forest than he has a right to. See FOREST.

Surcharge of Common, is a disturbance of common of pasture, by putting more cattle therein than the pasture and herbage will sustain, or the party hath a right to do. This injury can only happen where the common is appendant or appurtenant, and of course limitable by law; or where, when in gross, it is expressly limited and certain; for where a man hath common in gross, *sans nombre*, or without stint, he cannot be a surcharge. In this case indeed there must be left sufficient for the lord's own beasts.

The usual remedies for surcharging the common are by the lord's distraining the surplus number, or by his bringing an action of trespass, or by a special action on the case, in which any commoner may be plaintiff. The ancient and most effectual method of proceeding is by writ of admeasurement of pasture.

Writ of Second Surcharge, de secunda superoneratione, is given by the statute of Westm. 2. 13 Edw. I. cap. 8. when, after the admeasurement of pasture hath ascertained the right, the same defendant surcharges the common again; and thereby the sheriff is directed to inquire by a jury whether the defendant has in fact again surcharged the common; and if he has, he shall then forfeit to the king the supernumerary cattle put in, and also shall pay damages to the plaintiff.

SURCINGLE, a girdle wherewith the clergy of the church of England usually tie their cassocks. See GIRDLE.

SURCOAT, a coat of arms, to be worn over body armour.

The surcoat is properly a loose thin taffety coat, with arms embroidered or painted on it. Such as is worn by heralds, anciently also used by military men over their armour to distinguish themselves by.

SURD, in arithmetic and algebra, denotes any number or quantity that is incommensurable to unity: otherwise called an *irrational number* or *quantity*. See ALGEBRA, Part I. Chap. IV.

SURETY, in law, generally signifies the same with BAIL.

SURF, is a term used by seamen to express a peculiar swell and breaking of the sea upon the shore. It sometimes forms but a single range along the shore, and at others three or four behind one another extending perhaps half a mile out to sea. The surf begins to assume its form at some distance from the place where it breaks, gradually accumulating as it moves forward till it gain, not uncommonly, in places within the limits of the trade-winds, a height of 15 or 20 feet, when it overhangs at top, and falls like a cascade with great force and a prodigious noise. Countries where surfs prevail require boats of a particular construction very different from the greater part of those which are built in Europe. In some places surfs are great at high, and in others at low water; but we believe they are uniformly most violent during the spring-tides.

It is not easy to assign the cause of surfs. That they are affected by the winds can hardly be questioned; but that they do not proceed from the *immediate* operation of the wind in the places where they happen, is evident from this circumstance, that the surf is often highest and most violent where there is least wind, and *vice versa*. On the coast of Sumatra the highest are experienced during the south-east monsoon, which is never attended with such gales as the north-west. As they are most general in the tropical latitudes, Mr Marsden, who seems to have paid much attention to the subject, attributes them to the trade-winds which prevail at a distance from shore between the parallels of 30 degrees north and south, whose uniform and invariable action causes a long and constant swell, that exists even in the calmest weather, about the line, towards which its direction tends from either side. This swell, when a squall happens or the wind freshens up, will for the time have other subsidiary waves on the extent of its surface, breaking often in a direction contrary to it, and which will again subside as a calm returns, without having produced on it any perceptible effect. Sumatra, though not continually exposed to the south-east trade-wind, is not so distant but that its influence may be presumed to extend to it; and accordingly at Poolo Pesang, near the southern extremity of the island, a constant southerly sea is observed, even after a strong north-west wind. This incessant and powerful swell rolling in from an ocean, open even to the pole, seems an agent adequate to the prodigious effects produced on the coast; whilst its very size contributes to its being overlooked. It reconciles almost all the difficulties which the phenomena seem to present, and in particular it accounts for the decrease of the surf during the north-west monsoon, the local wind then counteracting the operation of the general one; and it is corroborated by an observation, that the surfs on the Sumatran coast ever begin to

(A) When the Abyssinian slaves are promoted to any office under the Mogul government, they are called *Siddees*.

to break at their southern extreme, the motion of the swell not being perpendicular to the direction of the shore. This explanation of the phenomena is certainly plausible; but, as the author candidly acknowledges, objections may be urged to it. The trade-winds and the swell occasioned by them are remarkably steady and uniform; but the surfs are much the reverse. How then comes an uniform cause to produce unsteady effects?

In the opinion of our author it produces no unsteady effects. The irregularity of the surfs, he says, is perceived only within the remoter limits of the trade-winds. But the equatorial parts of the earth performing their diurnal revolution with greater velocity than the rest, a larger circle being described in the same time, the waters thereabout, from the lessened centrifugal force, may be supposed more buoyant; to feel less restraint from the sluggish principle of matter; to have less gravity; and therefore to be more obedient to external impulses of every kind, whether from the winds or any other cause.

SURFACE. See SUPERFICIES.

SURFEIT, in medicine, a sickness with a sensation of a load at the stomach, usually proceeding from some error in diet, either with regard to the quantity or quality of the food taken. Sometimes, however, a surfeit is only a plethora from indolence and full but improper feeding; in which case perspiration is defective; and eruptions form themselves on the skin.

A surfeit from animal food, as muscles, putrid flesh, &c. is best remedied by the use of vegetable acids, which may be taken diluted with water, a vomit being premised, and this even though a vomiting and purging both attend.

When an excess of feeding is the cause, the primæ viæ being evacuated, and the nature of the plethora attended to, that the load may be properly evacuated, the indication of cure will be, to recover the perspiratory discharge, consistent with which diuretics may be used in preference to medicines which produce any other evacuation.

SURFEIT, in farriery. See FARRIERY, § xix.

SURGE, in the sea-language, the same with a wave. See WAVE.

SURGEON, or CHIRURGEON, one that professes the art of SURGERY.

In England there are two distinct companies of surgeons now occupying the science or faculty of surgery; the one company called *barbers*, the other *surgeons*, which latter are not incorporated.—The two are united to sue, and be sued, by the names of masters or governors and commonalty of the mystery of barbers and surgeons of London. 32 H. VIII. c. 42.

No person using any barbery or shaving in London, shall occupy any surgery, letting of blood, or other matter; drawing of teeth only excepted. And no person using the mystery or craft of surgery shall occupy or exercise the feat or craft of barbary, or shaving, neither by himself, nor any other for his use. 32 H. VIII. c. 42.

By the same statute, surgeons are obliged to have signs at their doors.

The French chirurgeons being refused to be admitted into the universities (notwithstanding that their art makes a branch of medicine), on pretence of its bordering a little on butchery or cruelty, associated themselves into a brotherhood, under the protection of S. Cosmus and S. Damian: on which account, according to the laws of their institution, they are obliged to dress and look to wounds *gratis* the first Monday of each month.

They distinguish between a chirurgeon of the long robe and a barber-chirurgeon. The first has studied physic, and is allowed to wear a gown. The skill of the other, besides what relates to the management of the beard, is supposed to be confined to the more simple and easy operations in chirurgy; as bleeding, tooth-drawing, &c.

They were formerly distinguished by badges: those of the long gown bore a case of instruments; the barber, a bason.

S U R G E R Y,

THAT part of medicine which treats of diseases to be cured or alleviated by the hand, by instruments, or by external applications.

CHAP. I. *History of Surgery.*

THAT surgery was coeval with the other branches of medicine, or perhaps antecedent to any of them, will not admit of doubt. The wars and contentions which have taken place among mankind almost ever since their creation, necessarily imply that there would be occasion for surgeons at a very early period; and probably these external injuries would for some time be the only diseases for which a cure would be attempted, or perhaps thought practicable.—In the sacred writings we find much mention of balsams, particularly the balm of Gilead, as excellent in the cure of wounds; though at the same time we are informed that there were some wounds which this balsam could not heal.

1 Surgery early practised.

Concerning the surgery practised among the Egyptians, Jews, and Asiatic nations, we know little or nothing. The Greeks were those from whom the art descended to us, though they confessedly received it from the eastern nations. The first Greek surgeons on record are Æsculapius and his sons Podalirius and Machaon. Æsculapius flourished about 50 years before the Trojan war; and his two sons distinguished themselves in that war both by their valour and skill in curing wounds. This indeed is the whole of the medical skill attributed to them by Homer; for in the plague which broke out in the Grecian camp, he does not mention their being at all consulted. Nay, what is still more strange, tho' he sometimes mentions his heroes having their bones broke, he never takes notice of their being reduced or cured by any other than supernatural means; as in the case of Æneas, whose thigh-bone was broken by a stone cast at him by Diomed. The methods which these two famous surgeons used in curing the wounds of their fellow-soldiers seems to have been the extracting or cutting out the darts which inflicted them, and applying emollient fomentations or styptics to them when necessary: and to these they undoubtedly attributed much more virtue than they could possibly possess; as appears from the following lines, where Homer describes Eurypylus as wounded and under the hands of Patroclus, who would certainly practise according to the directions of the surgeons.

2 History of it among the Greeks.

Patroclus cut the forky steel away;
Then in his hands a bitter root he bruis'd,
The wound he wash'd, the styptic juice infus'd.
The *closing flesh* that instant ceas'd to glow;
The wound to torture, and the blood to flow.

Till

Till the days of Hippocrates we know very little of what was the practice of the Greek surgeons. From him, however, we learn, that the practice of blood-letting, cupping, and scarification, was known to them; also the use of warm and emollient fomentations, issues made with hot irons, pessaries, injections, fumigations, &c. Hippocrates also gives directions with regard to fractures, luxations, ulcers, fistulas. He directs the extension, reduction, bandages, and splints, proper to be used in fractures and luxations of different bones, with several machines to increase the extension when necessary. He directs the laxity and tightness of the bandages; the intervals for unloosing and binding them on again; the position and repose of the fractured member, and the proper regimen; and he mentions the time when a callus is usually formed. He treats also of fractures of the skull, and the method of applying the trepan. In his treatment of ulcers, he speaks of reducing fungous flesh by means of escharotics, some of which are alum, nitre, verdigrise, quicklime, &c.

In the time of Ptolemy Philopater of Egypt, medicine, all the branches of which had hitherto been practised by the same person, was now divided into three, viz. the dietetic, pharmaceutic, and surgical; from which time to the present, surgery has continued to be reckoned a distinct profession from medicine, though very improperly, in the opinion of the best authors.

Surgery appears not to have existed in Rome, notwithstanding the warlike genius of the people, for more than 500 years. Archagathus, a Greek, was the first professor of that art in the city; and so frequently employed the knife, hot irons, and other cruel methods of cure, that he was branded with the opprobrious title of *carnifex*, and expelled the city, where no physician or surgeon of eminence again made his appearance for 180 years. At this time Asclepiades undertook the profession of medicine; but seems to have dealt little in surgery. Neither have we any thing of importance on that subject till the time of Celsus, who flourished during the reigns of Augustus and Tiberius.—In his surgery, all the improvements from Hippocrates to his own days are collected; the most minute and trifling diseases are not omitted. An eminent surgeon, of the modern, emphatically exhorts every person in that profession "to keep Celsus in his hands by day and by night." He describes the signs of a fractured skull, the method of examining for the fracture, of laying the bone bare by an incision in the form of the letter X, and afterwards of cutting away the corners, and of applying the trepan, with the marks of danger and of recovery. He observed, that sometimes, though very rarely, a fatal concussion of the brain might happen, the blood-vessels within the skull being burst, yet the bone remaining entire. After the operation of the trepan, sponges and cloths wetted with vinegar, and several other applications, were made to the head; and, throughout, severe abstinence was enjoined. In violent fractures of the ribs, he ordered venesection; low diet; to guard against all agitation of the mind, loud speaking, motion, and every thing that might excite coughing or sneezing. Cloths wetted with wine, roses and oil, and other applications, were laid over the fracture. The cure of fractures, in the upper and lower extremities, he said were nearly alike; that fractures differ in degree of violence and danger, in being simple or compound, that is, with or without a wound of the flesh, and in being near to the joint. He directs the extension of the member by assistants; the reduction, by the surgeon's hands, of the fractured bones into their natural situation; and to bind the fractured part with bandages of different lengths, previously dipped in wine and oil: on the third day fresh bandages are to be applied, and the fractured member fomented with warm vapour, especially during the inflammation. Splints, if necessary, are to be applied, to retain the bones in a fixed position. The fractured arm is to be suspended in a broad sling hung round the neck: the fractured leg is to be inclosed in a kind of case, reaching above the ham, and accommodated likewise with a support to the foot, and with straps at the side, to keep the leg steady: in the fractured thigh-bone, the case is to extend from the top of the hip to the foot. He describes the method of treating compound fractures, and of removing small fragments of splinters of bones; and the manner of extracting darts. In luxations of the shoulder, he mentions several methods of giving force to the extension, and of replacing the dislocated bone. One method similar to that of Hippocrates was, to suspend the patient by the arm; the fore-part of the shoulder, at the same time, resting upon the top of a door, or any other such firm fulcrum. Another method was to lay the patient supine, some assistants retaining the body in a fixed position, and others extending the arm in the contrary direction; the surgeon, in the mean time, attempting, by his hands, forcibly to reduce the bone into its former place.

If a large inflammation was expected to ensue after a wound, it was suffered to bleed for some time, and blood was drawn from the arm. To wounds accompanied with considerable hæmorrhagy, he applied a sponge wet in vinegar, and constant pressure: If necessary, on account of the violence of the hæmorrhagy, ligatures were made round the vessels, and sometimes the bleeding orifice was seared up with the point of a hot iron. On the third day fresh dressings were applied. In considerable contusions, with a small wound of the flesh, if neither blood-vessels nor nerves prevented, the wound was to be enlarged. Abstinence and low diet, upon all such accidents, were prescribed; cloths wet with vinegar, and several other applications, were to be applied to the inflamed part. He observes, that fresh wounds may be healed without compound applications. In external gangrene, he cut into the sound flesh; and when the disease, in spite of every effort, spread, he advised amputation of the member. After cutting to the bone, the flesh was then separated from it, and drawn back, in order to save as much flesh as possible to cover the extremity of the bone. Celsus, though extremely diffuse in the description of surgical diseases, and of various remedies and external applications, treats slightly of the method of amputating; from which, comparing his treatise with the modern systems, we might infer that the operation was then seldomer practised than at present. He describes the symptoms of that dangerous inflammation the carbuncle, and directs, immediately to burn, or to corrode the gangrened part. To promote the suppuration of abscesses, he orders poultices of barley-meal, or of marshmallows, or the seed of linseed and fenugreek. He also mentions the compositions of several repellent cataplasms. In the *erysipelas*, he applies ceruse, mixed with the juice of solanum or nightshade. Sal ammoniac was sometimes mixed with his plasters.

He is very minute in describing diseases of the eyes, ears, and teeth, and in prescribing a multitude of remedies and applications. In inflammation of the eyes, he enjoined abstinence and low diet, rest, and a dark room: if the inflammation was violent, with great pain, he ordered venesection, and a purgative; a small poultice of fine flower, saffron, and the white of an egg, to be laid to the forehead to suppress the flow of pituita; the soft inside of warm wheat bread dipped in wine, to be laid to the eye; poppy and roses were also added to his collyriums, and various ingredients too tedious to enumerate. In chronic watery defluxions

History.

xions of the eyes, he applied aftringents, cupped the temples, and burnt the veins over the temple and forehead. He couched cataracts by depreffing the cryftalline lens to the bottom of the orbit. Teeth, loofened by any accident, he directs, after the example of Hippocrates, to be faftened with a gold thread to thofe adjoining on each fide. Previous to drawing a tooth, he ordered the gum to be cut round its neck; and if the tooth was hollow, it was to be filled with lead before extraction, to prevent its breaking by the forceps. He defcribes not only the inflammation, but likewife the ulceration, or the ozæna: he alfo defcribes the polypus, and fome other difeafes affecting the nofe.

He defcribes feveral fpecies of herniæ or rupture, and the manual affiftance required in thofe complaints. After the return of the inteftines into the abdomen, a firm comprefs was applied to that part of the groin through which they protruded, and was fecured by a bandage round the loins. In fome cafes, after the return of inteftinal ruptures, he diminifhed the quantity of loofe fkin, and formed a cicatrix, fo as to contract over the part, to render it more rigid and capable of refifting. He defcribes various difeafes of the genital parts, the hydrocele or dropfy of the fcrotum, a difficulty of urine, and the manner of drawing off the water by a catheter; the figns of ftone in the bladder, and the method of founding or feeling for that ftone. Lithotomy was at that time performed by introducing two fingers into the anus; the ftone was then preffed forward to the perinæum, and a cut made into the bladder; and by the finger or by a fcoop the ftone was extracted. He defcribes the manner of performing this operation on both the fexes, of treating the patient, and the figns of recovery and of danger.

Celfus directed various corrofive applications and injections to fiftulas; and, in the laft extremity, opened them to the bottom with a knife, cutting upon a grooved inftrument or conductor. In old callous ulcers, he made a new wound, by either cutting away the hard edges, or corroding them with verdigrife, quicklime, alum, nitre, and with fome vegetable efcharotics. He mentions the fymptoms of caries in the bone; directs the bone to be laid bare, and to be pierced with feveral holes, or to be burnt or rafped, in order to promote an exfoliation of the corrupted part; afterwards to apply nitre and feveral other ingredients. One of his applications to a cancer was auripigmentum or arfenic. He directs the manner of tapping the abdomen in afcites, and of drawing blood by the lancet and cupping-glaffes. His cupping-glaffes feem not to have been fo convenient as the modern: they were made either of brafs or horn, and were unprovided with a pump. He cured varicofe veins by uftion or by incifion. He gives directions for extracting the dead fœtus from the womb, in whatever pofition it fhould prefent; and, after delivery, to apply to the private parts foft cloths wet in an infufion of vinegar and rofes. In Celfus's works there is a great redundance and fuperfluity of plafters, ointments, efcharotics, collyriums, of fuppurating and difcutient cataplafms, and external applications of every kind, both fimple and compound: Perhaps, amongft the multitude, there are a few ufeful remedies now laid afide and neglected.

The laft writer of confequence who flourifhed at Rome was Galen, phyfician to the emperor Marcus Aurelius. His works are for the moft part purely medicinal; although he wrote alfo on furgery, and made Commentaries on the Surgery of Hippocrates. He opened the jugular veins, and performed arteriotomy at the temples; directed leeches, fcarification, and cupping-glaffes, to draw blood. He alfo defcribed with accuracy the different fpecies of herniæ or ruptures.

In the year 500 flourifhed Aëtius, in whofe works we meet with many obfervations omitted by Celfus and Galen, particularly on the furgical operations, the difeafes of women, the caufes of difficult labours, and modes of delivery. He alfo takes notice of the dracunculus, or Guinea worm. Aëtius, however, is greatly excelled by Paulus Egineta, who flourifhed in 640; whofe treatife on furgery is fuperior to that of all the other ancients. He directs how to extract darts; to perform the operation fometimes required in dangerous cafes of rupture or hernia. He treats alfo of aneurifm. Galen, Paulus, and all the ancients, fpeak only of one fpecies of aneurifm, and define it to be "a tumor arifing from arterial blood extravafated from a ruptured artery." The aneurifm from a dilatation of the artery is a difcovery of the moderns. In violent inflammations of the throat, where immediate danger of fuffocation was threatened, Paulus performed the operation of bronchotomy. In obftinate defluxions upon the eyes, he opened the jugular veins. He defcribes the manner of opening the arteries behind the ears in chronic pains of the head. He wrote alfo upon midwifery. Fabricius ab Aquapendente, a celebrated furgeon of the 16th century, has followed Celfus and Paulus as text-books.

4 Among Arabians.

From the time of Paulus Egineta to the year 900, no writer of any confequence, either on medicine or furgery, appeared. At this time the Arabian phyficians Rhazes and Avicenna revived in the eaft the medical art, which, as well as others, was almoft entirely extinguifhed in the weft. Avicenna's *Canon Medicinæ*, or General Syftem of Medicine and Surgery, was for many ages celebrated through all the fchools of phyfic. It was principally compiled from the writings of Galen and Rhazes. The latter had correctly defcribed the fpina ventofa, accompanied with an enlargement of the bone, caries, and acute pain. In difficult labours, he recommends the fillet to affift in the extraction of the fœtus; and for the fame purpofe, Avicenna recommends the forceps. He defcribes the compofition of feveral cofmetics to polifh the fkin, and make the hair grow, or fall off.

Notwithftanding this, however, it was not till the time of Albucafis that furgery came into repute among the Arabians. Rhazes complains of their grofs ignorance, and that the manual operations were performed by the phyficians fervants. Albucafis enumerates a tremendous lift of operations, fufficient to fill us with horror. The hot iron and cauteries were favourite remedies of the Arabians; and, in inveterate pains, they repofed, like the Egyptians and eaftern Afiatics, great confidence in burning the part. He defcribes accurately the manner of tapping in afcites; mentions feveral kinds of inftruments for drawing blood; and has left a more ample and correct delineation of furgical inftruments than any of the ancients. He gives various obftetrical directions for extracting the fœtus in cafes of difficult labour. He mentions the bronchocele, or prominent tumor on the neck, which, he tells us, was moft frequent among the female fex. We are alfo informed by this writer, that the delicacy of the Arabian women did not permit male furgeons to perform lithotomy on females; but when neceffary, it was executed by one of their own fex.

From the 11th century to the middle of the 14th, the hiftory of furgery affords nothing remarkable except the importation of that naufeous difeafe the leprofy into Europe. Towards the end of the 15th century the venereal difeafe is faid to have been imported from America by the firft difcoverers of that continent.

At the beginning of the 16th century, furgery was held in contempt in this ifland, and was practifed indifcriminately

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by barbers, farriers, and ſow-gelders. Barbers and ſurgeons continued, for 200 years after, to be incorporated in one company both in London and Paris. In Holland and ſome parts of Germany, even at this day, barbers exerciſe the razor and lancet alternately.

It is within the laſt three centuries that we have any conſiderable improvement in ſurgery; nor do we know of any eminent Britiſh ſurgical writers until within the laſt 130 years. "In Germany (ſays Heiſter) all the different ſurgical operations, at the beginning even of the 18th century, were left to empirics; while regular practitioners were contented to cure a wound, open a vein or an abſceſs, return a fractured or luxated bone; but they ſeldom or never ventured to perform any of the difficult operations." He alſo ſpeaks of their groſs ignorance of the Latin language.

The firſt ſurgical work of the 16th century worthy of notice is that of J. Carpus. F. ab Aquapendente, an Italian, publiſhed a Syſtem of Surgery, containing a deſcription of the various diſeaſes, accidents, and operations. Boerhaave pays this author the following compliment: *Ille ſuperavit omnes, et nemo illi hanc diſputat gloriam; omnibus potius quam hocce carere poſſumus.* About the ſame period, A. Parey, a Frenchman, made ſeveral important additions to ſurgery, particularly in his collection of caſes of wounds, fractures, and other accidents which occur during war. The ancients, who were ignorant of powder and fire-arms, are defective in this part of military ſurgery. Parey pretends to have firſt invented the method of tying with a needle and ſtrong ſilk-thread waxed the extremities of large arteries, after the amputation of a member. The ligature of the blood-veſſels is, however, merely a revival of the ancient practice, which had fallen into diſuſe: Throughout the dark ages, the hot iron, cauteries, and ſtrong aſtringents, were ſubſtituted in its place. B. Maggius and L. Botallus wrote on the cure of gunſhot wounds. J. A. Cruce wrote a ſyſtem of ſurgery.

In the 17th century, ſurgery was enriched with ſeveral ſyſtems, and with detached or miſcellaneous obſervations. The principal authors are, M. A. Severinus, V. Vidius, R. Wiſeman, Le Clerc, J. Scultetus, J. Mangetus, C. Magatus, Spigelius, F. Hildanus, T. Bartholin, P. de Marchett.

Since the commencement of the preſent century, ſurgery has been enriched with many valuable and important improvements, of the greateſt part of which we have availed ourſelves in the courſe of the following treatiſe. But as it would far exceed the limits of a work of this nature to enumerate the names and writings of ſuch authors as have lived within the above period, and beſides, as it appears very unimportant to do ſo, we ſhall at once proceed to the next part of our ſubject.

Chap. II. *Of Wounds.*

Sect. I. *Of Simple Wounds.*

The firſt thing to be conſidered in the inſpection of a wound is, whether it is likely to prove mortal or not. This knowledge can only be had from anatomy, by which the ſurgeon will be able to determine what parts are injured; and, from the offices which theſe parts are calculated to perform, whether the human frame can ſubſiſt under ſuch injuries. It is not, however, eaſy for the moſt expert anatomiſt always to prognoſticate the event with certainty; but this rule he ought always to lay down to himſelf, to draw the moſt favourable prognoſis the caſe will bear, or even more than the rules of his art will allow. This is particularly incumbent on him in ſea-engagements, where the ſentence of death is executed as ſoon as pronounced, and the miſerable patient is thrown alive into the ſea, upon the ſurgeon's declaring his wound to be mortal. There are, beſides, many inſtances on record, where wounds have healed, which the moſt ſkilful ſurgeons have deemed mortal. The following wounds may be reckoned mortal.

Simple Wounds.

7 Wounds that are neceſſarily mortal.

1. Thoſe which penetrate the cavities of the heart, and all thoſe wounds of the viſcera where the large blood-veſſels are opened; becauſe their ſituation will not admit of proper applications to reſtrain the flux of blood.

2. Thoſe which obſtruct or entirely cut off the paſſage of the nervous influence through the body. Such are wounds of the brain, cerebellum, medulla oblongata, and ſpinal marrow; though the brain is ſometimes injured, and yet the patient recovers. Wounds likewiſe of the ſmall blood-veſſels within the brain are attended with great danger, from the effuſed fluids preſſing upon the brain. Nor is there leſs danger where the nerves which tend to the heart are wounded, or entirely divided; for, after this, it is impoſſible for the heart to continue its motion.

3. All wounds which entirely deprive the animal of the faculty of breathing.

4. Thoſe wounds which interrupt the courſe of the chyle to the heart; ſuch are wounds of the receptacle of the chyle, thoracic duct, and larger lacteals, &c.

5. There are other wounds which prove fatal if neglected and left to nature: ſuch are wounds of the larger external blood-veſſels, which might be remedied by ligature.

8 Symptoms of wounds in different parts of the body.

In examining wounds, the next conſideration is, whether the parts injured are ſuch as may be ſuppoſed to induce dangerous ſymptoms, either immediately or in ſome time during the courſe of the cure. In order to proceed with any degree of certainty, it is neceſſary to be well acquainted with thoſe ſymptoms which attend injuries of the different parts of the body. If the ſkin only and part of the cellular ſubſtance is divided, the firſt conſequence is an effuſion of blood; the lips of the wound retract, become tumefied, red and inflamed, leaving a gap of conſiderable wideneſs according to the length and deepneſs of the wound. Beſides, if a very conſiderable portion of ſkin and cellular ſubſtance is divided, a ſlight fever ſeizes the patient; the effuſion of blood in the mean time ſtops, and the wound is partly filled up with a cake of coagulated blood. Below this cake, the ſmall veſſels pour forth a clear liquor, which in a ſhort time is converted into pus (ſee the articles Pus and Mucus). Below this pus granulations or new fleſh ariſe, the cake of coagulated blood looſens, a new ſkin covers the place where the wound was, and the whole is healed up; only there remains a mark, called a *cicatrix* or *ſcar*, ſhowing where the injury had been received.

9 Of wounds of the ſkin and cellular ſubſtance.

10 Of the muſcles.

All wounds are accompanied with a conſiderable degree of pain, eſpecially when the inflammation comes on, though the diviſion reaches no farther than the ſkin and cellular ſubſtance. If the muſcular fibres are divided, the pain is much greater, becauſe the ſound part of the muſcle is ſtretched by the contraction of the divided part and the action of the antagoniſt muſcle, which it is now leſs fitted to bear. The wound alſo gaps much more than where the cellular ſubſtance only is divided, inſomuch that, if left to itſelf, the ſkin will cover the muſcular fibres, without any intervention of cellular ſubſtance; and not only a very unſightly cicatrix remains, but the uſe of the muſcle is in ſome meaſure loſt.—If the muſcle happens to be totally divided, its parts retract to a very conſiderable diſtance; and unleſs proper methods be taken, the uſe of it is certainly loſt ever afterwards.

11 Of the arteries.

If by a wound any conſiderable artery happens to be divided, the blood flows out with great velocity, and by ſtarts; the patient ſoon becomes faint with loſs of blood; nor

Simple Wounds.

nor does the hæmorrhagy stop until he faints away altogether, when the ends of the divided vessel close by their natural contractility; and if as much vis vitæ still remains as is sufficient to renew the operations of life, he recovers after some time, and the wound heals up as usual. The part of the artery which is below the wound in the mean time becomes useless, and its sides collapse, so that all the inferior part of the limb would be deprived of blood, were it not that the small branches sent off from the artery above the wounded place become enlarged, and capable of carrying on the circulation. Nature also, after a wonderful manner, often produces new vessels from the superior extremity of the divided artery, by which the circulation is carried on as formerly. However, the consequences of such a profuse hæmorrhagy may be very dangerous to the patient, by inducing extreme debility, polypous concretions in the heart and large vessels, or an universal dropsy. This happens especially where the artery is partially divided; because then the vessel cannot contract in such a manner as to close the orifice: however, if the wound is but small, the blood gets into the cellular substance, swelling up the member to an extreme degree, forming what is called a *diffused aneurism*. Thus the hæmorrhagy soon stops externally, but great mischief is apt to flow from the confinement of the extravasated blood, which is found to have the power of dissolving not only the fleshy parts, but also the bones themselves; and thus not only the use of the limb is entirely lost, but the patient is brought into great danger of his life, if proper assistance be not obtained in a short time.

12
Of the ligaments, nerves, and tendons.

Wounds of the ligaments, nerves, and tendons, are likewise attended with bad consequences. When a nerve is entirely divided, the pain is but trifling, though the consequences are often dangerous. If the nerve is large, all the parts to which it is distributed below the wound immediately lose the power of motion and sensation; nor is it uncommon, in such cases, for them to be seized with a gangrene. This, however, takes place only when all or the greatest part of the nerves belonging to a particular part are divided. If the spinal marrow, for instance, be divided near the head, the parts below soon lose their action irrecoverably; or if the bundle of nerves passing out of the axilla be divided or tied, sensation in the greatest part of the arm below will probably be lost. But though a nerve should be divided, and a temporary palsy be produced, it may again reunite, and perform its former functions. If a nerve be wounded only, instead of being divided, the worst symptoms frequently ensue.

13
Of the thorax and its contents.

Wounds which penetrate the cavities of the thorax are always exceedingly dangerous, because there is scarce a possibility of all the viscera escaping unhurt. A wound is known to have penetrated the cavity of the thorax principally by the discharge of air from it at each inspiration of the patient, by an extreme difficulty of breathing, coughing up blood, &c. Such wounds, however, are not always mortal; the lungs have frequently been wounded, and yet the patient has recovered.—Wounds of the diaphragm are almost always mortal, either by inducing fatal convulsions immediately, or by the ascent of the stomach, which the pressure of the abdominal muscles forces up through the wound into the cavity of the thorax; of this Van Swieten gives several instances.—Even though the wound does not penetrate into the cavity of the thorax, the very worst symptoms may follow. For if the wound descends deeply among the muscles, and its orifice lies higher, the extravasated humours will be therein collected, stagnate, and corrupt in such a manner as to form various sinuses; and after having eroded the pleura, it may at length pass into the cavity of the thorax. The matter having once found a vent into this cavity, will be continually augmenting from the discharge of the sinuous ulcer, and the lungs will at last suffer by the surrounding matter. If, in cases of wounds in the thorax, the ribs or sternum happen to become carious, the cure will be extremely tedious and difficult. Galen relates the case of a lad who received a blow upon his sternum in the field of exercise: it was first neglected, and afterwards badly healed; but, four months afterwards, matter appeared in the part which had received the blow. A physician made an incision into the part, and it was soon after cicatrized: but in a short time a new collection of matter made its appearance, and upon a second incision the wound refused to heal. Galen found the sternum carious; and having cut off the diseased part, the pericardium itself was observed to be corroded, so that the heart could be seen quite naked; notwithstanding which, the wound was cured in no very long time.

There is sometimes difficulty in determining whether the wound has really penetrated into the thorax or the abdomen; for the former descends much farther towards the sides than at the middle. But as the lungs are almost always wounded when the cavity of the thorax is penetrated, the symptoms arising from thence can scarcely be mistaken. —Another symptom which frequently, though not always, attends wounds of the thorax, is an emphysema. This is occasioned by the air escaping from the wounded lungs, and insinuating itself into the cellular substance; which being pervious to it over the whole body, the tumour passes from one part to another, till at last every part is inflated to a surprising degree. An instance is given in the Memoirs of the Royal Academy, of a tumour of this kind, which on the thorax was eleven inches thick, on the abdomen nine, on the neck six, and on the rest of the body four; the eyes were in a great measure thrust out of their orbits by the inflation of the cellular substance; and the patient died the fifth day. This was occasioned by a stab with a sword.

Wounds of the abdomen are not less dangerous than those of the thorax, on account of the importance of the viscera which are lodged there. When the wound does not penetrate the cavity, there is some danger of an hernia being formed by the protrusion of the peritonæum through the weakened integuments, and the danger is greater the larger the wound is. Those wounds which run obliquely betwixt the interstices of the muscles often produce sinuous ulcers of a bad kind. For as there is always a large quantity of fat interposed everywhere betwixt the muscles of the abdomen, if a wound happens to run between them, the extravasated humours, or matter there collected, not meeting with free egress through the mouth of the wound, often makes its way in a surprising manner through the cellular substance, and forms deep sinuosities between the muscles; in which case the cure is always difficult, and sometimes impossible. 14 Of the abdomen and its viscera.

If a large wound penetrates the cavity of the abdomen, some of the viscera will certainly be protruded through it; or if the wound is but small, and closed up with fat so that none of the intestines can be protruded, we may know that the cavity of the abdomen is pierced, and probably some of the viscera wounded, by the acute pain and fever, paleness, anxiety, faintings, hickcough, cold sweats, and weakened pulse, all of which accompany injuries of the internal parts. The mischiefs which attend wounds of this kind proceed not only from the injury done to the viscera themselves, but from the extravasation of blood and the discharge of the contents of the intestines into the cavity of the abdomen; which, being of a very putrescent nature, soon bring on the most violent disorders. Hence wounds of the abdominal viscera are very often mortal. This, however, is not always the case, for the small intestines have been totally divided, and

ple nds. and yet the patient has recovered. Wounds both of the small and large intestines have healed spontaneously, even when they were of such magnitude that the contents of the intestine was freely discharged through the wound in it, and after part of the intestine itself has been protruded through the wound of the integuments.

When the mesentery is injured, the danger is extreme, on account of the numerous vessels and nerves situated there. Wounds of the liver, spleen, and pancreas, are also exceedingly dangerous, although there are some instances of the spleen being cut out of living animals without any considerable injury.

From the preceding account of the symptoms attending wounds in the different parts of the body, the surgeon may be enabled to judge in some measure of the event; though it must always be remembered, that wounds, even those which seemed to be of the slightest nature, have, contrary to all expectation, proved mortal, chiefly by inducing convulsions, or a locked jaw; so that no certain prognostic can be drawn on sight of recent wounds. We shall now, however, proceed to consider their treatment.

nent nds. For the cure of wounds, it has been already observed, that the ancients imagined balsams, the juice of herbs, &c. to be a kind of specifics. In after-ages, and in countries where balsams are not easily to be procured, salves have been substituted in their place; and even at this day there are many who reckon a salve or ointment essentially necessary for healing the slightest cut. It is certain, however, that the cure of wounds cannot be effected, nay, not even forwarded in the least, by ointments, unless in particular cases or by accident. That power which the human frame has of repairing the injuries done to itself, which by physicians is called *vis medicatrix naturæ*, is the sole agent in curing external injuries; and without this the most celebrated balsams would prove ineffectual. When a wound has been made with a sharp instrument, and is not extensive, if it be immediately cleaned, and all the extravasated blood sucked (A) out, it will almost always heal by the first intention in a very short time. Indeed the cures performed by this simple process are so surprising, that they would be incredible were we not assured of their reality by eye-witnesses. When this process is either neglected or proves unsuccessful, there are three stages to be observed in the cure of a wound: the first, called *digestion*, takes place when the ends of the wounded vessels contract themselves, and pour out the liquor which is converted into pus. As soon as this appears, the second stage, in which the flesh begins to *grow up*, takes place; and as this proceeds, the edges of the wound acquire a fine bluish or pearl colour, which is that of the new skin beginning to cover the wound as far as the flesh has filled it up. This process continues, and the skin advances from all sides towards the centre, which is called the *cicatrizing* of the wound. For the promoting of each of these processes, several ointments were formerly much in vogue. But it is now found, that no ointment whatever is capable of promoting them; and that it is only necessary to keep the wound clean, and to prevent the air from having access to it. This, indeed, nature takes care to do, by covering the wound with a cake of coagulated blood; but if a wound of any considerable magnitude should be left entirely to nature, the pus would form below the crust of coagulated blood in such quantity, that it would most probably corrupt, and the wound degenerate into a corroding ulcer. It is necessary, therefore, to cleanse the wound frequently; and for this purpose it will be proper to apply a little ointment spread on soft scraped lint. For the first dressing, dry lint is usually applied, and ought to be allowed to remain for two or three days, till the pus is perfectly formed; after which the ointment may be applied as just now directed; and, in a healthy body, the wound will heal without further trouble. As to the ointment employed, it is almost indifferent what it be, provided it has no acrid or stimulating ingredient in its composition. Simple Wounds.

But though, in general, wounds thus easily admit of a cure, there are several circumstances which require a different treatment, even in simple divisions of the fleshy parts, when neither the membranous nor tendinous parts are injured. These are, 1. Where the wound is large, and gapes very much, so that, if allowed to heal in the natural way, the patient might be greatly disfigured by the scar. It is proper to bring the lips of the wound near to each other, and to join them either by adhesive plaster or by suture, as the wound is more superficial, or lies deeper. 2. When foreign bodies are lodged in the wound, as when a cut is given by glass, &c. it is necessary by all means to extract them, before the wound is dressed; for it will never heal until they are discharged. When these bodies are situated in such a manner as not to be capable of being extracted without lacerating the adjacent parts, which would occasion violent pain and other bad symptoms, it is necessary to enlarge the wound, so that these offending bodies may be easily removed. This treatment, however, is chiefly necessary in gunshot wounds, of which we shall treat in the next section. 3. When the wound is made in such a manner that it runs for some length below the skin, and the bottom is much lower than the orifice, the matter collected from all parts of the wound will be lodged in the bottom of it, where, corrupting by the heat, it will degenerate into a fistulous ulcer. To prevent this, we must use compresses, applied so that the bottom of the wound may suffer a more considerable pressure than the upper part of it. Thus the matter formed at the bottom will be gradually forced upwards, and that formed at the upper part will be incapable of descending by its weight; the divided parts, in the mean time, easily uniting when brought close together. Indeed, the power which nature has of uniting different parts of the human body is very surprising; for, according to authors of credit, even if a piece of flesh be totally cut out, and applied in a short time afterwards to the place from whence it was cut, the two will unite. That a part cut out of a living body does not entirely lose its vital power for some time, is evident from the modern practice of transplanting teeth; and from an experiment of Mr Hunter's at London, he put the testicle of a cock into the belly of a living hen, which adhered to the liver, and became connected to it by means of blood-vessels *. We have therefore the greatest reason to hope, that the divided parts of the human body, when closely applied to each other, will cohere without leaving any sinus or cavity between them. However, if this method should fail, and matter still be collected in the depending part of the wound, it will be necessary to make an opening in that part in order to let it out; after which the wound may be cured in the common way. 4. During the course of the cure, it sometimes happens that the wound, instead of filling up with fleshy granulations of a florid colour, shoots up into a glassy-like substance which rises above the level of the surrounding skin, while, at

* See *Blood*, n° 19.

(A) See an account of the method of sucking wounds in Mr John Bell's *Discourses on Wounds*, Part I. Discourse v. p. 215.

Simple Wounds. at the fame time, inftead of laudable pus, a thin ill-coloured and fetid ichor is difcharged. In this cafe the lips of the wound lofe their beautiful pearl colour, and become callous and white, nor does the cicatrizing of the wound at all advance. When this happens in a healthy patient, it generally proceeds from fome improper management, efpecially the making ufe of too many emollient and relaxing medicines, an immoderate ufe of balfams and ointments. Frequently nothing more is requifite for taking down thefe fungus than dreffing with dry lint; at other times deficcative powders, fuch as calamine, tutty, calcined alum, &c. will be neceffary; and fometimes red precipitate mercury muft be ufed. This laft, however, is apt to give great pain, if fprinkled in its dry ftate upon the wound; it is therefore moft proper to mix it with fome yellow bafilicon ointment, which makes a much more gentle, though at the fame time an efficacious efcharotic. Touching the overgrown parts with blue vitriol is alfo found very effectual.

16 Of the regimen of patients in wounds. Hitherto we have confidered the wounded patient as otherwife in a ftate of perfect health; but it muft be obferved, that a large wound is capable of difordering the fyftem to a great degree, and inducing dangerous difeafes which did not before exift.—If the patient is ftrong and vigorous, and the pain and inflammation of the wound great, a confiderable degree of fever may arife, which it will be neceffary to check by bleeding, low diet, and other parts of the antiphlogiftic regimen, at the fame that the inflamed lips of the wound and parts adjacent are to be treated with emollient fomentations or cataplafms till the pain and fwelling abate. On the other hand, it may happen, when the patient is of a weak and lax habit, that the vis vitæ may not be fufficient to excite fuch an inflammation in the wound as is abfolutely neceffary for its cure. In this cafe, the edges of the wound look pale and foft; the wound itfelf ichorous and bloody, without any figns of flefhy granulations; or if any new flefh fhoots up, it is of the fungous flabby kind above-mentioned. To fuch wounds all external applications are vain; it is neceffary to ftrengthen the patient by proper internal remedies, among which the bark has a principal place, until the wound begins to alter its appearance. In fuch perfons, too, there is fome danger of a hectic fever by the abforption of matter into the body when the wound is large; and this will take place during the courfe of the cure, even when the appearances have been at firft as favourable as could be wifhed. This happens generally when the wound is large, and a great quantity of matter formed: for by this difcharge the patient is weakened; fo that the pus is no fooner formed, than it is by the abforbent veffels re-conveyed into the body, and feverifh heats immediately affect the patient. For this the beft remedy is to exhibit the bark copioufly, at the fame time fupporting the patient by proper cordials and nourifhing diet. Indeed, in general, it will be found, that, in the cafe of wounds of any confiderable magnitude, a more full and nourifhing regimen is required than the patient, even in health, has been accuftomed to; for the difcharge of pus alone, where the quantity is confiderable, proves very debilitating, if the patient is not ftrengthened by proper diet. And it is conftantly found, that the cure of fuch fores goes on much more eafily when the patient is kept in his ufual habit of body, than when his fyftem is much emaciated by a very low allowance; and, for the fame reafon, purgatives, and whatever elfe tends to weaken the conftitution, are improper in the cure of wounds.

17 Of hæmorrhagies from wounds. Hæmorrhagies very frequently happen in wounds, either from a divifion of one large artery, or of a number of fmall ones. In this cafe, the firft ftep to be taken by the furgeon is to effect a temporary ftoppage of the blood by means of compreffion. He is then to tie up all the veffels in the manner to be afterwards defcribed. Simple Wounds.

When the principal arteries of a wound have been tied, and a little blood continues to be difcharged, but appears to come from fundry fmall veffels only, an experienced furgeon is inclined to think, that the neceffary compreffion of the bandages will in all probability effect a total ftoppage of the hæmorrhagy. In a general oozing of a fmall quantity of blood from the whole furface of a fore, and when no particular veffel can be diftinguifhed, there is a neceffity for trufting to this remedy; but whenever an artery can be difcovered, of whatever fize it may be, it ought unqueftionably to be fecured by a ligature. But it frequently happens, that confiderable quantities of blood are difcharged, not from any particular veffel, but from all the fmall arteries over the furface of the fore. In wounds of great extent, particularly after the extirpation of cancerous breafts, and in other operations where extenfive fores are left, this fpecies of hæmorrhagy often proves very troublefome by being exceedingly difficult to fupprefs.

Bleedings of this kind feem evidently to proceed from two very different and oppofite caufes. *Firft*, Either from too great a quantity of blood contained in the veffels, or from an over-degree of tone in the veffels themfelves; or, perhaps, from a combination of both thefe caufes. But, *fecondly*, Such evacuations undoubtedly happen moft frequently in fuch conftitutions as are very relaxed and debilitated; either from a particular ftate of the blood, or from a want of tone in the containing veffels, or, in fome inftances, from a concurrence of both.

In conftitutions perfectly healthy, on the occurrence of wounds even of the moft extenfive nature, as foon as the larger arteries are fecured, all the fmall veffels which have been divided are diminifhed, not only in their diameters, but alfo in their length; in confequence of which, they recede confiderably within the furface of the furrounding parts. This caufe of itfelf would probably, in the greateft number of inftances, prove fufficient for reftraining all lofs of blood from the fmaller arteries. Another very powerful agent however is provided by nature for producing the fame effect. From the extremities of the divided veffels which at firft difcharged red blood only, there now, in their contracted ftate, oozes out a more thin, though vifcid fluid, containing a great proportion of the coagulable parts of the blood; and this being equally diftributed over the furface of the wound, by its balfamic agglutinating powers has a very confiderable influence in reftraining all fuch hæmorrhagies.

When a tedious oozing occurs in a patient young and vigorous, and where the tone of the mufcular fibres is evidently great, the moft effectual means of putting a ftop to the difcharge is to relax the vafcular fyftem, either by opening a vein in fome other part, or, what gives ftill more immediate relief, by untying the ligature on one of the principal arteries of the part, fo as to allow it to bleed freely: thofe violent fpafmodic twitchings too, fo frequent after operations on any of the extremities, when they do not depend on a nerve being included in the ligature with the artery, are in this manner more effectually relieved than by any other means.

By the fame means the patient, from being in a febrile heat and much confufed, foon becomes very tranquil: the violent pulfation of the heart and larger arteries abates, and the blood not being propelled with fuch impetuofity into the fmaller veffels of the part, they are thereby left at more liberty to retract. In the mean time the patient ought to be kept exceedingly cool; wine and other cordials fhould be rigidly avoided; cold water, acidulated either with the mineral

ral or vegetable acids, ought to be the only drink; motion of every kind, particularly of the part affected, should be guarded against; and the wound being gently covered with soft charpie, ought to be tied up with a bandage so applied as to produce a moderate degree of pressure on the extremities of the divided parts.

As soon as a sufficient quantity of blood has been discharged, the wound being dressed, and the patient laid to rest, a dose of opium proportioned to the violence of the symptoms ought to be immediately exhibited. It ought to be remarked, however, that in all such circumstances, much larger doses of the remedy are necessary than in ordinary cases requiring the use of opiates. Small doses, instead of answering any good purpose, seem frequently rather to aggravate the various symptoms; so that whenever they are here had recourse to, they ought always to be given in quantities sufficient for the intended effect.

But hæmorrhagies of this nature happen much more frequently in relaxed enfeebled habits, where the solids have lost part of their natural firmness, and the fluids have acquired a morbid tenuity. In this case a moderate use of generous wine ought to be immediately prescribed; for nothing tends so much, in such circumstances, to restrain hæmorrhagies, as a well-directed use of proper cordials. By tending to invigorate and brace the solids, they enable the arterial system to give a due resistance to the contained fluids; and have also a considerable influence in restoring to the fluids that viscidity of texture, of which in all such instances we suppose them to be deprived.

A nourishing diet also becomes proper; the patient ought to be kept cool; and the mineral acids, from their known utility in every species of hæmorrhagy, ought also to be prescribed. Rest of body is here also proper; and opiates, when indicated either by pain or spasmodic affections of the muscles, ought never to be omitted.

Together with these remedies adapted to the general system, particular dressings, appropriated to the state of the parts to which they are to be applied, have been found very beneficial. In healthy constitutions, soon after the discharge of blood is over, the parts are covered with a viscid coagulable effusion from the mouths of the now retracted arteries; but in constitutions of an opposite nature, where the solids are much relaxed, the blood in general is found in such an attenuated state as to afford no secretion of this nature.

To supply as much as possible the deficiency of this natural balsam, different artificial applications have been invented. Dusting the part with starch or wheat-flour has sometimes been found of use, and gum arabic in fine powder has been known to answer when these failed.

Applications of this kind, indeed, have been used with success in all such hæmorrhagies, with whatever habit of body they happen to be connected; but they have always proved more particularly serviceable in relaxed constitutions, attended with an attenuated state of the blood and an enfeebled muscular system. Alcohol, or any other ardent spirits, impregnated with as great a quantity as they can dissolve of myrrh, or any other of the heating viscid gums, may be here used with freedom, though in constitutions of an opposite nature they ought never to be employed. The balsamum traumaticum of the shops, a remedy of this nature, has long been famous for its influence in such cases: but that indiscriminate use of this and similar applications which has long prevailed with some practitioners, has undoubtedly done much harm; for as they are all possessed of very stimulating powers, they of course tend to aggravate every symptom in wounds connected with a tense state of fibres, when much pain, and especially when spasmodic muscular affections prevail.

Simple Wounds.

By a due perseverance in one or other of the plans here pointed out, it will seldom happen that hæmorrhagies of this nature are not at last put a stop to: but when the contrary does occur, when, notwithstanding the use of the remedies recommended, a discharge of blood still continues; together with the means already advised, an equal moderate pressure ought to be applied over the whole surface of the sore, to be continued as long as the necessity of the case seems to indicate.

In finishing the dressings of such wounds, after the charpie and compresses have been applied, a bandage properly adapted to the part ought to conclude the whole, and in such a manner as to produce as equal a degree of pressure over the surface of the sore as possible. But it now and then happens that no bandage whatever can be so applied as to produce the desired effect; and in such cases the hand of an assistant is the only resource; which being firmly applied over the dressings, so as to produce a very equal degree of pressure, will commonly succeed when no other remedy is found to have much influence.

13 Symptoms which sometimes succeed blood-letting.

Wounds of the nerves, tendons, and ligaments, are attended with much more violent symptoms than those where even considerable arteries are divided, and frequently resist every method of cure proposed by the most skilful practitioners. In the simple process of blood-letting, it frequently happens that the tendinous expansion called the *aponeurosis* of the biceps muscle is wounded, or even the tendon of that muscle itself is punctured, by the point of the lancet; or sometimes a nerve which happens to lie in the neighbourhood is partially divided. Any one of these wounds, though they are the smallest we can well suppose to be given, are frequently very dangerous and difficult of cure. It sometimes immediately happens on the introduction of the lancet, that the patient complains of a most exquisite degree of pain; and when this occurs, we may rest assured that either a nerve or tendon has been wounded. On some occasions, by proper management, such as evacuating a considerable quantity of blood at the orifice newly made, by keeping the part at perfect rest, and preserving the patient in as cool a state as possible, the pain at first complained of will gradually abate, and at last go off entirely, without any bad consequence whatever. At other times, however, this pain which occurs instantaneously on the introduction of the lancet, instead of abating, begins soon to increase; a fullness, or small degree of swelling, takes place in the parts contiguous to the wound; the lips of the sore become somewhat hard and inflamed; and, in the course of 24 hours or so from the operation, a thin watery serum begins to be discharged at the orifice.

If, by the means employed, relief is not soon obtained, these symptoms generally continue in nearly the same state for two or perhaps three days longer. At this time the violent pain which at first took place becomes still more distressing; but instead of being sharp and acute as before, it is now attended with the sensation of a burning heat, which still goes on to increase, and proves, during the whole course of the ailment, a source of constant distress to the patient. The fullness and hardness in the lips of the wound begin to increase, and the swelling in the neighbouring parts gradually extends over the whole members. The parts at last become exceedingly tense and hard; an erysipelatous inflammatory colour frequently appears over the whole member; the pulse by this time has generally become very hard and quick; the pain is now intense, the patient exceedingly restless; twitchings of the tendons oc-

cur to a greater or leſſer degree; on ſome occaſions, a locked jaw and other convulſive affections ſupervene; and all theſe ſymptoms continuing to increaſe, it moſt frequently happens that the torture under which the patient has been groaning is at laſt terminated by death.

19 Opinions about the cauſe of theſe ſymptoms.

Different opinions have prevailed reſpecting the cauſe of theſe ſymptoms. By ſome they have been imputed to wounds of the tendons. By others the tendons are ſuppoſed to be ſo entirely deſtitute of ſenſibility, as to be quite incapable of producing ſo much diſtreſs; ſo that wounds of the nerves they conſider, on all ſuch occaſions, as the true cauſe of the various ſymptoms we have mentioned.

20 Mr John Hunter's opinion.

One or other of theſe ideas continued to be the only ſource for explaining the various phenomena found to occur in this malady, till a different opinion was ſuggeſted by the late ingenious Mr John Hunter of London. Mr Hunter ſuppoſes, that all the dreadful ſymptoms found now and then to be induced by the operation of blood-letting, may be more readily accounted for from an inflamed ſtate of the internal ſurface of the vein, than from any other cauſe. Such a ſtate of the vein he has often traced in horſes that have died of ſuch ſymptoms from veneſection, and the ſame appearances have ſometimes occurred alſo in the human body. And on other occaſions, inflammation having in this manner been once excited, has been known to terminate in ſuppuration; and the matter thus produced being in the courſe of circulation carried to the heart, Mr Hunter ſuppoſes that in ſuch caſes death may have been induced by that cauſe alone.

There can be no reaſon to doubt the fact held forth by Mr Hunter, that in ſuch inſtances the vein in which the orifice has been made has frequently after death been found greatly inflamed: but however ingenious his arguments may be for concluding that the ſtate of the vein is the original cauſe of all the bad ſymptoms enumerated, and although we muſt allow that ſuch an inflammatory affection of a vein muſt have a conſiderable influence in aggravating the various ſymptoms previouſly induced by other cauſes; yet we may very fairly conclude, that it could not probably in any one inſtance be able to account with ſatisfaction for their firſt production.

In many inſtances the patient, at the very inſtant of the operation, feels a very unuſual degree of pain. In ſome caſes, the violence of the pain is almoſt unſupportable. Now this we can never ſuppoſe to have been produced by the mere puncture of a vein; for although the coats of veins are not perhaps entirely deſtitute of feeling, yet we know well that they are not endowed with ſuch a degree of ſenſibility as to render it probable ſuch intenſe pain could ever be induced by their being punctured in any way whatever.

21 Not juſt.

This inflamed ſtate of the veins therefore, as detected by Mr Hunter after death, muſt be conſidered rather as being produced by, than as being productive of, ſuch affections; and that ſuch ailments ſhould frequently produce an inflammation of the contiguous veins, is a very probable conjecture. In the courſe of 48 hours or ſo from the operation, when the febrile ſymptoms are juſt commencing, ſuch a degree of hardneſs and evident inflammation is induced over all the parts contiguous to the orifice, that it would be ſurpriſing indeed if the vein, which is thus perhaps entirely ſurrounded with parts highly inflamed, ſhould eſcape altogether.

22 Really owing to the partial wounding of a nerve or tendon.

We ſhall therefore proceed upon the ſuppoſition of this inflamed ſtate of the veins being a conſequence rather than the cauſe of ſuch ailments; and of courſe we now revert to one or other of the opinions long ago adopted on this ſubject, that all the train of bad ſymptoms found on ſome occaſions to ſucceed veneſection, proceeds either from the wound of a nerve or of a tendon.

That a partial wound of a nerve will now and then produce very diſtreſſing ſymptoms, no practitioner will deny: but it has been attempted to be ſhown, that tendons are almoſt totally deſtitute of ſenſibility; and it has therefore been ſuppoſed, that their being wounded can never account for the various ſymptoms known to occur in ſuch caſes. There is great reaſon however to think, that in different inſtances the ſame train of ſymptoms have been induced by different cauſes; that in one inſtance a wounded nerve, and in others pricks of the tendons, have given riſe to them, as we have already ſuppoſed.

23 Method of obviating theſe ſymptoms, and of curing the wound.

In order to prevent as much as poſſible the conſequent inflammation and other ſymptoms which uſually enſue, a conſiderable quantity of blood ſhould be immediately diſcharged at the orifice juſt made: the limb, for ſeveral days at leaſt, ought to be kept in a ſtate of perfect reſt, care being at the ſame time taken to keep the muſcles of the part in as relaxed a ſtate as poſſible: the patient ſhould be kept cool; on a low diet; and, if neceſſary, gentle laxatives ought to be adminiſtered.

When, notwithſtanding theſe means, the ſymptoms, inſtead of diminiſhing, rather become more violent; if the lips of the orifice turn hard and more inflamed, if the pain becomes more conſiderable, and eſpecially if the ſwelling begins to ſpread, other remedies come then to be indicated. In this ſtate of the complaint, topical blood-letting, by means of leeches applied as near as poſſible to the lips of the wound, frequently affords much relief; and when the pulſe is full and quick, it even becomes neceſſary to evacuate large quantities of blood by opening a vein in ſome other part.

The external applications uſually employed in this ſtate of the complaint are warm emollient fomentations and poultices. In ſimilar affections of other parts no remedies with which we are acquainted would probably be found more ſucceſsful; but in the complaint now under conſideration, all ſuch applications, inſtead of being productive of any advantage, rather do harm. The heat of the part is here one of the moſt diſtreſſing ſymptoms; and warm emollient applications rather tend to augment this ſource of uneaſineſs. The lips of the wound alſo are rendered ſtill more hard, ſwelled, and of courſe more painful; and the ſwelling of the contiguous parts is increaſed. The beſt external remedies are cooling aſtringents, eſpecially the ſaturnine applications. The parts chiefly affected being alternately covered over with cloths wet with a ſolution of ſaccharum ſaturni, and pledgits ſpread with Goulard's cerate, are kept more cool and eaſy than by any other remedy hitherto uſed. The febrile ſymptoms which occur muſt at the ſame time be attended to, by keeping the patient cool, on a low diet, preſerving a lax ſtate of the bowels; and, if neceſſary, farther quantities of blood ought to be evacuated.

On account of the violence of the pain, which is ſometimes ſo exceſſive as to deſtroy entirely the patient's reſt, opiates ought to be freely exhibited; and when twitchings of the tendons and other convulſive ſymptoms ſupervene, medicines of this kind become ſtill more neceſſary. In order, however, to have a proper influence in this ſtate of the complaint, opiates ought to be given in very full doſes; otherwiſe, inſtead of anſwering any good purpoſe, they conſtantly tend to aggravate the different ſymptoms, not only by increaſing the heat and reſtleſſneſs, but by having an evident influence in rendering the ſyſtem more ſuſceptible than it was before of the pain and other diſtreſſing effects produced upon it by the wound.

It often happens, however, either from neglecting the wound or from improper treatment, that all theſe remedies are had recourſe to without any advantage whatever: the fever, pain,

 and

and swelling of the parts continuing, convulsive affections of the muscles at last occur, all tending to indicate the most imminent danger. In this situation of matters, if we have not immediate recourse to some effectual means, the patient will soon fall a victim to the disorder; and the only remedy from which much real advantage is to be expected, is a free and extensive division of the parts in which the orifice producing all the mischief was at first made. We know well, from the repeated experience of ages, that much more pain and distress of every kind is commonly produced by the partial division either of a nerve or of a tendon, than from any of these parts being at once cut entirely across. Now the intention of the operation here recommended, is to produce a complete division of the nerve or tendon we suppose to have been wounded by the point of the lancet, and which we consider as the sole cause of all the subsequent distress.

This operation being attended with a good deal of pain, and being put in practice for the removal of symptoms from which it is perhaps difficult to persuade the patient that much danger can occur, all the remedies we have mentioned should be first made trial of before it is proposed: but at the same time, care ought to be taken that the disorder is not allowed to proceed too far before we have recourse to it; for if the patient should be previously much weakened by the feverish symptoms having continued violent for any length of time, neither this remedy nor any other with which we are acquainted would probably have much influence. So soon therefore as the course already prescribed has been fairly tried, and is found to be inadequate to the effects expected from it, we ought immediately to have recourse to a free division of the parts chiefly affected.

Wherever a wounded or ruptured tendon may be situated, the limb should be placed in such a manner as will most readily admit of the retracted ends of the tendon being brought nearly together; and when in this situation, the muscles of the whole limb in which the injury has happened must be tied down with a roller, so as to prevent them from all kinds of exertion during the cure, endeavouring at the same time to keep the parts easy and relaxed. Thus in a wound or rupture of the tendon of the rectus muscle of the thigh, the patient's *leg* should be kept as much as possible stretched out during the cure, while the thigh should be in some degree bent, to relax the muscle itself as far as possible.

In similar affections of the tendo Achillis, the *knee* should be kept constantly bent to relax the muscles of the leg, and the foot should be stretched out to admit of the ends of the ruptured tendon being brought nearly into contact. A roller should be applied with a firmness quite sufficient for securing the muscles and tendons in this situation; but care must be taken to prevent it from impeding the circulation. With this view, fine soft flannel should be preferred either to linen or cotton; for being more elastic, it more readily yields to any swelling with which the limb may be attacked.

The late Dr Monro was the first who gave any accurate directions for the treatment of rupture in the large tendons; and it is perhaps given with more precision, from his having himself experienced the effects of this misfortune in the tendo Achillis.

He used a foot-sock or slipper, made of double quilted ticking, and left open at the toe; from the heel of which a strap went up above the calf of the leg. A strong piece of the same materials went round the calf, and was fastened with a lace. On the back part of this was a buckle, through which the strap of the foot-sock was passed, by which the calf could be brought down, and the foot extended at pleasure. Besides there was a piece of tin applied to the fore part of the leg, to prevent the foot from getting into any improper posture during sleep. After proposing to walk, he put on a shoe with a heel two inches deep; and it was not till the expiration of five months that he ventured to lay aside the tin plate; and he continued the use of the high-heeled shoe for two years. The whole apparatus is represented Plate CCCCXCII. fig. 124.

From this treatment a knowledge may be formed of the treatment necessary to be followed in the laceration of tendons of other parts of the body.

25 Wounds of the thorax.

In wounds of the thorax, even though none of the viscera should be wounded, we may yet reasonably expect that a considerable quantity of blood will be extravasated; and this, if very large, must be evacuated if possible. However, it ought to be particularly observed, that this extravasated blood should not be discharged before we are assured that the wounded vessels have done bleeding. When the pulse appears sufficiently strong and equal, the extremities are warm, no hickup or convulsion appears, and the patient's strength continues, we may then know that the internal hæmorrhagy has ceased, and that the means for discharging the blood may now be safely used. Matter, water, blood, &c. have sometimes vanished from the cavities of the thorax, and been afterwards discharged by sweat, urine, &c. Yet this but seldom happens; and if we were to trust to nature only in these cases, it is certain that many would perish from a destruction of the vital viscera by the extravasated and putrid blood, who by an artificial extraction of the same blood might have been saved.

Wounds of the abdomen must be closed as soon as possible, and then treated as simple wounds; only they ought to be dressed as seldom and expeditiously as may be. A spare diet, with other parts of the antiphlogistic regimen, is here absolutely necessary. 26 Wounds of the abdomen. It sometimes happens, that, thro' a large wound of the abdominal integuments, the intestine comes out without being injured; yet, if it remains for any time exposed to the air, the case is commonly very dangerous. The most certain method, in all such cases, is to return the protruded part as soon as possible; for although writers in general formerly recommended warm fomentations, &c. to be previously applied, the latest authors upon this subject consider the most natural and proper fomentation to be that which is produced by the heat and moisture of the patient's belly, and that therefore the intestines, if no mortification has taken place, are to be cleared from extraneous matter, and immediately returned.

When the wound of the abdomen is large, the intestines easily prolapse, but are as easily returned. But when part of an intestine has been forced through a narrow wound, the disorder is much more dangerous. For the prolapsed intestine being distended by flatus, or the ingested aliments driven thither by the peristaltic motion, it will be inflamed, tumefied, and incapable of being returned through the stricture of the wound; whence a stoppage of the circulation and gangrene will soon follow. In this case the utmost care is to be taken to reduce the intestine to its natural size. When this cannot be accomplished by other means, some practitioners of great eminence have even advised the puncturing of the intestine in different places in order to discharge the flatus. This practice has also been recommended in an incarcerated hernia, but is exceedingly disapproved of by Mr Pott and later writers; and it seems to be very dubious whether any good can possibly arise from it. To puncture any part that is already inflamed, must undoubtedly add to the inflammation; and it is very improbable that the

the difcharge of flatus procured by the punctures would at all be a recompenfe for the bad confequences produced by the increafed inflammation. The method of Celfus is much more eligible: It is to dilate the wound fo as to reduce the inteftine with eafe. Sometimes part of the inteftine is loft either by fuppuration or gangrene. In this cafe, all that can be done is to ftrike a fingle ftitch through the wounded bowel, and to fix it to the external wound by paffing the future alfo through the fides of the wound. The ends of the inteftine may perhaps adhere; or at any rate the wound will continue to perform the office of an anus, out of which the feces will continue to be difcharged during life. The directions given by fome furgeons about interting the upper end of the gut into the lower, and ftitching them together, are perfectly impracticable, as Mr John Bell has fhown in his important Difcourfes on Wounds*; and even if they were practicable, would certainly produce new mortification, which could not but be fatal.

* Part II. Difcourfes 4th and 5th.

When the omentum appears prolapfed, the fame general treatment is to be obferved; only that, when it is dry and mortified, the dead part may fafely be extirpated.—We fhall conclude the article of abdominal wounds with a cafe from the memoirs of the academy of fciences for the year 1705, which fhows that we ought not to defpair, even though the moft defperate fymptoms fhould take place, as long as any vis vitæ remains. A madman wounded himfelf in 18 different places of the abdomen. Eight of thefe penetrated the cavity, and injured the contained vifcera; he had a diarrhœa, naufea, and vomiting, tenfion of the abdomen, with difficult refpiration and violent fever, fo that his life was defpaired of. During the firft four days he was blooded feven times; and during the greateft part of the cure his diet confifted almoft entirely of flefh-broths, with the addition of fome mild vegetables. By thefe means he was not only cured of his wounds, but reftored to his right fenfes. Seventeen months after, he went mad again, and threw himfelf over a precipice, by which he was inftantly killed: on opening the body, the wounds were found to have penetrated the middle lobe of the liver, the inteftinum jejunum, and the colon.

Such extraordinary cures are to be imputed, according to the fatisfactory explanation of Mr J. Bell, to the abdomen being perfectly full, and conftantly fubjected to ftrong preffure between the diaphragm and abdominal mufcles; which keeps the parts contiguous to a wound clofely applied to it, prevents the difcharge of fæces or even of blood in fome meafure, and gives an opportunity for a very fpeedy adhefion between the parts.

27 Wounds of the head.

In wounds of the head, where the cellular membrane only is affected, and the aponeurofis and pericranium untouched, phlebotomy, lenient purges, and the ufe of the common febrifuge medicines, particularly thofe of the neutral kind, generally remove all the threatening fymptoms. When the inflammation is gone off, it leaves on the fkin a yellowifh tint and a dry fcurf, which continue until perfpiration takes them away; and upon the removal of the difeafe, the wound immediately recovers a healthy afpect, and foon heals without further trouble. But in the worft kind of thefe wounds, that is, where a fmall wound paffes through the tela cellulofa and aponeurofis to the pericranium, the patient will admit of more free evacuations by phlebotomy than in the former. In both, the ufe of warm fomentations is required; but an emollient cataplafm, which is generally forbid in the eryfipelatous fwellings, may in this latter cafe be ufed to great advantage. Where the fymptoms are not very preffing, nor the habit very inflammable, this method will prove fufficient; but it fometimes happens that the fcalp is fo tenfe, the pain fo great, and the fymptomatic fever fo high, that by waiting for the flow effect of fuch means the patient runs a rifk from the continuance of the fever; or elfe the injured aponeurofis and pericranium, becoming floughy, produce an abfcefs, and render the cafe both tedious and troublefome. A divifion of the wounded part, by a fimple incifion down to the bone, about half an inch or an inch in length, will moft commonly remove all the bad fymptoms; and if it be done in time, will render every thing elfe unneceffary.

The wounds penetrating into the cavities of the joints do not feem at firft alarming; yet, by expofure to the air, the lining membrane of fuch cavities acquire fuch a degree of fenfibility as to endanger life when they are large. As foon therefore as any extraneous body, pufhed into the joint, is removed, the admiffion of the external air is to be guarded againft as much as poffible. If the wound be not too large, this may be done by pulling the fkin over the wound of the joint; and, to prevent its retraction, rather adhefive plafter, with proper bandaging, is to be ufed. But when inflammation is come on, repeated and copious blood-letting, together with fomentations, become neceffary; and as the pain, in thefe cafes, is apt to be violent, opiates muft be adminiftered; but fhould matter be formed in the cavity of the joint, free vent muft be give to it. 28 Wounds of the joints.

Sect. II. *Of contufed and lacerated Wounds.*

When the fmall veffels are broken by a blow with any hard inftrument without penetrating the fkin, at the fame time that the folid fibres of the part are crufhed, the injury is termed a *contufion:* and when at the fame time the fkin is broken, it is termed a *contufed and lacerated wound;* becaufe in this cafe the parts are not fairly divided as with a knife, but torn afunder or violently ftretched.

Every contufion therefore, whether the fkin is broken or not, may properly be reckoned a wound; for where the injury is fo flight that none of the contents of the fmall veffels are extravafated, it fcarce deferves to be mentioned. The immediate confequence of a contufion, therefore, is a fwelling, by reafon of the extravafation juft mentioned; and the fkin becomes difcoloured by the blood ftagnating under it: but as this fluid, even though covered by the fkin, cannot long remain in its natural ftate, it thence happens, that the contufed part foon lofes its florid red colour, and becomes blue or black; the thinner parts being in the mean time gradually taken up by the abforbent veffels, which at laft happens to the blood itfelf; the blue difappears, and is fucceeded by a yellowifh colour, fhowing that the blood is now diffolved; after which the part recovers its former appearance, and the ruptured veffels appear to have united as though nothing had happened. 2 Symptoms and cure of contufions.

Thefe are the fymptoms which attend the flighteft kind of contufions; but it is evident, that where the blow is fo violent as to rupture or crufh fome of the large nerves, or blood-veffels, all the bad confequences which attend fimple wounds of thofe parts will enfue, and they will not at all be alleviated by the circumftance of the fkin being whole. Hence it is eafy to fee how a contufion may produce ulcers of the worft kind, gangrene, fphacelus, carious bones, &c.; and if it happens to be on a glandular part, a fcirrhus or cancer is very frequently found to enfue. Even the vifcera themfelves, efpecially of the abdomen, may be injured by contufions to fuch a degree as to produce an inflammation, gangrene, or fcirrhus, nay inftant death, without rupturing the fkin.

Sect. III. *Of Gun-ſhot Wounds.*

Gun-shot wounds can be conſidered in no other light than contuſed wounds. In thoſe made by a muſket or piſtol ball, the moſt immediate conſiderations are, to extract the ball, or any other extraneous body which may have lodged in the wounded part; and to ſtop the hemonhagy, if there is an effuſion of blood from the rupture of ſome conſiderable artery.

It is frequently neceſſary to enlarge the wound in order to extract the ball; and if it has gone quite through, (provided the ſituation of the part wounded will admit of its being done with ſafety), the wound is to be laid freely open through its whole length; by which means any extraneous body will be more readily removed, and the cure facilitated.

In order to get at the ball, or any other foreign matter, probing is to be uſed as ſparingly as poſſible: and this muſt evidently appear to any one who will only conſider the nature of the ſymptoms attendant on penetrating wounds of the breaſt or belly, either from a bullet or ſharp inſtrument; the thruſting in a probe to parts under ſuch circumſtances being unavoidably a freſh ſtab on every repetition of ſuch practice. Wherever probing is neceſſary, the finger is to be preferred as the beſt and trueſt probe, where it can be uſed.

If a ball, or any other foreign body, happens to be lodged near the orifice, or can be perceived by the finger to lie under the ſkin, though at ſome diſtance from the mouth of the wound, we ſhould cut upon it and take it out: but when it is ſunk deep, and lies abſolutely beyond the reach of the finger, it muſt appear evident, upon the leaſt reflection, that thruſting, firſt a long probe in queſt of the bullet, and then, as has been practiſed likewiſe, a longer pair of forceps, either with or without teeth, into a wound of that kind, though with a ſort of certainty to extract it, muſt either contuſe, or irritate and inflame, the parts to a great degree; and conſequently do as much, or more miſchief, than the ball did at firſt by forcing its paſſage ſuch a length of way. And ſhould they at the ſame time lay hold of any conſiderable artery or nerve along with the ball (which can ſcarce ever fail of being the caſe), what ſhocking conſequences would attend ſuch a proceeding! Nor would attempts of this ſort be leſs injurious in caſe a bullet ſhould happen to be lodged in the cavity of the belly or breaſt. Such attempts are the leſs neceſſary, becauſe a great number of inſtances have occurred, where balls have been quietly lodged in ſeveral parts of the body, till after many years they have worked themſelves a paſſage towards the ſurface, and were very eaſily extracted; and many where balls have been entirely left behind.

In caſe the wound be occaſioned by a muſket or piſtol ſhot, and of courſe but ſmall, it will be neceſſary to dilate it without delay, provided the nature of the part will admit of this with ſafety: for in wounds near a joint, or in very membranous or tendinous parts, the knife, as well as forceps, ſhould be put under ſome reſtraint; nor ſhould any more opening be made than what is abſolutely requiſite for the free diſcharge of the matter lodged within.

Where the wounded perſon has not ſuffered any great loſs of blood, and this is generally the caſe, it will be adviſable to open a vein immediately, and take from the arm a large quantity; and to repeat bleeding as circumſtances may require, the ſecond, and even the third day. Repeated bleedings in the beginning draw after them many advantages. They prevent a good deal of pain and inflammation, leſſen any feveriſh aſſaults, forward the digeſtion, and ſeldom fail to obviate impoſthumations, and a long train of complicated ſymptoms which are wont otherwiſe to interrupt the cure, miſerably haraſs the poor patient, and too often endanger his life; and even where the feveriſh ſymptoms run high, and there is almoſt a certainty that matter is forming, bleeding, in that ſtate, is very frequently of great advantage. Gun-ſhot Wounds.

33 Regimen.

For the firſt 12 days it will be proper to obſerve a cooling regimen, both in reſpect of the medicines that may be preſcribed, and the diet requiſite for the ſupport of nature. It is abſolutely neceſſary likewiſe that the body be conſtantly kept open. Unleſs, therefore, nature does this office of herſelf, a ſtool ſhould be every day procured, either by emollient clyſters, or ſome gentle laxative taken at the mouth; and whenever there is much pain in the wounded parts, immediate recourſe muſt be had to opium.

34 External applications.

As to external applications, whatever is of a hot ſpirituous nature is remarkably injurious on theſe occaſions, and what no wounded part can in any degree bear. The wound may be dreſſed with pledgits of any emollient ointment; the whole being covered with a common poultice, or, in ſome caſes, the preparations of lead may be uſed. An opiate ſhould now be adminiſtered; and the part affected being placed in the eaſieſt and moſt convenient poſture, the patient ſhould be laid to reſt. The formation of matter, in every contuſed wound, is an object of the firſt importance; for, till this takes place, there is often reaſon to ſuſpect that gangrene may happen. With a view to haſten ſuppuration, the warm poultices ſhould be frequently renewed, and they ſhould be continued till the tenſion and ſwelling, with which wounds of this kind are uſually attended, be removed, and till the ſore has acquired a red, healthy, granulating appearance, when it is to be treated like a common ulcer.

Gun ſhot wounds are commonly covered from the beginning with deep ſloughs, and various remedies are recommended for removing them. Every appearance, however, of this kind with which they are attended proceeds entirely from contuſion; and, excepting the injury be extenſive, the ſlough is not often perceptible, or it is ſo thin as to come away along with the matter at the firſt or ſecond dreſſing. Although emollient poultices be extremely uſeful, they ought to be no longer continued than till the effects already mentioned are produced; otherwiſe they will not only relax the parts, but alſo produce too copious a diſcharge of matter, which is ſometimes attended with great danger. A too copious flow of matter may proceed from different cauſes; but in whatever way it may have been produced, the practice to be adopted muſt be nearly the ſame. Every collection which appears muſt have a free outlet, and the limb laid in that poſture which will moſt readily admit of its running off. In ſuch circumſtances, nouriſhing diet and Peruvian bark in conſiderable quantities are highly uſeful. When the diſcharge continues copious, in ſpite of every effort to check it, detached pieces of bone or ſome extraneous matter are probably the cauſe. In ſuch a ſituation nothing will leſſen the quantity of matter till ſuch ſubſtances be removed. The wound ought therefore again to be examined, and looſe bodies removed. Pieces of cloth have been known to be removed by ſetons, when that method was practicable, after every other method had failed. Opium likewiſe is frequently uſeful in checking an exceſſive diſcharge, when it happens to be kept up by irritation.

Although no conſiderable hemorrhagy may happen at firſt in gun-ſhot wounds; yet after the ſloughs commonly produced upon ſuch occaſions have come off, ſome conſiderable arteries may be expoſed, and then a dangerous hemorrhagy may enſue. The hemorrhagy is often preceded by a great heat in the injured parts, and with a throbbing pulſatory pain. At this period it may frequently be pre-

Poisoned Wounds. vented by plentiful blood-letting, particularly local. But if the hemorrhagy has fairly taken place, and from arteries of considerable size, nothing will do but the proper application of ligatures. As the discharge in these cases would often prove dangerous before the surgeon could be procured, the attendants should be furnished with a tourniquet, with directions to apply it, upon the first appearance of blood.

Scarifying improper. Till of late years the scarifying of gun-shot wounds was a practice which prevailed very universally among surgeons; and it was expected by this, that the sloughs with which wounds are sometimes covered would sooner separate, and that the cure would thereby be more readily performed. It is now, however, known, that this practice, instead of being useful, very generally does harm by increasing the inflammation. It should therefore be laid entirely aside. When a gun-shot wound cannot easily or safely be laid open from one end to the other, perhaps it may be proper to introduce a cord through the sinus. This, however, should not be attempted till the first or inflammatory state of the wound is over: but when a cord cannot be properly introduced, on account of the situation or direction of the wound, compression may prove equally useful here as in cases of punctured wounds.

36 Mortification. Mortification happening after gun-shot wounds, is to be treated in the same manner as if it had arisen from any other cause, only bark is not to be promiscuously used; as, in plethoric habits, it may prove hurtful, though in debilitated relaxed habits it will be extremely useful; but even in such it should never be given while much pain and tension continue.

Sect. IV. *Of Poisoned Wounds.*

37 Treatment of wounds poisoned by the bite of animals. Poison may be introduced into the system various ways. The effects of the poison introduced by the stings of insects may frequently be prevented by applying immediately vinegar or ardent spirits. After inflammation has come on, the most effectual remedy is the washing the parts with cold water. The bite of a viper is not always dangerous; but as we can never judge with certainty whether the wound be poisoned or not, and as the poison of this animal acts very speedily upon the system, its bad effects ought to be prevented by every possible means. The injured part ought either to be cut out immediately, or destroyed with the actual or potential cautery.

Formerly suction was much employed, and frequently with success: it should not, however, prevent the removal of the part. After the part has been removed, we should endeavour to produce a plentiful suppuration. When the poison appears to have entered the system, the application of warm oil over the whole body has been extolled; and it has been said that advantage has been derived from the internal use of it. From some late observations, however, the efficacy of this remedy is much to be doubted. Perhaps a plentiful sweat, kept up for a considerable time, is the most certain method yet discovered. Small doses of volatile alkali frequently repeated is more to be depended on for producing this effect than any other remedy.

38 Wounds from the bite of mad animals. The bite of a mad animal occasions the most formidable poisoned wound known in this country. In these wounds hydrophobia indeed does not always ensue; but when it does, death is almost certainly the consequence. A variety of nostrums for preventing and curing this disease have been held forth to the public; but there is scarcely any well attested fact of any one of them proving useful. Nothing yet known can be depended upon but the immediate removal of the injured part, either with the scalpel or the actual or potential cautery; which, together with a plentiful suppuration, has, in different instances, appeared to answer the purpose effectually; at least, patients treated in this manner have escaped, while others bit at the same time by the same animal have suffered. The sooner the operation is performed, the more effectual it is likely to prove; but it ought not to be omitted, even though some time has elapsed from the time that the wound was inflicted; for there is reason to suppose that this poison does not enter the system so quickly as several others are observed to do. Sea-bathing has been much recommended in all ages as a preventive; but there are few well attested cases of its being attended with advantage. Many practitioners depend much on mercury; and as it can be used along with any other plan of treatment, it ought not to be neglected.

When wounds are poisoned by the application of matter from certain sores, as those of the venereal or cancerous kinds, or from any of the vegetable poisons, it is better to remove the part affected immediately, than to undergo a course of medicines generally slow and often doubtful in their operations.

The metallic poisons do not fall to be considered in this place; for however deleterious they may be when taken into the stomach, they seldom appear to be otherwise hurtful, when applied to wounds than by irritating or corroding the parts with which they come in contact.

CHAP. III. *Inflammation and its Consequences.*

Sect. I. *Of Inflammation and Suppuration.*

Inflammation and Suppuration.

Inflammation of any part is accompanied with increased heat, redness, and painful tension. For the remote and proximate causes of inflammation, together with the treatment of inflammatory diseases, see *Phlegmasiæ*, article Medicine. Inflammation is commonly divided into two species, the *phlegmonic* and *erythematic*. The first is distinguished by considerable swelling, throbbing pain, and circumscribed bright red colour. The second by superficial swelling, burning pain, dull red colour, apt to spread, disappearing when pressed, and quickly returning; the part affected is frequently covered with small vesicles. The consequences of inflammation are suppuration and gangrene, unless the inflammation be checked and terminated by resolution.—That an inflammation will terminate in suppuration may be known from the length of time it has continued, from the remission of the pain and hardness, the greater elevation of the skin in the middle part, a change of colour from red to bluish or livid, a slight fever with shivering, and from a fluctuation of matter perceived on handling the part. 3 Symptoms of inflammation. 4 Its consequences, suppuration and gangrene.

During the first stage of the inflammation, however, we ought, for the most part, to endeavour to resolve it, or prevent the suppuration. Yet some cases must be excepted. For instance, those inflammatory swellings which sometimes occur in fevers, or succeed to them, ought always to be brought to suppuration; and it might be very dangerous to attempt a resolution of them. In swellings of a scrophulous nature, it is perhaps best to do nothing at all, either with a view to resolve or suppurate. Thus it might be dangerous to make use of repellent applications, at the same time that it is by no means advisable to promote their suppuration; the cure of such swellings, when opened, proving always very troublesome; while at the same time it is known, that such swellings may remain for a very long time without any risk to the patient. In the lues venerea, too, as we are possessed of a certain antidote for the disorder, it is best not to attempt the suppuration of any buboes which may appear; 4 When resolution should be attempted.

pear; as the cure of them, when opened, very often proves extremely troubleſome; and as their being opened cannot contribute any thing towards their cure.

Where the inflammation is but beginning, and the ſymptoms are not ſo violent as to affect the general ſyſtem, topical remedies, with a due attention to regimen, often anſwer in reſolving them. The firſt thing to be attended to in the caſe of every inflammation, is the removal of the exciting cauſes, which either have brought on the inflammation originally, or which may continue it after it is begun. Such are extraneous bodies in wounds, pieces of fractured bones, luxations, &c. Of all the various applications for an inflamed part, thoſe of a ſedative nature are chiefly to be depended upon; and, next to theſe, emollients. Of the former kind we may conſider all the different preparations of lead diſſolved in vinegar; together with vinegar itſelf, which generally acts alſo as a ſedative. Among the latter we may place the mild expreſſed oils, as alſo the ſoft ointments made with theſe oils and pure wax.

When we ſpeak of ſedative medicines, however, it muſt not be underſtood that all of that claſs are to be uſed indiſcriminately. Thus opium, though one of the moſt powerful of all ſedatives, yet as its application, externally, to the human body, is always attended with ſome degree of irritation, however uſeful it may at times be found in ſome particular ſpecies of inflammatory diſorders, will never, probably, as an external application, become of general uſe in theſe caſes. Warm emollient fomentations alſo, though powerful ſedatives, as tending more effectually to remove tenſion and pain than perhaps any other remedy, are conſtantly found to be improper where a reſolution is to be wiſhed for. Their conſtant effect is, either to bring the ſwelling to a ſuppuration, or to relax the parts in ſuch a manner as to render the removal of the diſorder always exceedingly tedious.

Mr Bell recommends the preparations of lead as proper applications, in caſes of external inflammation, where we wiſh for a reſolution. The beſt method of applying it, he ſays, is in the form of a watery ſolution; and he gives the following formula: "℞. Sacchar. ſaturn. ʒſs.; ſolve in acet. pur. ℥iv.; et adde aq. fontan. diſtillat. ℔ij. The addition of vinegar renders the ſolution much more complete than it otherwiſe would be; and without it indeed a very conſiderable proportion of the lead generally ſeparates and falls to the bottom.

In making uſe of this ſolution in caſes of inflammation, as it is of conſequence to have the parts affected kept conſtantly moiſt with it, cataplaſms prepared with it and crumb of bread in general anſwer that intention exceedingly well. But when the inflamed part is ſo tender and painful as not eaſily to bear the weight of a poultice, which is frequently the caſe, pieces of ſoft linen moiſtened with the ſolution anſwer the purpoſe tolerably well. Both ſhould be applied cold, or at leaſt with no greater warmth than is merely neceſſary for preventing pain or uneaſineſs to the patient: they ſhould be kept almoſt conſtantly at the part, and renewed always before turning ſtiff or hard.

When the tenſion and irritation on the ſkin are conſiderable, emollients are often attended with very great advantage: the parts affected being, in ſuch a ſtate of the diſorder, gently rubbed over with any of the mild expreſſed oils two or three times a-day, the tenſion, irritation, and pain are often very much relieved, and the diſcuſſion of the tumor thereby greatly promoted.

In every caſe of inflammation, indeed, emollient applications would afford ſome relief. But as the preparations of lead, already recommended, prove in all ſuch diſorders ſtill more advantageous; and as unguents of every kind tend conſiderably to blunt the action of lead: theſe two ſets of remedies ſhould as ſeldom as poſſible be allowed to interfere with one another; and emollients ſhould accordingly never be preſcribed, but when the circumſtances already mentioned, of irritation, tenſion, and pain, are ſo conſiderable as to render their application altogether neceſſary.

Inflammation and Suppuration.

When the part affected with inflammation is not very tender, or lies deep, applications of vinegar are often had recourſe to with conſiderable advantage: the moſt effectual form of uſing it ſeems to be by way of cataplaſm, made with the ſtrongeſt vinegar and crumb of bread. In ſuch caſes, an alternate uſe of this remedy, with the ſaturnine ſolution, has produced more beneficial effects than are commonly obſerved from a continued courſe of any one of them.

At the ſame time that theſe applications are continued, blooding with leeches, or cupping and ſcarifying, as near as poſſible to the part affected, is generally of very great ſervice; and in no caſe of local inflammation ſhould ever be omitted. In all ſuch caſes, the whole body, but more eſpecially the diſeaſed part, ſhould be preſerved as free as poſſible from every kind of motion; and, for the ſame reaſon, the neceſſity of a low cooling diet, in every inflammatory diſorder, appears obvious, as does alſo a total abſtinence from ſpirituous and fermented liquors.

43
Blood-letting, when proper for this purpoſe.

In ſlight caſes of inflammation, a due perſeverance of the ſeveral articles taken notice of will, in general, be found ſufficient for every purpoſe. But when there is likewiſe a full, hard, or quick pulſe, with other ſymptoms of fever, general blood-letting becomes neceſſary; the quantity of blood taken away being always to be determined by the violence of the diſorder, and by the age and ſtrength of the patient. Evacuation, however, ſhould never be carried to a greater height than what is merely neceſſary for moderating the febrile ſymptoms; for if ſuppuration ſhould take place after the ſyſtem is too much reduced, its progreſs is thereby rendered much more ſlow and uncertain, nor will the patient be ſo able to bear the diſcharge that muſt enſue upon opening the abſceſs. The uſe of gentle laxatives, together with cooling diaphoretic medicines, are alſo attended with very good effects.

Theſe different evacuations being premiſed, the next object of conſequence is to procure eaſe and quietneſs to the patient; which is often, in inflammatory caſes, of more real ſervice than any other circumſtance whatever. The moſt effectual remedy for this purpoſe is opium; which, when pain and irritation are conſiderable, as in extenſive inflammations very frequently happens, ſhould never be omitted. In large wounds, eſpecially after amputations and other capital operations, alſo in punctures of all kinds, large doſes of opium are always attended with remarkable good effects. In all ſuch caſes, however, opium, in order to have a proper influence, ſhould, as was obſerved, be adminiſtered in very large doſes; otherwiſe, inſtead of proving ſerviceable, it ſeems rather to have the contrary effect; a circumſtance which is perhaps the chief reaſon for opiates in general having been very unjuſtly condemned in every caſe of inflammation.

By a proper attention to the different circumſtances taken notice of, in the courſe of three or four days, and ſometimes in a ſhorter ſpace of time, reſolution of the tumor will in general begin to take place; at leaſt before the end of that period it may, for the moſt part, be known how the diſorder is to terminate. If the heat, pain, and other attending ſymptoms abate, and eſpecially if the tumor begins to decreaſe, without the occcurrence of any gangrenous appearances, we may then be almoſt certain that by a continuance of the ſame plan a total reſolution will in time be effected.

But, on the contrary, if all the different ſymptoms rather

increaſe;

Inflammation and suppuration.

increafe; and efpecially if the tumor turns larger, and fomewhat foft, with an increafe of throbbing pain; we may then with tolerable certainty conclude, that fuppuration will take place; and fhould therefore immediately defift from fuch applications as were judged proper while a cure was thought practicable by refolution, and endeavour to affift nature as much as poffible in the formation of pus, or what is called maturation of the tumor. For this purpofe there is nothing better than to preferve a proper degree of heat in the parts. This is commonly done by the means of warm fomentations and cataplafms; and when thefe are regularly and frequently renewed, nothing, it is probable, could more effectually anfwer the purpofe. But in the ordinary manner in which they are applied, by the cataplafms being renewed only once, or at moft twice a day, they muft always, it is imagined, do more harm than good. For fo foon as the degree of heat they were at firft poffeffed of is diffipated, the moifture kept up by them, with the confequent evaporation which enfues, muft always render the part a great deal colder than if it had been merely wrapped in flannel without the ufe of any fuch application.

44
Method of promoting fuppuration.

In order to receive all the advantages of fuch remedies, the part affected fhould be well fomented with flannels preffed out of any warm emollient decoction, applied as warm as the patient can eafily bear them, continued at leaft half an hour at once, and repeated four times a day.

Immediately after the fomentation is over, a large emollient poultice fhould likewife be applied warm, and renewed every fecond or third hour at fartheft. Of all the forms recommended for emollient cataplafms, a common milk-and-bread poultice, with a proportion of butter or oil, is perhaps the moft eligible; as it not only poffeffes all the advantages of the others, but can at all times be more eafily obtained.

Roafted onions, garlic, and other acrid fubftances, are frequently made ufe of as additions to maturating cataplafms. When there is not a due degree of inflammation in the tumor, and when it appears probable that the fuppuration would be quickened by having the inflammatory fymptoms fomewhat increafed, the addition of fuch fubftances may then be of fervice; but when ftimulants are neceffary in fuch cafes, a fmall proportion of ftrained galbanum, or of any of the warm gums, diffolved in the yolk of an egg, and added to the poultices, is a more certain form of applying them. Whenever the inflammation, however, takes place to a proper degree, fuch ftimulating fubftances never can be neceffary; and in many cafes, it is apprehended, they may even do mifchief.

In fuch tumors as, from their being poffeffed of little or no inflammation, are commonly faid to be of a cold nature, as they are generally indolent, and proceed very flowly to fuppuration, plafters compofed of the warm gums are often had recourfe to with confiderable advantage. In fuch cafes, they are not only of ufe by the ftimulus and irritation they occafion, but by the heat which they tend to preferve in the part. They become particularly neceffary when the patient, by being obliged to go abroad, cannot have cataplafms frequently enough renewed, or fo conveniently applied; but when fome fuch objection does not occur, the latter, for very obvious reafons, fhould always be preferred.

45
Dry cupping.

Dry cupping, as it is termed, that is, cupping without the ufe of the fcarificator, upon or as near as poffible to the part affected, is frequently had recourfe to with advantage in promoting the fuppuration of tumors. It is only, however, in fuch as thefe laft mentioned, where there feems to be a deficiency of inflammation, that it can ever either be neceffary or ufeful; but in all tumors of a real indolent nature, and where there is ftill fome probability of a fuppuration, no remedy is more effectual.

Inflammation and fuppuration.

Thefe different applications, under the reftrictions taken notice of, being continued for a longer or fhorter time, according to the fize of the tumor, its fituation, and other circumftances, a thorough fuppuration may in general at laft be expected.

Matter being fully formed in a tumor, is known by a remiffion of all the fymptoms taking place; the throbbing pain, which before was frequent, now goes off, and the patient complains of a more dull, conftant, heavy pain: the tumor points at fome particular part, generally near to its middle; where, if the matter is not encyfted, or deep feated, a whitifh yellow appearance is obferved, inftead of a deep red that formerly took place; and fluctuation of a fluid underneath is, upon preffure, very evidently difcovered. Sometimes, indeed, when an abfcefs is thickly covered with mufcular and other parts, though, from concurring circumftances, there can be little doubt of there being even a very confiderable collection of matter, yet the fluctuation cannot be readily diftinguifhed: it does not, however, often happen, that matter is fo very deeply lodged as not to be difcovered upon proper examination. 46
Signs of matter formed.

This, however, is a circumftance of the greateft confequence in practice, and deferves more attention than is commonly given to it. In no part of the furgeon's employment is experience in former fimilar cafes of greater ufe to him than in the prefent; and however fimple it may appear, yet nothing, it is certain, more readily diftinguifhes a man of obfervation and extenfive practice, than his being able eafily to detect collections of deep-feated matter; whilft nothing, on the contrary, fo materially affects the character of a furgeon, as his having, in fuch cafes, given an inaccurate or unjuft prognofis; as the event, in diforders of that nature, comes generally at laft to be clearly demonftrated to all concerned.

Together with the feveral local fymptoms of the prefence of pus already enumerated, may be mentioned the frequent fhiverings to which patients are liable on its firft formation: thefe, however, feldom occur fo as to be diftinctly obferved, unlefs the collection is confiderable, or feated internally in fome of the vifcera.

After the matter is fully formed, and the abfcefs brought to maturity, the only remedy is to open it, and give vent to the pus it contains. In many cafes, indeed, nature will do the work, and abfceffes, when fuperficially feated, will certainly burft of themfelves: but where the matter lies deep, we are by no means to wait for this fpontaneous opening; as the pus will acquire an acrimony before it can break through the integuments, which may prove very prejudicial to health. However, it is a general rule not to open abfceffes till a thorough fuppuration has taken place; for, when laid open long before that period, and while any confiderable hardnefs remains, they commonly prove more troublefome, and feldom heal fo kindly. 4
Of o[pening] abfce[ffes].

In fome cafes, however, it is neceffary to deviate from this general rule, and to open them a good deal fooner; particularly in all fuch critical abfceffes as occur in malignant fevers. In like manner, in the plague, we are commonly advifed to open fuch tumors, fo foon as they are at all tolerably advanced, and not to wait till they are fully maturated; as, from experience in thefe diforders, it is found to be of more confequence, for the removal of the original difeafe, to have a quick difcharge of matter produced, than any harm the patient can ever fuffer from having a fwelling fomewhat prematurely laid open.

In abfceffes, alfo, fituated on any of the joints, or upon either

either of the large cavities of the breast and abdomen, and more especially when they seem to run deep, they should always be opened as soon as the least fluctuation of matter is discovered. For, when the resistance is on every side equal, they just as readily point inwardly as outwardly: and the consequence of a large abscess bursting into either of the large cavities, is well known most frequently to prove fatal: An instance of which, in the following case, with very little attention, might have been prevented. A surgeon of eminence, and of very extensive practice, was applied to by a young healthy looking man, with a large abscess upon the left side of his chest. A fluctuation of a fluid was, upon pressure, very evidently discovered; and it was agreed, by other two practitioners who were present, that an opening should be made to give vent to the matter. But the operator, being much engaged in business, could not fix on an earlier period for doing it than the third day from the patient's applying to him: unluckily, however, the patient died suddenly in his bed the night before the abscess was to have been opened. On examining the body, the tumor had disappeared entirely, without any external opening being observable; and, on opening the thorax, it was found to have burst inwardly upon the lungs, and produced immediate suffocation.

In every other circumstance, however, except in the cases alluded to, the rule in opening abscesses is, as was already remarked, To allow a thorough suppuration to take place, before any vent whatever be given to the matter; and it being then determined to lay the collection open, the next question that occurs, is with respect to the manner of doing it.

There are three ways of opening an abscess so as to give an outlet to the matter; by caustic, by incision, or by the introduction of a seton. The first is more agreeable to timid patients, who are afraid of the pain of incision, but is attended with some inconveniences which render the method of incision much preferable. Caustic acts slowly, and produces a long continued pain; besides, no kind of caustic has yet been invented, the effects of which can be confined to a certain determinate extent; hence the patient is liable to suffer much unnecessary pain, as the caustics commonly employed are either the lapis infernalis or lunar caustic. The abscess is to have a slip of adhesive plaster applied to it, with a slit cut in it of a size somewhat less than the opening is intended to be. This slit is to be filled with caustic reduced into a powder, and wetted to make it act more quickly. It is then to be covered over with a plaster, and the whole is secured with a firm compress and bandage. The time necessary for the caustic to make a sufficient opening will depend upon the thickness of the skin and strength of the caustic; but generally it requires several hours. When we find that an eschar is made, it is to be softened with any emollient ointment until it can be readily separated; after which, the matter is to be discharged, and the abscess treated as one opened by incision.

The method of opening abscesses by the knife is, to make an incision of such a size as to give free vent to the matter. The opening is to be made in the under part of the tumor, that the matter may pass readily out. It has been a practice among surgeons either to open a large abscess from end to end, or at least through two-thirds of its length; but from the bad consequences which often attend this method, the latest practitioners have thought it better merely to give a free discharge to the matter, without exposing the part to the action of the air.

The third method, viz. that by the seton, is now frequently employed. It has the advantage of being attended with little pain, emptying the abscess in a gradual manner, and completely preventing the access of the air, which, in the other two methods, is often attended with bad consequences; and it frequently performs a cure in a much shorter time.

There are various instruments for introducing the seton: it may even frequently be done by a lancet and common probe; but the instruments represented in Plate CCCCLXXXVII. fig. 1. and 2. are more frequently employed. One of these being threaded with glover's soft silk, is to be introduced through the upper part of the tumor; but if the blunt one (fig. 2.) be employed, it will be necessary to have the assistance of a lancet; the instrument is then to be brought out at the under part of the tumor, and in this way the matter will be allowed to run gradually off.

The usual mode of dressing an abscess the first time is with dry lint. In the course of dressing, it will be proper to have regard to the situation of the abscess, and as much as possible to make the patient favour the discharge by his ordinary posture: and to this end also, the discharge must be assisted by compress and bandage: the compress may be made of soft old linen, applied according to the nature of the part and the season of the year. The frequency of dressing will depend on the quantity of discharge: once in 24 hours is ordinarily sufficient; but sometimes twice, or perhaps three times, is necessary.

Gangrene.

Sect. II. *Of Gangrene.*

The other consequence of inflammation is gangrene, which may terminate in mortification. When the colour of an inflamed part changes to a dark red, when blisters arise on it containing an ichorous fluid, we know that it has become gangrenous. When it becomes black, flaccid, and insensible, when it loses heat, and acquires a putrid smell, it has proceeded to complete mortification. A gangrene seldom affects those who enjoy a good habit of body, though, even in them, it may be brought on accidentally by whatever destroys the texture of *a part*; as contusion, long continued pressure, or whatever deprives *a part* of its nourishment. In like manner, cold, by putting a stop to the circulation, may produce gangrene, and frequently does so in cold climates. This comes on suddenly, without any pain or previous inflammation; and the patient himself is frequently insensible of it, till he is informed of his situation by some other person.

A defect in the circulation, in extreme old age, frequently occasions mortification in the extremities.

51 Dry gangrene.

There are some instances of what is called *dry gangrene*, in which the parts continue totally mortified for a great length of time, without either turning very flaccid, or running into dissolution. But such cases never occur from inflammation; they happen commonly from the flow of blood to such parts being put a stop to by compression of one kind or another, as tumors, ligatures, or other similar causes, obstructing the principal arteries which used to supply them; which, when the stoppage of the circulation is complete, always occasions a very slow, tedious, mortification; and as the parts in such instances are no longer supplied with fresh quantities of fluids, while a considerable evaporation must still be going on, such a degree of humidity cannot therefore possibly occur as does in other cases of gangrene. So that species of the disorder has, perhaps, with propriety enough, been termed the *dry gangrene*.

52 White gangrene.

There is another variety of the disease termed *white gangrene*; in which the parts supposed mortified do not turn black, but retain nearly their former colour, &c. Whether such a complaint, however, can with propriety be denominated *gangrene* or not, may properly be doubted: but as it is chiefly that species of the disorder which succeeds inflammation

Gangrene. mation that is here particularly treated of, and in which no such varieties are ever observed, it is not necessary to carry the inquiry farther.

53 Prognosis. The prognosis in every case of gangrene is doubtful at first, as, even in the slightest cases, the patient may suffer from the spreading of the disease; but slight cases, from external injuries, are more favourable than those which arise from internal causes, though no person can be considered safe till the diseased parts are separated, and even entirely cast off. When inflammation happens round a mortified part, more especially if pus be formed, we may pretty certainly pronounce that the mortified part will be thrown off.

54 Means of preventing gangrene with great inflammation. When there is reason to suspect from the violence of the fever and great heat of the inflamed part, that it will terminate in gangrene, blood-letting, and whatever may have a tendency to moderate the inflammation, may check its progress. But as the patient, in such cases, is sometimes apt to sink afterwards, nothing more ought to be done than is merely necessary to moderate the present symptoms. If an inflamed surface put on a gangrenous appearance when the patient is weak, and the pulse low, we must have recourse to whatever may invigorate the system, viz. a nourishing diet, with the free use of wine. Peruvian bark likewise is to be given in as great quantities as the stomach of the patient will permit. When the stomach cannot bear enough in substance, which is the best form of exhibiting it, it may be given either in form of tincture or joined with aromatics. External applications, such as are of a stimulating nature, may likewise be useful.

55 Arising from cold. In the case of gangrene arising from cold, the part must be immersed in very cold water, or rubbed with snow; for if any thing warm be applied, or the patient brought near a fire, it certainly mortifies. If the whole body has become torpid with cold, the same practice must be followed; the very cold water should be afterwards changed for some that is a little warmer, and the patient gradually brought to a proper degree of heat. Rubbing with salt is sometimes found useful. If the whole body be benumbed, cordials are not to be administered too suddenly. A glass of cold wine should first be given, afterwards warm wine by itself, or with spices. If stronger cordials be required, ardent spirits may be employed. Notwithstanding the greatest attention, however, a mortification sometimes takes place, and in some instances very suddenly; as in the case of carbuncle, where, after an inflammation has continued for scarcely 24 hours, the parts become black, and end in real mortification.

56 Scarifications and external application to mortified parts improper. In the treatment of mortified parts, a variety of external applications have been pointed out, and particularly those of the antiseptic kind; such as all the warm gums and balsams, ardent spirits, and even alcohol: and to admit of their nearer application to the sound parts, with a view to the preservation of these from putrefaction, deep scarifications through the diseased, and into the sound parts, have been generally recommended. But although such articles may be of use in preserving dead animal substances from corruption; yet that they will always prove serviceable in the same manner in living bodies, is probably very much to be doubted. And it is even apprehended, by the strong irritation they always occasion when applied to a living fibre, that, in such cases as the present, they may rather do mischief; it being only a very slight degree of inflammation that is required to bring on a suppuration. The incisions, when carried into the sound parts, with a view to facilitate the operation of such remedies, may likewise do harm; not only from the risk of wounding the blood-vessels, nerves, and tendons, that lie in the way, but also by allowing a free and farther entrance of the putrescent fluids into the parts not yet affected: and unless they are carried so deep as freely to reach the sound parts, applications of the antiseptic kind can never have any effect in answering the purpose for which they were intended.

All the advantages commonly observed from the great variety of applications recommended for gangrene, are obtained with more ease, and generally with more certainty, from the use of any gentle stimulating embrocation; which, by exciting a slight irritation upon the surface, and especially when assisted by a free use of the bark, at last commonly produces such a degree of inflammation as is wished for. With this view, a weak solution of sal ammoniac in vinegar and water has been known to answer exceedingly well: a dram of the salt to two ounces of vinegar and six of water, forms a mixture of a very proper strength for every purpose of this kind; but the degree of stimulus can be easily either increased or diminished, according to circumstances, by using a larger or smaller proportion of the salt.

Although, for the reasons formerly advanced, incisions may not in general be proper; yet in such cases where the mortification runs very deep, it is sometimes of service to make scarifications into the diseased parts, so as to remove part of them; which, by taking off a considerable load perhaps of putrid flesh, not only lessens the fetor, which in such cases is always considerable, but often renders it more easy for the sound parts to free themselves from the remainder. When with this view, however, incisions are had recourse to, care should always be taken that they be not carried the length of the sound parts.

When by the use of external or internal remedies, a separation of the mortified part has been effected, and a discharge of pus produced, the remaining sore is then to be considered merely as a simple purulent ulcer, and may be treated in the same manner.

CHAP. IV. *Of Ulcers, White Swellings, Cancers, and Burns.*

Sect. I. *Of Ulcers.*

A solution of continuity in any of the softer parts of the body, discharging either pus, sanies, or any other vitiated matter, is termed *ulcer;* and when the same circumstances happen to the bones, the term *caries* or *carious ulcer* is adopted.

Ulcers are distinguished by their particular disorders, though it seldom happens that the affections are not complicated; and when we lay down rules for the management of one species of ulcer, it is generally requisite to apply them to almost all others. However, the characters of most eminence are, the callous ulcer, the sinuous ulcer, and the ulcer with caries of the adjacent bone: besides this there is the putrid, the corrosive, the varicose ulcers, &c.; but as they have acquired their names from some particular affection, we shall speak of the treatment of them under the general head of ulcers. 57 Different kinds of ulcers.

It will be often in vain to pursue the best means of cure by topical application, unless we are assisted by internal remedies; for as many ulcers are the effects of a particular indisposition of body, it will be difficult to bring them into order while the cause of them remains. Those which are cancerous and scrophulous seem to gain the least advantage from physic; for if in their beginnings they have sometimes been very much relieved, or cured, by salivation, or any other evacuation, they are also often irritated and made worse by them.

When an ulcer becomes foul, and discharges a nasty thin ichor, the edges of it, in process of time, tuck in, and, growing skinned and hard, give it the name of a *callous ulcer;* 58 Of callous ulcers.

cer; which, as long as the edges continue in that ſtate, muſt neceſſarily be prevented from healing. But we are not immediately to deſtroy the lips of it in expectation of a ſudden cure; for while the malignity of the ulcer remains which was the occaſion of the calloſity, the new lips will be ſubject to a relapſe of the ſame kind, however often the external ſurface of them be deſtroyed: we are to endeavour to bring the body of the ulcer into a diſpoſition to recover by other methods. It ſometimes happens to poor laborious people, who have not been able to afford themſelves reſt, that lying a-bed will in a ſhort time give a diverſion to the humours of the part, and the callous edges, ſoftening, will without any great aſſiſtance ſhoot out a cicatrix, when the ulcer is grown clean and filled with good fleſh. The effect of a ſalivation is generally the ſame; and even an iſſue ſometimes diſpoſes a neighbouring ulcer to heal. But though calloſities be frequently ſoftened by theſe means, yet when the ſurface of the ulcer begins to yield thick matter and little granulations of red fleſh ſhoot up, it will be proper to quicken nature by deſtroying the edges of it, if they remain hard. The manner of doing this, is by touching them a few days with the lunar cauſtic, or *lapis infernalis*. Some chooſe to cut them off with a knife: but this is very painful, and not more efficacious. When the lips do not tuck down cloſe to the ulcer, but hang looſe over it, as in ſome venereal buboes, the eaſieſt method is to cut them off with the ſciſſars.

To digeſt the ulcer, or to procure good matter from it when in a putrid ſtate, there are an infinity of ointments invented; but the baſilico flavum, alone, or ſoftened down ſometimes with turpentines, and ſometimes mixed up with different proportions of red precipitate, ſeems to ſerve the purpoſe of bringing an ulcer to cicatrization as well as any of the others. When the ulcer is incarned, the cure may be finiſhed as in other wounds; or if it do not cicatriſe kindly, it may be waſhed with aq. calcis, or aq. phag. or dreſſed with a pledgit dipt in tinct. myrrhæ: and if excoriations are ſpread round the ulcer, they may be anointed with ſperm. cet. ointment, or any other ſoft ointment.

The red precipitate has of late years acquired the credit it deſerves for the cure of ulcers; but, by falling into general uſe, is very often unſkilfully applied: when mixed with the baſilicon, or, what is nearer, a cerate of wax and oil, it is moſt certainly a digeſtive, ſince it hardly ever fails to make the ulcer yield a thick matter in 24 hours, which diſcharged a thin one before the application of it.

ov- gous If the ulcer produces a ſpongy fleſh, ſprouting very high above the ſurface, it will be neceſſary to deſtroy it by ſome of the eſcharotics, or the knife. This fungus differs very much from that belonging to healing wounds, being more eminent and lax, and generally in one maſs; whereas the other is in little diſtinct protuberances. It approaches often towards a cancerous complexion, and when it riſes upon ſome glands ſometimes actually degenerates into a cancer. When theſe excreſcences have ariſen in venereal ulcers, eſcharotics ſhould be applied. Thoſe in uſe, are the vitriol, the lunar cauſtic, the lapis infernalis, and more generally the red precipitate powder.

It is but ſeldom that theſe inveterate funguſes appear on an ulcer; but it is very uſual for thoſe of a milder kind to riſe, which may often be made to ſubſide by preſſure and the uſe of mild eſcharotics: however, if the aſpect of the ſore be white and ſmooth, as happens in ulcers accompanied with a dropſy, and often in young women with obſtructions, it will anſwer no purpoſe to waſte the excreſcences until the conſtitution is repaired, when moſt probably they will ſink without any aſſiſtance. In ulcers alſo, where the ſubjacent bone is carious, great quantities of looſe flabby fleſh will grow up above the level of the ſkin: but as the caries is the cauſe of the diſorder, it will be in vain to expect a cure of the excreſcence until the rotten part of the bone be removed; and every attempt with eſcharotics will be only a repetition of pain to the patient, without any advantage. Ulcers.

When the pain and inflammation are exceſſive, bleeding and other evacuations will often be ſerviceable; and above all things, reſt and a horizontal poſition; which laſt circumſtance is of ſo great importance to the cure of ulcers of the legs, that unleſs the patient will conform to it ſtrictly, the ſkill of the ſurgeon will often avail nothing: for as the indiſpoſition of theſe ſores is in ſome meaſure owing to the gravitation of the humours downwards, it will be much more beneficial to lie along than ſit upright, though the leg be laid on a chair; ſince even in this poſture they will deſcend with more force than if the body was reclined.

In ulcers of the legs, accompanied with varices or dilatations of the veins, the method of treatment will depend upon the other circumſtances of the ſore; for the varix can only be aſſiſted by the application of bandage, which muſt be continued a conſiderable time after the cure. The neateſt bandage is the laced ſtocking, which is particularly ſerviceable in this caſe; though alſo, if the legs be œdematous, or if, after the healing of the ulcers, they ſwell when the patient quits his bed, it may be worn with ſafety and advantage. There are inſtances of one vein only being varicous; which, when it happens, may be deſtroyed by tying it above and below the dilatation, as in an aneuriſm; but this operation ſhould only be practiſed where the varix is large and painful. 60 Ulcers accompanied with varices.

Ulcers of many years ſtanding are very difficult of cure; and in old people the cure is often dangerous, frequently exciting an aſthma, a diarrhœa, or a fever, which deſtroys the patient, unleſs the ſore break out again: ſo that it is not altogether adviſable to attempt the abſolute cure in ſuch caſes; but only the reduction of them into better order, and leſs compaſs, which, if they be not malignant, is generally done with reſt and proper care. The cure of thoſe in young people may be undertaken with more ſafety; and in all caſes of ſtubborn ulcers, the bark, very copiouſly given, will be found of the utmoſt ſervice. 61 Cure of old ulcers dangerous.

When an ulcer or abſceſs has any ſinuſes or channels opening and diſcharging themſelves into the ſore, they are called *ſinuous ulcers*. Theſe ſinuſes, if they continue to drain a great while, grow hard in the ſurface of their cavity, and then are termed *fiſtulæ*, and the ulcer a *fiſtulous ulcer*: alſo, if matter be diſcharged from any cavity, as thoſe of the joints, abdomen, &c. the opening is called a *ſinuous ulcer* or a *fiſtula*. 62 Of ſinuous ulcers.

The treatment of theſe ulcers depends upon a variety of circumſtances. If the matter of the ſinus be thick, ſtrict bandage and compreſs will ſometimes bring the oppoſite ſides of the ſinus to a reunion: if the ſinus grow turgid in any part, and the ſkin thinner, ſhowing a diſpoſition to break, the matter muſt be made to puſh more againſt that part, by plugging it up with a tent; and then a counter opening muſt be made, which proves often ſufficient for the whole abſceſs, if it be not afterwards too much tented, which locks up the matter and prevents the healing; or too little, which will have the ſame effect: for dreſſing quite ſuperficially does ſometimes prove as miſchievous as tents, and for nearly the ſame reaſon; ſince ſuffering the external wound to contract into a narrow orifice before the internal one be incarned, does almoſt as effectually lock up the matter as a tent. To preſerve, then, a medium in theſe caſes, a hollow tent of lead or ſilver may be kept in the orifice, which, at the ſame time that it keeps it open, gives vent to the matter. The abſceſs where the counter opening is 63 Treatment.

made

Ulcers. made most frequently are those of compound fractures, and the breast: but the latter do oftener well without dilatation than the former; though it must be performed in both, if practicable, the whole length of the abscess, when after some trial the matter does not lessen in quantity, and the sides of it grow thinner; and if the sinuses be fistulous, no cure need be expected without dilatation.

When an ulcer with loose rotten flesh discharges more than the size of it should yield, and the discharge is oily and stinking, in all probability the bone is carious; which may easily be distinguished by running the probe through the flesh: and if so, it is called a *carious ulcer*. The cure of these ulcers depends principally upon the removal of the rotten part of the bone, without which it cannot heal. Those caries which happen from the matter of abscesses lying too long upon the bone, are most likely to recover: those of lues venerea very often do well, because that distemper fixes ordinarily upon the middle and outside of the densest bones, which admit of exfoliation; but those produced by scrophula, where the whole extremities of the spongy parts of the bone are affected, are exceedingly dangerous.

64 Of carious ulcers. All enlarged bones are not necessarily carious; and there are ulcers sometimes on the skin which covers them, which do not communicate with the bone, and consequently do well without exfoliation: nay, it sometimes happens, though the case be rare, that, in young subjects particularly, the bones will be carious to such a degree, as to admit a probe almost through the whole substance of them; and yet afterwards admit of a cure, without any notable exfoliation.

65 Treatment. The method of treating an ulcer with caries, is by applying a caustic of the size of the scale of the bone which is to be exfoliated; and after having laid it bare, to wait till the carious part can without violence be separated, and then heal the wound. In order to quicken the exfoliation, there have been several applications devised; but that which has been most used in all ages, is the actual cautery, with which surgeons burn the naked bone every day, or every other day, to dry up, as they say, the moisture, and by that means procure the separation: but as this practice is never of great service, and always cruel and painful, it is now pretty much exploded. Indeed, from considering the appearance of a wound, when a scale of bone is taken out of it, there is little doubt that burning retards rather than hastens the separation; for as every scale of a carious bone is flung off by new flesh generated between it and the sound bone, whatever would prevent the growth of these granulations would also in a degree prevent the exfoliation; which must certainly be the effect of a red-hot iron applied so close to it.

Some caries of the bones are so very shallow, that they crumble insensibly away, and the wound fills up; but when the bone will neither exfoliate nor admit of granulations, it will be proper to scrape it with a rugine, or perforate it in many points with a convenient instrument down to the quick. In scrophulous cases, the bones of the carpus and tarsus are often affected; and from their sponginess they are seldom cured: so that when these, or indeed the extremities of any of the bones, are carious through their substance, it is advisable to amputate; though there are instances in the scrophula, but more especially in critical abscesses, where, after long dressing down, the splinters, and sometimes the whole substance, of the small bones, have worked away, and a healthy habit of body coming on, the ulcer has healed; but these are so rare, that no great dependence is to be laid on such an event. The dressings of carious bones, if they are stinking, may be dossils dipped in the tincture of myrrh; otherwise those of dry lint are easiest, and keep down the edges of the ulcer better than any other gentle applications. Wh Swel

Sect. II. *Of White Swellings.*

There are two species of white swellings, Mr Benjamin Bell observes; the one of a mild nature, and frequently admitting of a cure; which the other never does. The former, named by our author the *rheumatic* species of white swelling, begins with an acute pain, seemingly diffused over the whole joint, and frequently extending along the tendinous aponeuroses of the muscles which communicate with it. There 6 Rheu white ling. is, from the beginning, an uniform swelling of the whole surrounding integuments. Great tension generally prevails; but at first there is seldom any external change of colour. From the commencement of the disease the motion of the joint is attended with exquisite pain, and the patient keeps it constantly in a relaxed posture, finding that the easiest. Hence the tendons become extremely stiff and rigid, till at last the joints have the appearance of complete and real anchyloses. The swelling now begins to augment, till the joint has acquired three or four times its natural size; the cuticular veins become turgid and varicose; at the same time that the muscular substance of the limb below decays, though it frequently acquires an equality in size by becoming œdematous; the pain becomes intolerable, especially when the person is warm in bed or otherwise heated; abscesses form in different parts, which, either breaking of themselves, or by being laid open, discharge considerable quantities of matter, but without any remarkable effect in reducing the size of the swelling. The pus discharged from these is at first of a tolerably good consistence, but soon degenerates into a thin ill-conditioned sanies. However, the orifices from whence it flows soon heal up, unless they are kept open by art; and new collections breaking out, they burst and heal up as before; so that in long-continued disorders of this kind, the surrounding integuments are often entirely covered with cicatrices.

In the mean time, the health of the patient gradually declines, from the violence of the pain, and the absorption of matter into the system, which takes place in some degree from its first formation in the different abscesses; but which never appears so evidently till the different abscesses have been laid open; after which a quick pulse, night-sweats, and a weakening diarrhœa, are sure to occur, which generally carry off the patient, if the member is not either amputated, or the disease cured some other way

6 Appe of the tecte on di tion. On dissecting limbs which have been amputated for white swellings, the original disease appears to have been a morbid thickening of the surrounding ligaments, without any other affection of the joint whatever; the bones and cartilages always remaining perfectly sound, as likewise the synovia both in quantity and consistence. In the more advanced stages of the disorder, the thickness of the ligaments is more considerable, and is generally attended with an effusion, into the surrounding cellular substance, of a thick glairy matter, which gives to swellings of this kind an elastic springy feel, independent of the collections of matter the fluctuation of which may also be perceived. Through this glairy matter the collections of pus run in various directions, without seeming, however, to mix with it. In some instances also a great many small hydatides are observed; all which form a confused mass, incapable of further dissection.

All the above-mentioned appearances have been observed without any affection of the bones or cartilages. But when, by a very long continuance of the disorder the ligaments come to be corroded by the different collections of

matter, the cartilages and in conſequence thereof the bones, ſoon begin to ſuffer. The tendons of the flexor muſcles, though very ſtiff and contracted, do not, upon diſſection, ſhow any ſigns of diſeaſe.

68 The above is an hiſtory of the mildeſt ſpecies of white ſwelling; the more inveterate kind our author names the *ſcrophulous white ſwelling*. In this the pain is commonly very violent; more acute than in the former; and, inſtead of being diffuſed, is confined to a particular ſpot, commonly the very middle of the joint. The ſwelling is commonly inconſiderable at firſt; inſomuch that, on ſome occaſions, even when the pain has been very violent, little difference in point of ſize could be obſerved between the diſeaſed and the ſound joint. The motion of the joint is attended with very great pain, and the tendons become ſtiff. As the diſorder advances, the pain becomes more violent, and the ſwelling increaſes, with an evident enlargement of the ends of the bones. The ſame elaſtic feel, together with ſimilar abſceſſes, occur in this as in the laſt: but upon opening them they commonly diſcharge a thin fetid ſtuff; the bones are found to be carious, and pieces of them are frequently diſcharged at the openings.

By the continuance of the diſorder, the conſtitution ſuffers, as in the firſt ſpecies of the diſeaſe; and a diarrhœa with night-ſweats commencing, the patient is ſoon reduced to little more than ſkin and bone.

69 Upon ſuch joints being diſſected in the firſt ſtages of the diſorder, the ſoft parts ſeem very little affected: but there is conſtantly obſerved an enlargement either of the whole ends of the bones, or of their epiphyſes; frequently of thoſe on one ſide of the joint only; in others, again, the bones on both ſides have been affected.

This enlargement ſometimes occurs without any other evident diſeaſe: but in general, and always in a more advanced ſtate of the complaint, the ſoft ſpongy parts of ſuch bones appear diſſolved into a thin, fluid, fetid matter; and that too, in ſome caſes, without the cartilages which ſurround them ſeeming much affected. In proceſs of time the cartilages are likewiſe diſſolved; and then the matter of the bones and ſofter parts mixing together, ſuch ſwellings exhibit in that ſtate a ſtill more confuſed collection than is generally obſerved even in the worſt ſtages of the other ſpecies of the diſorder.

In the farther progreſs of this diſeaſe the ſurrounding ſoft parts likewiſe ſuffer: The ligaments become thickened, and the contiguous cellular membrane is ſtuffed with the viſcid glairy matter obſerved in the other ſpecies of the diſorder.

70 We come now to the conſideration of the different cauſes which tend to produce this diſeaſe. That the ligaments of the joints only are firſt affected in this diſorder is rendered evident by diſſection. The thick glairy effuſions into the cellular membrane are probably occaſioned by an exudation from the veſſels of thoſe ligaments that have been originally inflamed, as ſuch parts never furniſh a proper fluid for the formation of purulent matter: In the courſe of the diſeaſe, indeed, abſceſſes containing real pus always appear; but never till inflammation has been communicated to the ſurrounding parts. We may conclude, therefore, that the firſt ſpecies of white ſwelling is always occaſioned by an *inflammatory* or *rheumatic affection* of the ligaments of ſuch joints as it attacks, from whatever cauſe ſuch inflammation may originally have proceeded.

The other ſpecies of the diſorder ſeems to be originally an affection of the bones; the ſurrounding ſoft parts coming only to ſuffer in the progreſs of the diſeaſe from their connection with and vicinity to theſe. This laſt ſpecies of white ſwelling generally begins without the patient being in the leaſt able to account for it: and from the effects which it produces on the bones attacked, appears to be a ſpecies of *ſpina ventoſa*; a diſeaſe of the bones probably of the ſame nature as ſcrophula is of the ſoft parts. Indeed, the appearances of the two diſorders, after making allowance for their different ſituations, are exceedingly ſimilar: they both begin with conſiderable enlargements or ſwellings of the parts, which generally end in ulcerations; they both likewiſe frequently occur in the ſame perſon at the ſame time. This ſpecies of white ſwelling is generally either attended with other evident ſymptoms of ſcrophula; or the patient, in an early period of life, has been ſubject to that diſeaſe; or, which is nearly the ſame, he is deſcended from ſcrophulous parents, and probably has the ſeeds of that diſeaſe lurking in his conſtitution. From all theſe circumſtances, it may with probability be concluded, that this ſpecies of white ſwelling is of a ſcrophulous nature: and ſince the other ſpecies of the diſorder is to be conſidered as an inflammatory affection, a thorough diſtinction between them is of very great importance; it will not be improper therefore to give a ſhort enumeration of the ſeveral diagnoſtic or moſt characteriſtic ſymptoms of each.

The pain in the firſt ſpecies is always, from the beginning, diffuſed over the whole joint, and ſometimes extends a conſiderable way along the muſcles that are attached to it: in the other ſpecies it is always at firſt, and ſometimes even when the complaint has been of conſiderable ſtanding, confined to a very ſmall circumſcribed ſpace. In the former, the ſwelling is always confined to the ſoft parts, and is from the beginning exceedingly evident: but in the latter, it is generally for ſome time hardly perceptible; and when it appears the bones are the parts chiefly affected, the ſurrounding teguments coming only to ſuffer on a farther progreſs of the diſeaſe. Theſe are the chief local differences of the two ſpecies of this diſorder; but ſome aſſiſtance in the diſtinction may likewiſe be obtained from the general habit of the patient, and from the manner in which the complaint may ſeem to have been produced. Thus, when ſuch ſwellings occur in young, ſtrong, plethoric, people, eſpecially in ſuch as have formerly been ſubject to rheumatiſm, they moſt probably will always prove of the mildeſt or rheumatic ſpecies of the diſorder: But when they appear in patients of ſcrophulous diſpoſitions, we need be under very little doubt in concluding them to be of a ſcrophulous nature.

The great utility of properly diſtinguiſhing the two different ſpecies of white ſwellings appears in no circumſtance ſo evident as in the treatment. In the one, there being ſome chance, by proper remedies, of being ſerviceable to the patient; whereas in the other, viz. the ſcrophulous, it is not probable that art will ever be able to afford much aſſiſtance.

In the rheumatic white ſwelling, as it is always at firſt evidently of an inflammatory nature, conſiderable advantages are commonly obtained by a due attention to a proper cooling courſe. The firſt remedy which, with this view, ſhould be put in practice, is blood-letting immediately from the part affected. Cupping and ſcarifying is here a principal remedy. The inſtrument ſhould be applied to each ſide of the diſeaſed joint; on each ſide of the rotula, for inſtance, when the knee is the part affected, and at leaſt eight or ten ounces of blood diſcharged; and this to be repeated at proper intervals, once, twice, or oftener, according to the violence of the ſymptoms and ſtate of the patient's ſtrength at the time. 71

Cupping is, in theſe caſes, much ſuperior to leeches, becauſe it is more expeditious, and becauſe of the ſwelling occaſioned by the application of any conſiderable number of theſe

White Swellings.

theſe animals proves frequently very troubleſome, and ſometimes interrupts for a time the uſe of other remedies.

Upon the anterior part of the joint, where the cupping-glaſſes have not been placed, a ſmall bliſter ſhould be directly applied, and the part kept open with iſſue-ointment, till the wounds from the ſcarificator are ſo far healed that a veſicatory may likewiſe be laid on one ſide of the joint; and ſo ſoon as that is nearly healed, the other ſide ſhould be alſo bliſtered. By thus alternately applying them, firſt to the one ſide and then to the other, almoſt a conſtant ſtimulus is kept up; which, in deep ſeated inflammations, ſeems to have fully a greater influence than all the diſcharge occaſioned by bliſters. Gentle cooling laxatives at proper intervals are alſo of uſe; and the patient ſhould, in every reſpect, be kept upon a ſtrict antiphlogiſtic courſe, both as to diet and every other circumſtance.

It is in the firſt ſtages only of the diſeaſe that ſuch a courſe can be of much ſervice; and in ſuch it has frequently been a means of curing diſorders which otherwiſe might have proceeded to the laſt ſtages of white ſwellings.

The original inflammatory affection being once over, theſe ſort of drains ſeem to have little or no influence, and ought not then to be long perſiſted in, as they prevent the uſe of other remedies, which, in an advanced ſtate of the diſeaſe, are commonly more efficacious.

The inflammation being moſtly gone, and while there are yet no appearances of the formation of matter, mercury has ſometimes been known of uſe; not given ſo as to ſalivate, but merely to affect the mouth gently, and to keep it ſomewhat ſore for a few weeks.

The beſt form of uſing it is by way of unction, as it allows, at the ſame time, the application of friction; which, in all ſuch ſwellings, may of itſelf be in ſome meaſure conſidered as a remedy. For this purpoſe, an ointment of quickſilver and hog's lard ſhould be prepared; but with ſo ſmall a proportion of the former, that the patient may admit of two drams of the ointment being rubbed in three times a-day. In order to rub that quantity of the medicine in with gentle friction, an hour each time is at leaſt neceſſary; for in the ordinary way of continuing friction for a few minutes only, it can ſeldom have much influence.

By Le Dran, and other French writers, falls of warm water on ſwellings of this nature are much recommended; and there is no doubt, that a long continued and reiterated application of that remedy may, in the firſt ſtages of ſuch complaints, be often attended with very good effects. By a proper uſe of theſe different applications, viz. of the ſeveral topical remedies in the firſt or inflammatory ſtate of the diſeaſe, and afterwards (ſtill, however, before the formation of matter) of mercurials, friction, &c. many affections of this nature have been entirely removed.

It frequently happens, by the bent poſition the limb has been for a long time kept in, that the uſe of the joint comes to be entirely loſt, having often acquired ſuch a degree of ſtiffneſs, that any attempts to move it are commonly attended with very great pain. This has been conſtantly attributed to one or other of two different cauſes, which are both in their nature incurable, viz. either to the ends of ſuch bones as compoſe the joints having run into one another, ſo as to become firmly conjoined in conſequence of the ſurrounding cartilages being abraded; or to the inſpiſſation, as it is termed, of the ſynovia of the joints, whereby their cavities are entirely filled up, and no ſpace left for the future motion of the bones.

Both theſe opinions, however, are in general very ill founded: as the ſtiffneſs almoſt always proceeds from a contraction of the muſcles and tendons. It may often be cured by a long continued uſe of emollients.

White Swellings.

The beſt emollient that can be uſed is pure olive oil applied warm; as much of it as can be eaſily rubbed in by an hour's gentle friction ſhould be regularly done at leaſt three times a-day; and inſtead of confining the friction altogether to the rigid tendons, it ſhould be extended over the whole muſcles, even to the inſertions of their other extremities; but more eſpecially on their fleſhy muſcular parts, where the principal cauſe of the continuance of ſuch complaints is probably ſeated.

The web or omentum of a new-killed ſheep, or of any other animal, applied over all the diſeaſed parts directly on being cut out of the animal, is ſometimes attended with advantage. The application ſhould be renewed as frequently as poſſible, once a-day at leaſt, or oftener when it can be done; for on being more than four or five hours applied it becomes diſagreeable; and after that time, indeed, as it commonly turns ſtiff, it cannot then probably be of much ſervice.

Bell's Surgery.

The diſorder has hitherto been ſuppoſed not to be ſo far advanced as to have occaſioned the formation of matter; for when come that length, no conſiderable advantages can be expected from any of the remedies as yet recommended: but even in that ſtate of the complaint, if the patient's health does not abſolutely require it, amputation of the member ſhould not be immediately had recourſe to. For by opening the different abſceſſes ſoon after their formation, the matter may be prevented from deſtroying the capſular ligaments of the joints, which, if once effected, would no doubt render that operation neceſſary. Even in point of ſucceſs from the operation, it ought never to be adviſed till the complaint is pretty far advanced. For in this diſorder, eſpecially, a greater proportion of patients have recovered after amputation, who have previouſly been conſiderably reduced by diarrhœas and other weakening ſymptoms, than of ſuch as have ſtill remained in a full plethoric habit of body."

72 When amputation should be perform[ed]

All the different obſervations hitherto made upon the treatment, relate particularly to the rheumatic ſpecies of the diſorder; and when had recourſe to in time, and duly perſiſted in, they will frequently be found of ſervice: but when the diſeaſe is ſo far advanced as to have deſtroyed the capſular ligaments of the joint, and perhaps even the cartilages and bones themſelves, amputation of the member is then no doubt the only reſource.

In the ſcrophulous white ſwellings, when the diſeaſed parts of the bone begin to caſt off, a cure may in that way, by aſſiſting the efforts of nature, be ſometimes obtained in the ſmall joints; but in all the large joints, as the knee, ankle, &c. it is not probable that any other reſource than amputation will ever afford much relief. And even the effects of that operation can ſeldom be depended on as laſting; for when the general ſcrophulous taint ſtill ſubſiſts in the conſtitution, the diſorder will moſt probably appear again in ſome other part; which, however, in the advanced ſtages of the diſeaſe, it is ſometimes neceſſary to run the riſk of, the pain being often ſo tormenting as to make it more eligible to ſubmit to any hazard rather than to bear it longer.

When, however, for ſome reaſon or other, amputation is determined againſt, as there being almoſt a certainty of the complaint ſoon returning, from the ſcrophulous diſpoſition appearing very ſtrong in the ſyſtem, it then becomes neceſſary to have recourſe to palliatives, ſo as to render the complaint as tolerable as poſſible: and with this view, opiates in large doſes, by moderating the pain and procuring reſt to the patient, will in general be found the principal remedy. In other reſpects, all ſuch medicines and articles of regimen as are found beneficial in ſcrophula, may be had recourſe to.

Sect. III. *Of Cancers.*

Cancers moſt commonly ariſe in the glandular parts of the body, where they are occaſioned by any bruiſe or contuſion, ſometimes a very ſlight one: and hence they are more common in the lips, and in the breaſts of women, than in any other parts of the body. Cancers have been generally diſtinguiſhed into *occult* and *open*. By the former are meant ſuch hard ſcirrhous ſwellings as are attended with frequent ſhooting pains, and which at laſt generally termi-
3 nate in the latter.

By the *open cancerous ulcer*, is underſtood that ſpecies of ſore which commonly ſucceeds to hard ſwellings of the glands; although in ſome inſtances it occurs without any previous hardneſs. The edges of the ulcer are hard, ragged, and unequal, very painful, and reverſe in different ways, being ſometimes turned upwards and backwards, and on other occaſions inwards. The whole ſurface of the ſore is commonly very unequal, there being in ſome parts conſiderable riſings, and in others deep excavations. The diſcharge, for the moſt part, is a thin dark-coloured fetid ichor; and is often poſſeſſed of ſuch a degree of acrimony as to excoriate, and even deſtroy, the neighbouring parts. In the more advanced ſtages of the diſeaſe, by the eroſion of blood-veſſels which occurs, conſiderable quantities of pure blood are ſometimes alſo diſcharged.

Patients labouring under real cancerous affections univerſally complain of a *burning* heat over the whole ulcerated ſurface; which, in general, is the moſt tormenting ſymptom that attends the diſorder; and thoſe ſhooting lancinating pains, which were troubleſome in the more occult ſtate of the complaint, become now a great deal more ſo.

Theſe are the moſt frequent ſymptoms which attend an ulcerated cancer; but the appearances of ſuch ſores are ſo various, that it is almoſt impoſſible in any deſcription to comprehend every one. When two, three, or more, however, of thoſe enumerated, concur together in the ſame ulcer, we may always be pretty certain of its being of the
4 cancerous kind.

Concerning the cauſes of cancers, there have been a great many conjectures, but without any ſolid foundation. It is of ſome moment, however, to determine whether they ariſe from ſome general diſorder in the ſyſtem, or whether they are only to be accounted local diſeaſes. Many of the moſt eminent practitioners have been of opinion that they ariſe from a general diſorder of the ſyſtem; and hence conſider them as totally incurable even by extirpation, as the latent ſeeds of the diſeaſe, in their opinion, will not fail to bring on a return of it ſomewhere or other. Of this opinion the late Dr Monro appears to have been; and in a paper on
5 this ſubject in the Edinburgh Medical Eſſays, declares, that "of near 60 cancers which he had been preſent at the extirpation of, only four patients remained free of the diſeaſe at the end of two years." From this bad ſucceſs, and the violent progreſs of the diſeaſe, he finally concludes againſt the extirpation of cancers, and propoſes only the palliative method of cure. But later practitioners have been a great deal more ſucceſsful; and a late publication by Mr Hill, ſurgeon at Dumfries, has put the uſefulneſs of extirpation beyond a doubt, when the operation is performed in time: though, after the diſeaſe has continued long, and the virus been abſorbed, the whole ſyſtem acquires a cancerous diſpoſition, and the diſeaſe almoſt certainly recurs in ſome other part. From internal medicines we can expect little or nothing in the cure of cancers; and external applications can do no more than palliate. Great expectations were formed from the powder and extract of cicuta; but it has ſo univerſally failed, that few put much confidence in it at preſent. However, it has ſometimes been of ſervice in caſes of a ſimple indurated gland; and even where the diſeaſe has been farther advanced, it has produced a better diſcharge, and diminiſhed the fetor of the ſore; but as it cannot be depended upon for a radical cure, a delay of the operation is never to be recommended.

Cancers.

No part of the body is more ſubject to cancer than the breaſts of women. Cancer of the mamma may ariſe at any period of life, though it ſeldom appears till about the time the menſes uſually diſappear. Tumors ariſing in the breaſt previous to this period have been conſidered by ſome practitioners as being only of a ſcrophulous nature; and it is probably owing to that circumſtance that ſeveral cures have been of late years made on tumors of the breaſt by mercurial frictions and other remedies.

76 Cancer of the mamma.

Scirrhus and cancer of the breaſts are diſtinguiſhed by the following marks: When the tumor is firſt obſerved, it is commonly in form of a ſmall hard knot in the glandular part of the mamma, while the ſkin at the ſame time is free from inflammation. It frequently continues in this ſtate for ſeveral months: by degrees, however, it increaſes conſiderably in ſize, and at laſt a ſharp pain is felt ſhooting towards the axilla. The lymphatic glands at the under edge of the pectoral muſcle and in the axilla are often enlarged, and an occult cancer is now formed. By degrees the integuments over this part of the tumor in the mamma become diſcoloured, and at laſt an ulceration or open cancer breaks out. Violent hemorrhagies now frequently enſue; the pain becomes ſtill more excruciating; and, unleſs proper aſſiſtance be given, the patient is generally cut off in not many months after the breaking out of the cancer.

77 Its ſymptoms.

In early ſtages, the diſeaſe in general may be conſidered as entirely a local affection, and a radical cure may be of courſe expected; but in proportion as the ſkin ſhall afterwards be found diſeaſed and adhering to the gland, and that to the pectoral muſcle, and the lymphatic glands near the mamma and in the arm-pit ſwelled, the chance of a cure becomes more doubtful, as the cancerous matter may have been abſorbed, and part of it carried into the ſyſtem. The moſt unfavourable ſtate for an operation is when there are ulcerations in the breaſt, large, deep, and of long ſtanding; and particularly if theſe are attended with great pain, when the arm of the affected ſide has become œdematous, and the health of the patient is much impaired. In this laſt ſtate very little is to be expected from a ſurgical operation.

78 Method of extirpating the mamma.

In extirpating the mamma, which we ſhall firſt ſuppoſe is to be done where the ſkin is ſound, and where the tumor has no uncommon adheſion to the pectoral muſcle, the patient ought to be placed horizontally in a bed, or upon a table covered with a mattreſs, &c. The operator is to be ſeated, and to have proper aſſiſtants. A longitudinal inciſion is then to be made with a common ſcalpel through the ſkin and cellular ſubſtance along the whole extent of the tumor, and at a little diſtance from the nipple, which is to be ſaved. When the longeſt diameter of the tumor is acroſs the body, inſtead of a longitudinal inciſion, a tranſverſe one is to be made. The integuments being diſſected from the mamma on both ſides of the inciſion, the patient's arm is to be extended to ſave the pectoral muſcle; and the whole glandular part is to be detached from the muſcle, though a ſmall portion only ſhould be diſeaſed, beginning at the upper ſide, and ſeparating downwards. If there be any indurated glands, they are to be carefully removed. If the patient be faint, a glaſs of wine, or ſome other cordial, is to be given. After the diſeaſed parts are removed, the wound is to be cleaned with a ſponge wrung out of warm water, which will generally render the ſmall bleeding veſſels more conſpicuous. The integuments are next to be cloſely ap-

Cancers. plied to the parts underneath, and retained there by the twifted future, and likewife by a few adhefive flips. A large pledgit of fimple ointment is now to be laid over the whole; and this is to be covered with a thick compress of lint, tow, or foft linen; and the dreffings to be kept in their place, and moderate preffure made by the napkin and fcapulary bandage.

By this method the integuments will generally foon adhere, and a cure will be performed by the firft intention. But it does not often happen that the operation is performed while this favourable mode of practifing it will anfwer.

In general, before extirpation of a breaft is recommended by the furgeon, or fubmitted to by the patient, a confiderable portion of the external integuments are fo much difeafed as to render it neceffary to feparate them along with the glandular part of the mamma. It fometimes happens likewife that the tumor adheres to the pectoral mufcle, and that again to the ribs. In either of thefe cafes it becomes neceffary to remove all the difeafed parts. For this purpofe, two incifions of an oval form, with fharp extremities, of a fufficient fize to include the whole of the affected parts, become neceffary. If again it be found, that befides the difeafe of the breaft, the lymphatic glands in the neighbourhood are indurated, or otherwife difeafed, the firft incifion ought to extend at once over thefe; and after the other parts have been removed, and the veffels fecured, the whole of the difeafed glands are to be extirpated; and in performing this part of the operation, confiderable affiftance may be given by fupporting them with a hook, or a ligature paffed through them, till they are entirely removed. When they lie deep in the axilla, the points of the fingers, or the end of the handle, will fometimes be fafer than the edge of the knife. After having removed all the glands which are in the fmalleft degree affected, the cut edges of the fkin are to be brought as near to each other as the nature of the cafe will allow, fo as to heal as much as poffible by the firft intention. After the wound is nearly, or perhaps entirely healed, an iffue, inferted into the arm of the oppofite fide, will be the beft means of preventing a relapfe.

Sect. IV *Burns.*

79 Confequences of burns. The immediate confequence of burns is a greater or lefs degree of inflammation; and the danger attending fuch accidents is in proportion to the extent of the injury. Burns which irritate the fkin only, without deftroying the cuticle, act nearly in the way of a common bliftering plafter. When the cuticle is deftroyed, no blifter takes place; a mortified flough is obferved; and when this feparates, an ulcer is

80 Cure. left. Where the cuticle is not deftroyed, relief may be procured by holding the part affected a confiderable time in very cold water, or fometimes by plunging it two or three times into water a little below the boiling point. Solutions of faccharum faturni, and other preparations of lead, have been recommended, as in the cafe of other inflammations. Vinegar is found a very effectual application, whether the fkin be found or bliftered. The part may be entirely immerfed in it, or linen rags dipt in the vinegar may be applied, and the parts kept conftantly moift, till the pain be removed. The fame application is ufeful where the fkin is rubbed off, or otherwife deftroyed. In this cafe, indeed, the vinegar is apt to give additional pain on its firft application; but this foon ceafes, and the part becomes much cooler and eafier. If the patient will not fuffer the vinegar to be applied immediately to the furface of the fore, a linen rag foaked in olive-oil may be previoufly laid on the part, covering the whole with the cloths dipped in vinegar; and thefe applications are to be occafionally repeated till the pain and inflammation be entirely removed; after which the parts are to be dreffed in the fame manner as in the cafe of a common blifter. In extenfive burns, where the irritation is great, along with external applications, opium fhould be prefcribed, in dofes adequate to the degree of pain. Even that ftupor with which patients in this fituation are fometimes attacked, is found to be more readily removed by opium than by any other remedy. With refpect to the blifters which arife upon burns, it has been difputed whether they ought to be opened, or allowed to remain till they dry up of themfelves. But, according to the opinions of the lateft authors, they ought to be opened as foon as any confiderable quantity of fluid is found in them. After the ferum is difcharged, a thin liniment of wax and oil, with a little faccharum faturni, fhould be applied to the part.

Burns. In cafes of very fevere burns, where, notwithftanding the above treatment, there is danger of a violent inflammation being induced, blood-letting, cooling purgatives, and other remedies adapted to the peculiar fymptoms, muft be ufed. When, again, burns are from the firft attended with lofs of fubftance, as commonly happens after the application of hot metallic bodies, we ought to have recourfe to the vinegar, as already mentioned, or to a liniment which is now in very common ufe for fuch purpofes, made of equal parts of lintfeed oil and lime-water, which, when fhaken together, forms a thick white fubftance, which often gives fpeedy relief; and it may be readily applied by daubing the parts frequently over with a foft pencil well foaked in it. Though this has been confidered as one of the beft applications in burns, yet, in fome cafes, more immediate relief has been procured from the application of Goulard's cerate, or the unguentum nutritum; and a weak folution of faccharum faturni has fometimes been of fervice.

When burns are occafioned by the explofion of gunpowder, fome of the grains of the powder are apt to be forced into the fkin. At firft they produce much irritation; and if they are not removed, they commonly leave marks which remain during life. They fhould, therefore, be picked out as foon as poffible after the accident; and to prevent inflammation, as well as to diffolve any power which may remain, the parts afflicted fhould be covered, for a day or two, with emollient poultices. In other refpects, injuries of this fort are to be treated like any other kind of burns.—When burnt parts are contiguous to each other, they are apt to adhere. To prevent this, pledgits covered with any proper dreffing ought to be inferted between them during the courfe of the cure. Ulcers arifing from burns are apt to become foft and fungous, and to rife above their natural level. When this is obferved, the emollient ointments, which may have been previoufly ufed, fhould be laid afide, and thofe of a moderately aftringent nature applied. Gentle compreffion with a roller is alfo of particular fervice. Advantage is likewife derived from faturnine wafhes, &c. One of the beft ointments, in fuch cafes, is the common calamine cerate. Thefe will commonly anfwer the purpofe; but when they prove infufficient, burnt alum, blue vitriol, or even lunar cauftic, may be neceffary. 81 Burns occafioned by gunpowder.

Chap. V. *Of Inflammatory Tumors.*

Inflammatory Tumors are fuch as are quick in their progrefs when compared with thofe of the indolent kind, and are attended with confiderable pain and other fymptoms of inflammation. We have here mentioned fuch only whofe treatment more properly belongs to the province of the furgeon, and which are placed according to their fituations in the different parts of the body.

Sect.

Sect. I. *Inflammation and Abſceſs of the Breaſts of Women.*

This diſorder occurs moſt frequently in nurſes by the ſtoppage of the milk, which is always occaſioned by ſudden or imprudent expoſure to cold.

In the early ſtages of the affection, reſolution is always to be attempted, unleſs the ſwelling appears to have an evident tendency towards ſuppuration. The remedies uſed in inflammation, in general, ſeem uſeful in every caſe of inflammation of the breaſts. When the patient happens to be nurſing, a ſudden evacuation of blood is apt to diminiſh the quantity of milk: In ſuch caſes, therefore, blood is to be extracted in ſmall quantities at a time. The application of cooling ſaturnine poultices is adviſable. When ſuppuration has taken place, the matter is to be diſcharged by making an inciſion in the moſt depending part of the tumor.

Sect. II. *Inflammation of the Teſticles.*

This diſeaſe is often owing to expoſure to cold, violent exerciſe, &c.; but moſt frequently to gonorrhœa virulenta, and never to matter falling down upon the teſtes, as was ſuppoſed by thoſe who gave it the name of *hernia humoralis*. Inflammation here rarely terminates in ſuppuration.

The beſt method for diſcuſſing the inflammation is by the application of leeches; after which the penis ought to be kept conſtantly moiſtened with a ſolution of ſaccharum ſaturni, and the ſcrotum and teſtes ſupported by a proper bandage. The bowels ſhould be kept moderately open; the patient ſhould uſe a low diet, and keep as much as poſſible in an horizontal poſture. If lues venerea be preſent, a cure cannot be expected without mercury. If the diſeaſe is owing to a ſudden ſtoppage of the diſcharge in gonorrhœa, the running ought to be reſtored, and promoted by bathing the penis in warm water, injecting warm oil, and the uſe of bougies. Theſe means will generally diſcuſs the inflammation. If matter form, it muſt be diſcharged.

Sect. III. *Of Venereal Buboes.*

A swelling of any of the lymphatic glands of the body is called a *bubo*; and when ſuch a ſwelling proceeds from venereal poiſon, it is termed *venereal bubo*. They ſeldom or never appear except in the lymphatic glands of the groin, arm-pit, or extremities, and much more frequently in the groin than anywhere elſe.

In the treatment of buboes, a ſtrict antiphlogiſtic regimen is to be uſed to promote a reſolution; the application of leeches to the hardened gland is particularly proper. In diſcuſſing venereal buboes, the application of mercurial ointment has a conſiderable effect. After ſuppuration is completely formed, the application of cauſtic to open the bubo is dangerous, leſt it ſhould corrode ſome of the conſiderable blood-veſſels, which generally lie contiguous to the bubo. Buboes, when opened by the knife, are ſaid to heal with more difficulty, and generally to leave a ſcar behind them. To allow them to burſt of themſelves, is therefore for the moſt part proper, except when the collection is ſo conſiderable as to preſs upon the neighbouring blood-veſſels. In ſuch a caſe, a ſmall inciſion may be made by the lancet, taking as much care as poſſible to prevent the admiſſion of the external air into the wound. When the edges of the opening grow callous, the application of lunar cauſtic to them becomes neceſſary. During the remaining part of the cure, mercury joined with opium is to be uſed.

Sect. IV. *Lumbar Abſceſs.*

The term *lumbar* may be applied to every abſceſs ſeated in the loins; but that which is here meant is ſuch as begins about the top of the os ſacrum, and is ſeated in the vicinity of the great pſoas muſcle. Inflammatory Tumors.

82 The ſymptoms begin with pain and tenſion about the loins, ſhooting upwards to the ſpine and downwards to the thigh. The diſeaſe has ſometimes a ſtrong reſemblance to nephritic affections, and is ſometimes miſtaken for lumbago. After ſuppuration takes place, ſhivering fits come on; and the pain now becoming dull, the patient imagines himſelf better, till matter points at the ſide of the anus, or in the groin. The firſt caſe is rare; and when it does occur, the tumor burſts, or is opened as a common abſceſs. In the other caſe, the matter is ſeated behind the faſcia of the groin, and ſometimes deſcends as far as the knee. The teguments commonly retain their natural appearance. Fluctuation is evident, eſpecially when the patient is in an upright poſture. It is often miſtaken for crural hernia; but may be eaſily diſtinguiſhed from it, by its ſlow progreſs, by pain in the lumbar region at the commencement of the diſeaſe, by the patient allowing the tumor to be handled freely, by fluctuation being evident, by the tumor becoming flaccid when the patient is in an horizontal ſituation, and by the abſence of all the ſymptoms by which hernia is diſtinguiſhed. Both diſeaſes may occur at once; but this is very rare, and a diſtinction is ſtill to be made. Symptoms of lumbar abſceſs.

83 It is diſcovered that this diſeaſe has, in general, been induced by conſiderable injury being done to the ſmall of the back or loins, either by twiſts, or ſevere bruiſes, or by ſudden expoſure to cold after the heat occaſioned by ſevere exerciſe, particularly in ſcrophulous habits. Were accidents of this nature immediately treated with that attention which their importance deſerves, the diſeaſe might frequently be prevented. Cauſe of this diſeaſe.

84 In the treatment the ſtricteſt antiphlogiſtic regimen ought to be obſerved. Blood-letting ought immediately to be performed, by ſcarifying deeply and leeching the injured part: neither are bliſters, opiates, gentle purgatives, and other remedies uſeful in inflammations, to be neglected. Treatment.

Authors have an idea that little advantage can be derived from laying open the abſceſs, on account of the great danger which may enſue from the admiſſion of air. Mr Benjamin Bell, however, is of an oppoſite opinion, and has always given vent to matter here as elſewhere, and no bad conſequences have been obſerved. The matter, when long lodged, has been found to deſtroy the ſoft parts and bones, and ſometimes to make its way into the cavity of the abdomen; all of which might be prevented by an early evacuation. For this purpoſe a trocar ſhould be uſed, which was tried by Mr Bell in one caſe with complete ſucceſs.

Some other caſes are lately narrated by authors, where, by the introduction of a ſeton, and drawing off the matter by ſlow degrees, and then by uſing compreſs, and ſometimes injections of gently irritating fluids, a cure has been performed in the courſe of a few months. If the caſe is doubtful, an opening ſhould be made with the knife in the ſame manner as in hernia. If the flow of matter continue conſiderable for the ſpace of two or three weeks, injections of a weak ſolution of ſaccharum ſaturni, lime water, or other gentle aſtringents, may be employed.

Sect. V. *Paronychia or Whitlow, and Chilblains.*

85 Whitlow is a painful and inflammatory ſwelling at the extremities of the fingers under the nails, terminating in an effuſion of clear ſerum below the ſkin, which is ſometimes ſo acrid as to corrode the perioſteum, and render the bones carious. At other times the inflammation runs ſo high that the whole of the arm ſwells, particularly the lymphatics, and ſometimes even the glands in the axilla. Of whitlow.

When this affection ariſes from external violence, the re-

medies

Inflammatory Tumors. medies employed for inflammation, in general, will be of service. When it arises from unknown causes, ardent spirits and astringents have been found useful, particularly when topical and general bleedings have been previously used. When an effusion of a serous matter takes place, it is immediately to be discharged, as it is almost impossible to convert it into proper pus. When this serum has continued so long as to render the bone carious, a removal of the whole bone, or of the carious portion, becomes necessary, in order to effect a complete cure.

86 Chilblains. Chilblains are inflammatory swellings, of a purple colour, chiefly affecting the heels, and sometimes also the fingers, toes, arms, hands, or feet, or even the tips of the nose and ears, attended with a stinging pain, and a degree of itching. The swelling sometimes cracks, and discharges an acrid serum: sometimes a mortification takes place, and an ulcer follows very difficult to heal.

This disorder is owing to the weaker action of the small vessels most remote from the heart, occasioned by cold or dampness, and occurs most frequently in people of a delicate constitution.

When the patient has been for some time exposed to the cold, and the parts are frost-bitten, they ought to be plunged into the coldest water and rubbed with salt; when they are only benumbed, rubbing them with camphorated spirit of wine will answer equally well: but when cracks take place, and an oozing of acrid matter ensues, poultices may be applied, but not long, as they are apt to give rise to fungous excrescences.

Sect. VI. *Of Contusions and Sprains.*

87 Symptoms of contusions and sprains. Contusions of the integuments and muscles produce pain, swelling, and inflammation, and these, in some cases, may extend to a considerable degree; but in general they are less violent than what take place in cases of sprains of ligaments or tendons; for in these there is frequently a total loss of motion for many weeks, and sometimes for years, if proper attention be not paid. An effusion of fluids always succeeds the injury, which seems to be, for the most part, of a serous nature, as the skin usually retains its natural colour; sometimes the tumefied parts are of a deep red, or leaden colour, owing to a rupture of some vessels conveying red blood.

88 Treatment. In the treatment of contusions and sprains, two circumstances require attention. 1. To endeavour to prevent the swelling as far as is practicable; 2. To employ those remedies afterwards which are known to be most powerful in preventing or removing inflammation. In contusions of the cellular substance, and even of the muscles, the effused fluids are commonly soon absorbed; but in sprains of the tendons or ligaments, a very troublesome, painful thickness of the injured parts is apt to continue for a great length of time, and in some instances even for life.

It is necessary, therefore, to obviate these symptoms as soon as possible; and for this purpose, cold astringent applications, as water, vinegar, &c, are most commonly used. Others again, with a view to relax the parts fully, make use of water as hot as the patient can bear it. By immersing the injured part in these immediately after the injury is received, the effusion will at least be somewhat obviated. When the pain is excessive, opiates become necessary.

After blood has been freely discharged, a repetition of the remedies already mentioned will be found to give great relief; care should be taken, at the same time, that the injured parts be kept in a relaxed and easy posture.

Chap. VI. *Of Indolent Tumors.*

Indolent Tumors. These are such as are slow in their progress, and may continue for a long time without being attended with either pain or inflammation; though occasionally almost all of them may be inflamed, and some of them, in that state, attended with considerable pain. They are of different kinds according to the nature of their contents, and appear in various parts of the body. They are seated in the adipose and cellular membrane; whence it often happens that they take place in the viscera themselves, where they are frequently mortal. Sometimes they are filled with a substance of the consistence of honey, and are thence called *meliceratous* tumors; sometimes they are filled with an harder substance, and are then called *atheromatous* tumors; at other times they are filled with a substance of the consistence of fat, and are then called *steatomatous*. Sometimes, however, they are found to be replenished with a fluid lymph coagulable by heat, and are then called *hydatids*. One set are filled with matter like the synovia of the joints, and get the name of *ganglions*.

89 Different kinds of indolent tumors.

9[?] How they are distinguished from other tumors and from one another. Tumors of this kind are easily distinguished from all others, as having neither heat, pain, nor pulsation, as is to be observed in those which incline to suppurate; and they are distinguished from each other, before they are laid open, by fluctuation being readily perceived in the meliceris: the atheroma is soft and compressible, but has no fluctuation; while the steatoma is commonly firm and rolls under the skin. But these rules are liable to considerable exceptions. The meliceris and atheroma are most commonly found upon the head, and the steatoma upon the other parts of the body; while ganglions are situated over the tendons of the muscles. These tumors must be either extirpated entirely, or laid open so as to dispose the cyst to slough off or granulate. If the matter be fluid, we may evacuate it by an opening made with a lancet, or by means of a seton; but as the matter is apt to collect again, it is better to remove the sac entirely. If large vessels or nerves prevent this from being done, then it is to be laid freely open and exposed to the air, so that the bag may granulate, or be thrown off. When the tumor is to be extirpated, a longitudinal incision is to be made through the integuments; after which the tumor may be frequently removed by the point of the finger, or by the end of a spatula, replacing the integuments with a view to heal by the first intention. In every pendulous tumor of this kind, with a narrow neck, we ought to divide the teguments near the bottom of the tumor, in an oval form, so that the wound may be afterwards properly covered with the remaining integuments. After the tumor is removed, the skin is to be replaced over the wound, and fixed with adhesive straps, covering it with a pledgit of cerate, a small compress of linen, with a bandage above all, to make a gentle pressure on the parts.

9[?] Treatment.

Sect. I. *Of Steatomatous and Sarcomatous Tumors.*

9[?] Steatomatous tumors. Steatomatous tumors have been ranked by authors among those of the encysted kind; but they have no other cyst containing them than the common cellular substance, somewhat condensed; and the particles of fat composing them are found of the same size with those in a sound part of the body.

Authors formerly advised the discussion of steatoms, or the prevention of their growth, by the application of pressure; but by such means the growth is rather promoted than retarded, nor have internal remedies been of any advantage. They can be removed therefore by an operation which is the same with that for the extirpation of encysted tumors.

9[?] Sarcomatous tumors. Sarcomatous tumors have nearly the same external appearance with those of the steatomatous kind. The term has been applied, in a general way, to scirrhi of the glands; but

ma, but sarcomatous tumors are likewise found in various other parts of the body, and are distinguished from steatoma by being firmer to the touch; internally they are found of a redder colour, or approaching that of muscles, in consequence of the greater number of vessels entering into their substance. These are to be treated in the same manner as steatoms; but the operation ought to be performed early, as they are more apt to degenerate into cancer.

SECT. II. *Of Ganglions, or Swellings of the Bursæ Mucosæ.*

GANGLIONS of the tendons are likewise tumors of the encysted kind, seated in the bursæ mucosæ, or sheaths of the tendons which belong to the extremities. They are most frequently met with over the tendons upon the back of the wrist, and often likewise about those of the ankle and other parts of the extremities. When pressed, they are found to possess a considerable degree of elasticity, from which, and from their situation, they may generally be distinguished from other encysted tumors. They seldom arrive at any great bulk, are not often attended with pain, and commonly the skin retains its natural appearance. On being laid open, they are found to contain a tough, viscid, transparent fluid, resembling the glaire of an egg.

They are generally produced by sprains, or contusions of the joints, or by rheumatism. In many instances, they go off insensibly, without any assistance from art; but as this is often not the case, means ought to be used for removing them. For this purpose, moderate friction frequently repeated, or gentle compression applied to them by means of thin plates of lead, &c. sometimes remove them. In some instances they have been removed by the application of blisters; but the most certain method is, to make a small puncture into the sac, and to draw a cord through it; or, after the puncture is made, to press out the contents, and then inject some gently stimulating fluid, as port wine and water heated blood-warm. Sometimes, in tumors of this kind, bodies of a cartilaginous nature, and of different shapes and sizes, are found; some quite smooth, others with peduncles; by which they are supposed by Dr Monro, in his work upon the bursæ mucosæ, to have been attached to the bursæ. As these cannot be removed by any remedy with which we are yet acquainted, it is found neccessary to discharge them. But as the parts may sometimes suffer from inflammation when the tumor is laid fully open, it may be punctured at each end; and, after pressing out the contents, a small cord may be introduced; after which gentle pressure may be applied with a compress and bandage over the course of the tumor. The cord however should not be continued so long as to induce any great degree of inflammation, for it is found that a slight degree of this sufficiently answers the purpose.

SECT. III. *Of Collections within the Capsular Ligaments of Joints, and of Cartilaginous Bodies contained there.*

COLLECTIONS here may consist of serum, blood, or pus and synovia combined. They are most frequently met with in the joint of the knee, and may be produced either by internal or external causes. These kinds of collections may in general be distinguished from each other.

Watery effusions, commonly called *dropsical* swellings of the joints, arise chiefly in consequence of severe rheumatic complaints; and when the tumor is not very large, the fluctuation of the fluid may be felt by pressure. When a large effusion appears immediately after a violent bruise, it is probable that it consists chiefly of blood: but when it succeeds a violent sprain, attended with great pain, inflammation, and swelling, terminating in an effusion, there is every reason to think that the contained fluid consists of pus mixed with synovia. Collections within the Capsular Ligaments of Joints, &c.

96 How distinguished from other affections.

Swellings of the joints are most apt to be confounded with collections in the bursæ mucosæ, or with matter effused in the adjacent cellular substance. From the first of these they are generally distinguished by the contained fluid passing readily from one side of the joint to the other, and from its being diffused over the whole of it; whereas, when it is contained in the bursæ, the tumor is confined to a particular part, and is seldom attended with much pain.

97 Treatment.

When such collections can safely be allowed to remain, the capsular ligament ought never to be opened, as they can often be removed by discutients. Even considerable collections arising from rheumatism may commonly be discussed by friction, fomenting the parts with warm vapour, keeping them constantly moist with saturnine solutions, covering them properly with flannel, and applying blisters. When these fail, supporting the part with a laced stocking, or with a roller, has frequently been of service. But whether a rheumatic tumor can be discussed or not, it ought not to be opened; for the inconvenience attending it is more intolerable than the pain and inflammation which may ensue. But when the matter would do mischief by lodging, it should be discharged. Effused blood and matter which succeed high degrees of inflammation are of this kind. Blood is frequently extravasated among soft parts without much detriment; but when in contact with cartilage or bone, it soon hurts them materially. The matter ought to be discharged so as most effectually to prevent the admission of air into the cavity of the joint. For this purpose the opening should be made with a trocar; and the skin, previously drawn tight to the upper part of the tumor, should be pulled down immediately on withdrawing the canula. A piece of adhesive plaster should be directly laid over the opening, and the whole joint should be firmly supported by a flannel roller properly applied. If the patient be plethoric, he should be blooded to such an extent as his strength will bear; he should be put upon a strict antiphlogistic regimen, and in every respect should be managed with caution; for inflammation being very apt to ensue, we cannot too much guard against it.

98 Method of discharging the matter.

99 Concretions in the joints.

Joints are sometimes rendered painful and stiff by the formation of different substances within the capsular ligaments. These are sometimes loose, and as firm as cartilage; and sometimes of a soft membranous nature, similar to those already observed in treating of swellings of the bursæ mucosæ.

In some cases these substances, especially the last species, retain nearly the same situation, without being much affected either by pressure or by the motion of the joint: in that case the pain is constant, but seldom severe. The first species, however, is commonly very moveable; and on being touched, they slip with such facility that it is difficult to fix them even with the fingers. These are only painful in particular situations.

100 When perfectly loose, may be extracted.

Where these concretions appear, upon examination, to be perfectly loose and detached, if the pain which they excite is very severe, we should venture in a cautious manner to take them out, by making an incision into the joint. But if there is reason to suspect that they are connected with any part of the joint, the patient ought to be advised to submit to the pain they induce, which in general will be rendered moderate by shunning exercise; but if, notwithstanding this, it becomes insupportable, amputation is the only resource.

101 Manner of extracting them.

The limb being firmly secured by assistants, in that posture which admits of the body to be taken out being felt most

Cartilaginous bodies in the capsular ligaments of joints, &c.

most distinctly, the surgeon should endeavour to fix it with his fingers towards the upper part of the joint, after an assistant has drawn the skin as much as possible upwards from the part where the incision is to be made. The operator with a scalpel is now to make an incision through the teguments and capsular ligament, directly upon the substance itself, of such a size as will admit of its being easily taken out; which may be done either with the finger or with the end of a blunt probe. If it is found to be connected by any small filaments either to the capsular ligament or to the cartilages of the joint, they should be cautiously divided, either with a probe-pointed bistoury, or probe-pointed scissars, after drawing the substance itself as far out as it can be got. When more concretions than one are found, they should all be taken out at the same opening, when this can be done; but when it cannot, it will be better to allow the first incision to heal before attempting the second, so as to avoid as much as possible the exciting of inflammation.

After the concretion is removed, the skin should be immediately drawn over the wound in the capsular ligament; and the lips of the opening in the skin being laid together, they should be secured in this situation by pieces of adhesive plaster, so as to prevent the air from finding access to the cavity of the joint. Till the wound be completely healed, the patient should not only be confined to bed, but the limb should be kept as much as possible in one posture, and a strict antiphlogistic regimen should be preserved.

Sect. IV. *Of Spina Bifida.*

Spina bifida, is a tumor which sometimes appears upon the lower part of the spine in new-born children. A fluctuation is distinctly perceived in it, and the fluid it contains can in some measure be pressed in at an opening between the vertebræ. In some cases this opening is owing to a natural deficiency of bone; in others, to the separation of the spinous processes of the vertebræ.

The disease proceeds from serum collected within the coverings of the spinal marrow. It is always fatal. Children labouring under it have been known to live for two or three years; but, in general, they linger and die in a few weeks. All that art has been able to do is to support the tumor by gentle pressure with a proper bandage. When a tumor of this kind is laid open or bursts, the child dies in a few hours. A tumor nearly of the same nature with this is sometimes met with upon different parts of the head in new-born children: it is formed by a fluid lodged beneath the membranes of the brain, which have been forced out at some unossified part of the skull. What we have said with respect to the former is exactly applicable to this.

Sect. V. *Of Scrophulous Tumors.*

We shall here only mention the surgical treatment of scrophulous tumors, having spoken of scrophula in general under the article Medicine. Some practitioners have recommended poultices, &c. to bring scrophulous tumors to suppuration; but the best practitioners have laid them aside, because they increase the soft and spongy state of the parts, by which they are prevented from healing.

102 Treatment of scrophulous tumors.

As external applications are ineffectual, it is better to allow scrophulous tumors to be as much exposed as possible, as this frequently renders the subsequent ulcer more easily cured. The other methods recommended for discussing these tumors are, the internal use of cicuta, burnt sponge, muriated barytes, a long continued use of the cold bath, particularly of sea-bathing, and drinking mineral or sea-water. These, to produce any effect, should be begun early, while the tumors are small, and long persisted in. When the tumors come to a state of suppuration, if they are seated upon the thorax or abdomen, or any of the large joints, free vent ought always to be given to the matter to prevent its bursting into these cavities; and when the abscess is large, this should be done with a trocar, or by passing a cord thro' it, in order to exclude the external air. When the tumors are not situated upon great cavities, it is better to allow them to break of themselves, as the sores commonly heal more readily, and the scar is pretty similar in both. The most proper applications to scrophulous sores seem to be those of the saturnine kind, as they diminish inflammation, and in some measure prevent the sore from spreading. When the bones become carious, they are to be treated like carious bones from other causes; but amputation cannot here be attended with advantage, as the disease proceeds from a fault in the constitution. After the sores are healed up, the introduction of an issue may assist in preventing their return.

Tumors of a scrophulous nature are sometimes apt to be mistaken for those of the scirrhous kind, and thus may be improperly extirpated. Scrophulous tumors deeply seated commonly have a degree of firmness, which, if they happen to be seated near a suspicious part, as close by the side of a woman's breast, may give occasion to such a mistake. But they may generally be distinguished by the softness even of the firmest kind of them, when compared with scirrhus. They have always a smooth equal surface; whereas scirrhus is somewhat unequal or knotty, and seated in the real substance of the gland; and a shooting pain is commonly felt in it from time to time, even from its first appearance. They are generally accompanied, too, with other symptoms of scrophula, which is not necessarily the case with scirrhus.

Sect. V. *Of Bronchocele.*

This is a tumor on the fore-part of the neck, seated between the trachea and skin, termed in French *goitre*. In this country it is very rare; but it is frequent among the inhabitants of the Alps, and other mountainous countries, and is supposed to be owing to the use of snow-water. It is seated most frequently in the thyroid gland; tho' in two cases examined by Mr Benjamin Bell this gland was diminished from the compression of the tumor, which was chiefly formed of condensed cellular substance, with effusions in different parts of it of a viscid brown matter. Dr Prosser considers bronchocele as a dropsical affection of the thyroid gland; and in confirmation of this, he gives an account of a dissection of a diseased gland of this kind by Dr Hunter, who found in it a great number of capsules filled with water. The swelling is at first soft, without pain or any evident fluctuation, and the skin retains its natural appearance; but as the tumor advances in size, it becomes unequally hard; the skin acquires a copper colour, and the veins of the neck become varicose; the face becomes flushed, and the patient complains of frequent headachs, as well as of stinging pains through the body of the tumor.

Calcined egg-shells have been recommended by authors as a specific for this disease; but little dependence is to be placed on such a remedy. Frequent frictions are found useful, especially when employed early; saponaceous and mercurial plasters, too, have in some cases proved serviceable; and repeated blisters have been known to retard its progress. In the enlarged state of the tumor no remedy yet known is powerful enough to discuss it. When the disease is far advanced, the removal of the tumor by an operation must be attended with great danger, on account of the enlarged state of the arteries, as well as its vicinity to the common carotids. It is therefore thought by some of the most experienced practitioners, that in such a situation it would not be

Ma- ri, , and rts. be adviſable to attempt extirpation, and that the patient ſhould rather truſt to the common palliative treatment. When the tumor, however, is not much increaſed, if other remedies have failed, and the diſeaſe is advancing, a ſurgeon might be warranted in attempting its extirpation.

SECT. VI. *Of Nævi Materni, Corns, and Warts.*

06 ma- NÆVI MATERNI are thoſe marks which frequently appear upon the bodies of children at birth, and which are ſuppoſed to originate from impreſſions made on the mind of the mother during pregnancy. They are of various forms; their colour is likewiſe various; though moſt frequently reſembling that of claret or red port wine. Many of theſe marks are perfectly flat, and never riſe above the level of the ſkin: theſe do not require the aſſiſtance of ſurgery; but in ſome caſes they appear in the form of ſmall protuberances, which frequently increaſe to a great ſize in the courſe of a few months. They appear to be firm and fleſhy. They ſometimes hang by ſlender attachments to the contiguous parts, but more generally they are fixed by broad baſes. They may be removed with as little danger as any other tumor of the ſarcomatous kind. They are ſupplied indeed more plentifully with blood than moſt other tumors are; and even ſometimes they appear to be entirely formed by a congeries of ſmall blood-veſſels; but the arteries which ſupply them may, for the moſt part, eaſily be ſecured by ligature. The operation ſhould never be long delayed; for as the ſize of the veſſels correſponds with that of the tumor, they ſometimes are ſo large as to throw out a good deal of blood before they can be ſecured. In performing it, the tumor is to be cut out, the arteries taken up, and the remaining ſkin brought as well together as the nature of the part will allow, and kept ſo by adheſive plaſter or ſuture. When the tumor is pendulous, and connected only by a narrow neck, it ſhould be extirpated by ligature.

07 ns. Corns are ſmall hard tubercles, commonly ſituated on the toes or other parts of the feet, and ſometimes on the hands. They are of a horny nature. They proceed from a diſeaſed ſtate of the cuticle, occaſioned by preſſure. The part becomes hard and thickened, with a ſmall white ſubſtance in the centre, which has a diſpoſition to become prominent. It likewiſe forms a depreſſion in the ſubjacent cutis vera, and ſometimes is ſaid to penetrate it. When corns are ſituated on parts much expoſed to preſſure, they irritate the ſkin, and produce an increaſed ſenſibility of the part, and thus occaſion much pain. The beſt preventative of corns is the wearing of wide ſhoes, and avoiding every kind of preſſure; and unleſs this be attended to, it will be found difficult to keep free from them. Various remedies are recommended for the cure or removal of corns. One is to bathe the part about half an hour in warm water, then to pare as much off them as poſſible without giving pain, and to apply over them any emollient ointment. If this treatment be frequently repeated, while preſſure from ſhoes is prevented, they generally fall off, and do not return if preſſure be afterwards avoided. Another method is to allow them to grow to ſome length through pieces of perforated leather, properly ſecured by plaſter or by any other means, and afterwards to cut round their root, by which they may for the moſt part be eaſily turned out. Or if ſuch irritating ſubſtances be applied to them as will raiſe a bliſter by ſeparating the cuticle from the cutis, the corn will be raiſed along with the cuticle, and may then be readily removed by a ſcalpel or ſciſſars. The ſurface of the cutis being now expoſed, is to be healed like any other part that has been bliſtered.

08 rts. Warts are ſmall, hard, indolent tumors, with a rough ſurface, appearing on different parts of the body, chiefly the hands and face, and more commonly in young people. Polypi When they appear in advanced life they are apt to degenerate into cancer, eſpecially when of a livid colour and with a ſmooth ſurface. If they do not prove troubleſome, nothing ſhould be done to them, as they generally either fall off or waſte gradually away. When from their ſize or ſituation they require to be removed, this, if they are pendulous or have narrow necks, is eaſily done by ligature; but if their baſes be broad, the ſcalpel or eſcharotic applications will be neceſſary. As few, however, will ſubmit to the former, the latter are generally employed. Eſcharotics of a mild nature give leaſt pain, and are leaſt apt to excite inflammation, which in theſe caſes it is difficult to remove, and are found to be quite ſufficient for the purpoſe. One of the beſt of theſe is crude ſal ammoniac: it ſhould firſt be moiſtened in water, and then well rubbed upon the warts two or three times a-day. Liquid ſalt of tartar, and ſometimes ſpirit of hartſhorn, has anſwered the ſame purpoſe: ſome recommend alſo the juice of onions. 109

Warts appearing on the penis as a ſymptom of venereal Warts on infection, are of the ſame nature, and to be cured by the the penis. ſame means. Mercury is of no advantage here, and commonly indeed does harm. When every other part of the diſeaſe is eradicated, the warts may generally be removed by waſhing them morning and evening in lime-water, or in a weak ſolution of ſaccharum ſaturni. They may be removed alſo by the knife, and the parts from whence they are cut afterwards touched with lunar cauſtic, to prevent them from returning: but when this method is practiſed, the operator ought to be certain that he has removed the wart entirely, for where part has been left the moſt formidable ſymptoms have ſometimes enſued.

SECT. VII. *Of Polypi.*

POLYPI are pendulous, fleſhy, indolent tumors, ſo called from their ſuppoſed reſemblance to the animal of that name. They may be found in different cavities of the body, and originate from the lining membrane; but thoſe which come under ſurgical treatment are found in the noſe, mouth, throat, and outer paſſage of the ear, and in the vagina and 110 rectum. They are divided into two claſſes; the one ſoft Polypi di- and compreſſible, the other extremely firm. Both of them vided into bleed on being fretted or roughly handled. The ſoft kind two kinds. ſhrivels and contracts in a dry atmoſphere, (this is particularly the caſe with thoſe of the noſe); but the firm are not affected by the influence of the weather. Their colour is commonly pale and tranſparent, and ſometimes a deep red.

The pain at the commencement of the diſorder is always inconſiderable; but increaſes in thoſe of a hard nature as they increaſe in ſize. Sometimes polypi of this kind become unequal, and form ulcers over the whole ſurface, diſcharging fetid matter in conſiderable quantity. They are apt at this time, unleſs extirpated, to degenerate into cancer. 111

Moſt frequently they ariſe from local injury, or whatever Their tends to produce and ſupport an inflamed ſtate of the part. cauſe. Scrophula and lues venerea, though conſidered by ſome authors as frequently giving riſe to them, ſeem only to be exciting cauſes; for in lues venerea in particular, polypi when preſent remain after the diſeaſe is cured. 112

The prognoſis muſt depend much upon their ſituation and Prognoſis. their conſiſtence. The ſoft kind being ſeldom painful, may be removed at any period with little danger; but the hard kind are generally not only painful, but more apt to degenerate into cancer, or to return after being removed. The ſoft kind therefore may be removed in general with ſucceſs; but when polypi of a harder nature exiſt, the prognoſis will be much more unfavourable.

Polypi.

113 Treatment. With respect to the treatment.—As long as they remain stationary, they are not to be touched; but when they continue to grow, we ought to use astringent remedies, especially a strong solution of alum, a decoction of oak bark, vinegar, ardent spirits, &c. The softer kinds of polypi may frequently be prevented for a long time from increasing in size, and sometimes they even become considerably smaller. Mercury has been found rather to make them worse; caustic and other corroding applications have been of use in the softer kind, though they have not produced a cure. Setons have likewise been used with little advantage. It is therefore found necessary to have recourse to a more effectual practice; and with this view the knife, sciffars, forceps, or ligature, are more generally recommended. The knife and sciffars may be used when the roots of the tumor can be readily come at; but polypi are seldom so situated as to render excision practicable; and even when they are, the hemorrhagy may be attended with considerable danger. The removal of a polypus by tearing or twisting it with the forceps, Plate CCCCLXXXVII. fig. 4. is occasionally practised; but as ligatures are less painful, and fully as effectual, they are now more generally employed. The ligatures consist of wire, catgut, silk cord, &c. Different methods have been employed for passing these over polypi, according to their different situations.

114 Method of applying a ligature to them. When the ligature is to be applied, it is to be passed double over the tumor, and conducted to the root of it by means of the fingers or by slit probes, as in Plate CCCCLXXXVII. fig. 5. or rings, Plate CCCCLXXXVII. fig. 6. as may be best suited to the shape and size of the passage. The ends of the ligature are then to be introduced into a single or double canula, as in Plate CCCCLXXXVII. fig. 7. which is to be pushed along the opposite side of the polypus till the end of the canula reach the root of it, when the ligature is to be drawn somewhat tight, and fastened to the canula which is to be left in the passage. The ligature is to be daily tightened till the tumor drop off. In this manner the largest polypus may be removed equally well with those of a smaller size. Should any part of it remain, it may be destroyed by caustic, and different instruments are contrived for conducting this to the root of the tumor

What has been said of the treatment of polypi in general, readily applies to those seated in the nose, outer passage of the ear, the rectum, and the vagina. It likewise applies to those in the throat; only that instead of passing the ligature through the mouth, it is to be passed through one of the nostrils. The operator is then to introduce one or two of his fingers into the mouth, and open the doubling of the ligature, which he is to pass over the polypus, and having pressed it down to the root of it, to proceed as before directed.

Chap. VII. *Of Diseases of the Bones.*

Diseases of the Bones.

The bones, as well as the softer parts, are liable to be swelled, either throughout their whole length, or to have tumors formed on particular parts of them.

115 Exostosis. Exostosis is one species of tumor of the bone. According to Mr Bromefield, no swelling should be called so, but an excrescence continued from a bone, like a branch from the trunk of a tree. Under this head therefore is ranked the *bony node*, which may be produced by external injury, such as contusions and fractures: it can hardly be called a disease, as pain seldom succeeds, but rather a deformity.

There are [illegible] or tumors observable on the bones which are often the consequence of venereal virus, and are termed

116 Tophus. *tophi, gummi*, or *nodes*.—Tophus is a soft tumor in the bone; and seems to be formed of a chalky substance, that is intermediate between the osseous fibres. These cretaceous extravasations are sometimes found on the ligaments and tendons, as well as on the bone; and may sometimes be taken out by the knife. We have many instances where chalk stones in gouty people make their way out through the skin of the fingers and toes.

117 Gummi. Gummi is a soft tumor on the surface of the bone, between it and the periosteum; and its contents resemble gum softened, from whence it has taken its name. Possibly, by obstruction in the nutrient vessels of the bone, a rupture of some of them occasions the serous liquor to escape, which, by making its way between the fibres of the bone, arrives at its surface; and being detained by the resistance of the periosteum, its most liquid parts being evaporated, and the remainder condensed by the inflammation, and consequently this inelastic covering being stretched, it becomes inspissated, and forms this species of *exostosis*, as it is generally called. When this is the cause, and the indisposition of the habit in general got the better of, pressure by a steel instrument, adapted to the part affected, is the proper cure.

118 Nodes. The confirmed venereal node has the appearance of a divarication of the osseous fibres, probably from some inspissated humour obstructing the nutrient vessels, but not extravasated; this occasioning an extension of the periosteum, produces a violent pain, which, when nocturnal, is the characteristic of a venereal cause. When the periosteum is thickened, but the bone not affected, a course of mercury, by attenuating the obstructed humour, and fitting it to be carried out of the body by the proper outlets, will often produce a perfect cure: but when the bone itself is diseased, this method will fail. But here the division of the extended periosteum has been known to give perfect ease.

The usual method, formerly, was to apply a caustic equal to the extent of the node, which being laid bare, required exfoliation before it could be cicatrized. If the incision is made early, that is, before matter be formed under the investing membrane, it seldom requires exfoliation; and, as we often find that the bone itself is not affected, but only the periosteum thickened, we may be deceived even after a careful examination: it is therefore proper that the patient should be pretty far advanced in a course of mercurial unction before even the incision is made; for, should the tumor decrease, and the pain abate during the course, chirurgical assistance, with the knife, most likely may become unnecessary.

119 Abscessus in medulla, or spina ventosa. A bone may become carious first in its internal parts; and that from external injury, as well as from a vitiated state of the animal-fluids. Authors seem not to agree as to the technical term for this kind of disease of the bones; some calling it *cancer* or *gangrena ossis*; others, *spina ventosa*, from the pointed extuberances usually attendant on this disorder of the bone; and some again *tereda*, from the appearance of the carious bone, like wood that is worm-eaten.

It is universally allowed, that this disease takes its rise from matter being formed either in the diploe, or in the marrow: whenever obstruction is begun in the vessels expanded on, or terminating in, the medullary cysts, the consequence will be inflammation, and, if not early removed, matter will form; for this reason this case may be called *abscessus in medulla*.

120 Symptoms of this disease. Whenever, then, a patient complains of dull heavy pain, deeply situated in the bone, possibly consequent to a violent blow received on the part some time before, though the integuments appear perfectly sound, and the bone itself not in the least injured, we have great reason to suspect an abscess in the medulla. Children of a bad habit of body, though they have not suffered any external injury, will often become lame, and complain of the limb being remarkably heavy; and though not attended with acute pain,

afes of Bones. pain, yet the dull throbbing uneafinefs is conftant. If rigors happen during the time the patient labours under this indifpofition, it generally implies that matter will be formed within the fubftance of the bone. If the extremities of the bone complained of begin, or if it becomes enlarged throughout its whole extent, it may be known to be an abfceffus in medulla, or true fpina ventofa, as it is called: if neither of thefe fymptoms take place, the great infenfibility of the bone in fome fubjects will prevent that acutenefs of pain ufual in other parts where matter is formed, though the acrid matter is eroding the bone during the whole time it is contained within it. This matter at length having made its way through, arrives at the periofteum, where it creates moft violent pain, as well from its fharpnefs as from its increafed quantity, occafioning an extenfion of the periofteum. The integuments then become fwelled and inflamed, and have a fort of emphyfematous feel. On being examined by preffure, the tumor will fometimes be leffened, from part of the matter retiring into the bone: from this appearance to the touch, moft likely the name of *ventofa* was

121 ument. added to the term *fpina*. When we are affured of matter being under the periofteum, we cannot be too early in letting it out, as it will fave a confiderable deal of pain to the patient, though probably it may not be of any confiderable advantage in refpect to the carious bone; for, where the fluids in general are vitiated, no chance of cure can be expected from topical remedies; but where the conftitution is mended, nature will fometimes affift us in her part, as the carious bone will be thrown off from the epiphyfes, or the teredines will be filled up by the offific matter that flows from the parts of the bone where fome of the fpinæ have come away.

If proper medicines are given, the children well fupported, and the parts kept clean and dry, patience and perfeverance will frequently give great credit to the furgeon. In cafe it fhould have been thought advifable to apply a trephine, to give free difcharge to the matter, the wafhing it away, as well as the fmall crumblings of the carious bone, by means of deterfive and drying injections, has been known to contribute greatly to the curing this kind of caries, after the habit of body in general had been mended.

122 brittle- the es. Befides thofe above-mentioned, the bones are liable to two oppofite difeafes; the one termed *friabilitas*, the other *mollities*; the former peculiar to adults, the latter more frequent in infants, though fometimes feen in adults, from a vitiated ftate of their juices.

The bones, when deprived of their cementing liquor, by paffing through fire, become friable. From repeated falivations, and in old people, they have been rendered extremely brittle; infomuch that in many fubjects they have been fractured merely from their weight and the action of the mufcles: but in fuch cafes, this is not owing to the friability of the bones, but to the lofs of fubftance, from the erofion of the bone by an acrimonious humour thrown on it: to which caufe perhaps may be attributed the difeafe called

123 kets. *rickets* in children. The effects of fcorbutic humour in rendering the bones foft in many inftances, have often been remarked.

By proper diet, gentle friction with coarfe cloths, exercife, and cold bathing, rickety children will frequently get their conftitution fo much changed, as that, by the time they arrive at the age of 20 years, there fhall not remain the leaft veftige of their former difeafe. The epiphyfes are generally moft affected in this fpecies of the diforder. For want of early attention to invalids of this fort, we find that their bones not only become foft, and yield to the powers of the mufcles, but remain diftorted the reft of their lives, though they have acquired a perfect degree of folidity. In fuch cafes, correcting the vitiated juices only will not reftore the bones to their natural ftate; therefore the affiftance of a fkilful mechanic is neceffary both to fupport the parts improperly acted on, and to alter the line of direction of the diftorted offeous fibres. Difeafes of the Bones.

Though the curvature of the extremities, or thicknefs of the ends of the bones near their articulations, may give the first alarm to thofe who are conftantly with children, yet there are other fymptoms that give earlier notice than thefe; and had they been timely difcovered by proper judges, it is highly probable that the curvature of the limbs in many children might not have happened. The belly generally becomes larger in this difeafe, from the increafed fize of the contained bowels, as it is not unlikely but that the mefenteric glands are the firft parts obftructed; obftructions of the liver, fpleen, and pancreas, foon follow; the head then becomes enlarged; then a difficulty of breathing, which is generally fuppofed to be the effects of taking cold, fucceeds; the fternum is elevated and fharp, and the thorax becomes contracted; the fpine is protruded in feveral parts; the pelvis altered, according to the preffure of the parts within, and habitual inclination of the patient, at times, to obtain that line of direction in which the perpendicular from the centre of gravity may fall within the common bafe of the body, the extremities of the cylindrical bones, and the ends of the ribs next the fternum, become enlarged; foon after this the bones in general become foft and flexible, yielding in fuch directions as the ftrongeft mufcles determine by their actions. 124 Symptoms of rickets.

The bones of children who die of this diforder, we obferve, are not only rendered foft, but the veffels within their fubftance are replete with blood of a texture totally broken, and having more the appearance of thin chocolate than blood: the periofteum in many places is feparated, and the intermediate fpace between it and the bone filled with extravafated fluid; and caries is almoft as frequent as the feparation of the periofteum. The mufcles in fuch bodies generally appear pale and flabby. 125 Appearance of the bones of rickety children.

Where the affection of the mefenteric glands is evident, Mr Bromefield afferts, that after a dofe or two of the pulvis bafilicus to empty the inteftines thoroughly, the purified crude quickfilver is by much the moft efficacious medicine to remove obftructions in thofe glands. When the belly begins to foften and fubfide, the chyle paffes without interruption, and the child begins to get flefh; then the cold bath becomes truly ferviceable, and the decoction or cold infufion of the Peruvian bark is a proper reftorative; but the cold bath ufed too early, or the bark given before there is a free circulation of chyle through the lacteals, would be very injurious. 126 Method of cure recommended by Mr Bromefield.

The mollities offium, in fome cafes, may be produced from a redundancy of the oleaginous parts of the blood, or from a laxity of the folids, by which the fluids are not fufficiently attenuated, nor properly blended and mixed: the confequence of which will be obftructed perfpiration, the habit in general loaded with grofs, phlegmatic, and ferous humours, and the offific matter not united or condenfed as in an healthy ftate. The method of cure confirms us in the caufe of thefe fymptoms; for, by ftrengthening the fibrous fyftem, by ufing gentle exercife, a dry diet, good air, aromatics, and cold bathing, this kind of invalids are generally reftored to health. 127 Of mollities offium.

Among the difeafes of the bones we may likewife take notice of that *palfy of the lower extremities* which takes place, as is generally fuppofed, in confequence of a curvature in fome part of the fpine. To this diftemper both fexes and all ages are equally liable. When it attacks an infant of only a year or two old or under, the true caufe of it is fel- 128 Palfy of the extremities from curvature of the fpine.

Difeafe of the Bones. dom difcovered until fome time after the effect has taken place. The child is faid to be uncommonly backward in the ufe of his legs, or it is thought to have received fome hurt in the birth. When the child is of an age fufficient to have already walked, and who has been able to walk, the lofs of the ufe of his legs is gradual, though in general not very flow. He at firft complains of being very foon tired, is languid, liftlefs, and unwilling to move much or at all brifkly. Soon after this he may be obferved frequently to trip and ftumble, though there be no impediment in his way: and whenever he attempts to move brifkly, he finds that his legs involuntarily crofs each other, by which he is frequently thrown down without ftumbling; and when he endeavours to ftand ftill in an erect pofture without fupport, even for a few minutes, his knees give way and bend forward. As the diftemper advances, it will be found that he cannot, without much difficulty and deliberation, direct either of his feet exactly to any one point; and very foon after this, both legs and thighs lofe a good deal of their natural fenfibility, and become quite ufelefs. In adults, the progrefs of the difeafe is much quicker, but the fymptoms nearly the fame.

Until the curvature of the fpine is difcovered, the complaint generally paffes for a nervous one; but when the ftate of the back bone is adverted to, recourfe is almoft always had to fome previous violence to account for it. That this might have been the cafe in fome few inftances might be admitted; but in by far the greateft number fome predifpofing caufe muft be looked for.

Mr Pott, who has written a treatife upon this difeafe, recommends it to our obfervation, that though the lower limbs are rendered almoft ufelefs, or even entirely fo, yet there are fome circumftances in which it differs from a common nervous palfy. The legs and thighs, though fo much affected, have neither the flabby feel of a truly paralytic limb; nor have they that feeming loofenefs at the joints, nor the total incapacity of refiftance which allows the latter to be twifted almoft in all directions: on the contrary, the joints have frequently a confiderable degree of ftiffnefs, particularly the ankles; by which ftiffnefs the feet of children are generally pointed downward, and they are prevented from fetting them flat upon the ground.

At firft the general health of the patient feems not to be at all, or at leaft not materially affected; but when the difeafe has continued for fome time, and the curvature is thereby increafed, many inconveniences and complaints come on; fuch as difficulty in refpiration, indigeftion, pain, and what they call *tightnefs at the ftomach*, obftinate conftipations, purgings, involuntary flux of urine and fæces, &c. with the addition of fome nervous complaints, which are partly caufed by the alterations made in the form of the cavity of the thorax, and partly by impreffions made on the abdominal vifcera.

Mr Pott was led to a knowledge of the true caufe and cure of this diftemper, from obferving the cafe of a youth of 14, who was reftored to the ufe of his limbs immediately after a feemingly accidental abfcefs near the part. From this he was inclined to think, that the curvature of the fpine was not the original caufe of the diforder, but that the furrounding parts were predifpofed towards it by fome affection of the folids and fluids there; and he was confirmed in thefe fufpicions by a variety of appearances, which he obferved both in the living body and upon diffection of the fubject after death; all of which are narrated at full length in his treatife upon this fubject.

"The remedy (fays he) for this moft dreadful difeafe confifts merely in procuring a large difcharge of matter, by fuppuration, from underneath the membrana adipofa on each fide of the curvature, and in maintaining fuch difcharge until the patient fhall have perfectly recovered the ufe of his legs. To accomplifh this purpofe, I have made ufe of different means, in fome few inftances, iffues made by incifion, and iffues made by cauftic; and although there be no very material difference, I do upon the whole prefer the laft. A feton is a painful and a nafty thing: befides which it frequently wears through the fkin before the end for which it was made can be accomplifhed. Iffues made by incifion, if they be large enough for the intended purpofe, are apt to become inflamed, and to be very troublefome before they come to fuppuration; but openings made by cauftic are not in general liable to any of thefe inconveniences, at leaft not fo frequently nor in the fame degree: they are neither fo troublefome to make or maintain. I make the efchars about this fize and fhape on each fide the curve, taking care to leave a fufficient portion of fkin between them. In a few days, when the efchar begins to loofen and feparate, I cut out all the middle, and put into each

a large kidney-bean: when the bottoms of the fores are become clean by fuppuration, I fprinkle, every third or fourth day, a fmall quantity of finely powdered cantharides on them, by which the fores are prevented from contracting, the difcharge increafed, and poffibly other benefit obtained. The iffues I keep open until the cure is complete; that is, until the patient recovers perfectly the ufe of his legs, or even for fome time longer: and I fhould think that it would be more prudent to heal only one of them firft, keeping the other open for fome time; that is, not only until the patient can walk, but until he can walk firmly, brifkly, and without the affiftance of a ftick: until he can ftand quite upright, and has recovered all the height which the habit or rather the neceffity of ftooping, occafioned by the diftemper, had made him lofe."

Chap. VIII. *Of Blood-letting.*

Sect. I. *Of Blood-Letting in general.*

Blood-letting is performed either to leffen the quantity of circulating fluid, or to relieve a particular part: hence we have the terms of *general* and *local* blood letting.

General blood-letting is either performed upon a vein or an artery; and from this circumftance arife the appellation of *phlebotomy* and *arteriotomy*.

Local or topical blood-letting is performed by fcarificators and cupping-glaffes, by leeches, or by punctures made with a lancet, as may be moft fuitable to the nature of the difeafe it is intended to remedy.

There are fome general rules and obfervations which relate equally to this operation in whatever part of the body it is practifed: thefe we fhall in the firft place enumerate, and fhall afterwards proceed to treat particularly of blood-letting in the arm and other parts. 129 General rules refpecting blood-letting.

I. In this, as in every other operation, the fituation of the patient, and of the operator likewife, ought to be precifely fixed. The fituation of a patient, during the operation of blood-letting, has a confiderable influence on the effects produced, and therefore merits particular attention. In fome diforders, it is the object of this remedy to evacuate a confiderable quantity of blood without inducing fainting: When this is the cafe, and when from former experience it is known that the patient is liable during the evacuation to fall into a faintifh ftate, a horizontal pofture ought to be preferred to every other; for fainting is not near fo ready to occur in a horizontal as in an erect pofture. It now and then happens, however, 130 Pofture of the patient.

however, that one material advantage expected from the operation of blood-letting, is the production of a ſtate of deliquium; as, for inſtance, in caſes of ſtrangulated hernia, where a general relaxation of the ſyſtem is ſometimes deſirable. In all ſuch circumſtances, inſtead of a horizontal poſture, the more erect the patient is kept, the more readily will a ſtate of fainting be induced. The patient ought to be ſo placed, that the principal light of the apartment ſhall fall directly upon the part to be operated upon, that the vein to be opened may be made as apparent as poſſible.

II. The patient being properly ſeated, the next ſtep is, by means of a proper bandage of ſilk, linen, or woollen cloth, which has more elaſticity, ſo to compreſs the vein intended to be opened, as to prevent the blood from returning to the heart. An equal degree of preſſure ought to be applied to all the other veins of the part: for if this be not attended to, the communication preſerved by the collateral correſponding branches would render the preſſure upon any one particular vein of very little importance. This preſſure upon the veins, by inducing an accumulation of their contents, tends to bring them more evidently into view, and conſequently renders it eaſier for the operator to effect a proper opening than he would otherwiſe find it. The preſſure, however, ought never to be carried ſo far as to obſtruct the circulation in the correſponding arteries, otherwiſe no diſcharge of blood can take place. When we ſee that it has the effect of raiſing the veins, while at the ſame time the pulſation of the artery is diſtinctly felt in that part of the member which lies on the ſide of the ligature moſt diſtant from the heart, we may be certain that it is to a very proper degree, and that it ought not to be carried farther; for by the ſwelling of the veins we are ſure that they are ſufficiently compreſſed; and by the arteries continuing to beat, it is evident that a continued flow of blood may be expected.

III. The reflux of blood to the heart being in this manner prevented, the next queſtion to be determined is, the beſt method of making an opening into the vein. Different inſtruments have been invented for this purpoſe; but there are two only which have been retained in uſe, and which are all therefore that here require to be mentioned. Theſe are the lancet and the phleam. This laſt, on being placed immediately on the part to be cut, is, by means of a ſpring, puſhed ſuddenly into the vein, and produces an opening of the exact ſize of the inſtrument employed.

When it is determined to employ the lancet, which is by far the ſafeſt, the form of that inſtrument is next the object of attention. The broad ſhouldered lancet ought to be laid entirely aſide; becauſe the broadneſs of its ſhoulders produces always a wound in the external teguments of perhaps three times the ſize of the opening made in the vein; a circumſtance which adds no advantage whatever to the operation; on the contrary, it produces much unneceſſary pain; renders it frequently a very difficult matter to command a ſtoppage of the blood; and the wounds produced by it are commonly ſo extenſive as to be liable to terminate in partial ſuppurations.

The ſpear-pointed lancet, on the contrary, repreſented in Plate CCCCLXXXVII. fig. 8. is in every reſpect well calculated for the purpoſe of veneſection. From the acuteneſs of its point, it enters the teguments and vein with very little pain; which is with many patients a circumſtance of no ſmall importance. We are ſure of making the opening in the vein equal, or nearly ſo, to the orifice in the external teguments; and the diſcharge of blood produced by an opening made with one of theſe lancets, is commonly put a ſtop to with great eaſe immediately on removing the ligature upon the vein.

IV. The form of lancet being thus fixed upon, we come now to ſpeak of the method of uſing it. The ſurgeon and patient being both properly ſeated, and the ligature having been applied for a ſhort ſpace of time in order to produce ſome degree of ſwelling in the veins, that vein is to be made choice of which, at the ſame time that it appears conſpicuouſly enough, is found to roll leſs than the others on being preſſed upon by the fingers. It is ſcarcely thought neceſſary to obſerve here, that when a vein appears to be ſo immediately connected with a contiguous artery or tendon, as evidently to produce ſome riſk of wounding theſe parts in the operation, another vein not liable to ſuch hazard, if it can be procured, ought undoubtedly to be preferred. Veins may lie directly above both arteries and tendons, and yet no manner of riſk be incurred by opening them, provided the operator is ſufficiently ſteady and attentive; but it does now and then happen, that veins are ſo nearly and intimately connected with theſe parts, as to render it hazardous even for the moſt dexterous ſurgeon to attempt this operation.

Blood-letting. 133 Method of performing the operation.

The vein being at laſt made choice of, the ſurgeon, if he is to uſe his right-hand in the operation, takes a firm hold of the member from whence the blood is to be drawn with his left, and with the thumb of the ſame hand he is now to make ſuch a degree of preſſure upon the vein, about an inch and a half below the part where the orifice is to be made, as not only to render the ſkin and teguments ſomewhat tenſe; but at the ſame time to interrupt for a little all communication between the under part of the vein and that portion of it lying between the ligature and the thumb placed as thus directed.

The lancet being drawn out ſo as to form nearly a right angle with the ſcales, the operator now takes it between the finger and thumb of his right-hand; and leaving at leaſt one half of the blade uncovered, he reſts his hand on the middle-finger, ring-finger, and little-finger, all placed as conveniently as poſſible in the neighbourhood of the vein from whence the blood is to be taken; and having puſhed the point of the inſtrument freely through the ſkin and teguments into the vein, he now carries it forward in an oblique direction, till the orifice is of the ſize he inclines to have it; taking care, during the time of puſhing on the lancet, that its point be kept in as ſtraight a direction as poſſible, for fear of dipping into the parts below.

The inſtrument is now to be withdrawn; and the ſurgeon, removing the thumb of his left hand, is to allow the vein to empty itſelf freely into the different cups previouſly provided for the purpoſe.

It is of importance to obſerve, that during the time the blood is diſcharging, the member ought to be kept in exactly the ſame poſture it was in when the lancet was firſt introduced: otherwiſe the orifice in the ſkin is apt to ſlip over the opening in the vein; a circumſtance which always proves inconvenient, and on ſome occaſions produces a good deal of trouble by the blood from the vein inſinuating itſelf into the ſurrounding cellular ſubſtance.

134 Method of producing a ſufficient flow of blood.

V. When the vein is properly cut, and the orifice is made ſufficiently large, it rarely occurs that any difficulty is experienced in procuring all the blood that is wanted. But when this laſt circumſtance occurs, from the patient becoming faintiſh, a ſtream of freſh air ought to be admitted to the apartment, wine or ſome other cordial ſhould be adminiſtered, and the patient ought to be laid in a horizontal poſture. By theſe means the faintiſhneſs will in general be ſoon removed: but if ſtill the blood ſhould not flow freely, the member ought to be put into all the variety of poſitions that can probably aſſiſt in bringing the openings of the ſkin and other teguments to correſpond with that of the vein; which will ſoon be known to have happened by the blood

blood beginning instantly to flow. Throwing the muscles of the part into constant action, by giving the patient a cane or any other firm substance to turn frequently round in his hand when the operation is done in the arm, will often assist in producing a constant flow of blood from a vein when every other means has failed: And, laftly, when the pulfe in the inferior part of the member is felt very feeble, or especially if it cannot be distinguifhed at all, we may be thereby rendered certain that the ligature is too tight, and may in general have it in our power to produce an immediate flow of blood, by removing the compreffion thus improperly made upon the arteries of the part.

135 Method of ftopping the [illegible] flux.

VI. A quantity of blood proportioned to the nature of the diforder being thus difcharged, the preffure upon the fuperior part of the vein fhould be immediately removed; and this being done, if the fpear-pointed lancet has been ufed, all farther lofs of blood will in general ftop immediately. The contrary of this, however, fometimes occurs, and blood continues to flow freely even after the ligature is removed. When this is the cafe, the operator ought to comprefs the vein both above and below the orifice, by means of the finger and thumb of one hand, fo as to prevent any farther lofs of blood. This being done, and the orifice being cleared of every particle of blood, the fides of it fhould be laid as exactly together as poffible; and a piece of court or any other adhefive plafter being fo applied as to retain them, it will feldom happen that any kind of bandage is neceffary: but when the blood has iffued with uncommon violence during the operation, and has been difficult to command after the removal of the ligature, in fuch inftances it will be prudent to apply a fmall comprefs of linen over the plafter, and to fecure the whole with a linen roller properly applied round the member.

Sect. II. *Of Venefection in different Parts of the Body.*

136 Venefection in the arm.

When venefection is to be performed in the arm, the ligature for ftopping the circulation ought to be placed about an inch or an inch and a half above the joint of the elbow, and brought twice round: in order to prevent the ends of it from interfering with the lancet, the knot fhould be made on the outfide of the arm. In general, one knot might anfwer; but a flip-knot being made above the firft, renders it more fecure, and it is very eafily done.

In forming the choice of a vein from whence blood is to be taken, the general rules we have already laid down upon this point muft be here particularly attended to. In general the artery lies fo low in this place, that the median bafilic vein, under which it commonly runs, may be opened with perfect fafety; and as this vein in general appears more confpicuous than any of the others, probably from the continued pulfation of the artery below obftructing in fome meafure the paffage of its contents, it is in this refpect therefore more properly calculated for this operation than any of the others. Other circumftances occur too which render the median bafilic preferable to the cephalic or median cephalic veins for the operation of blood-letting. The former, viz. the median bafilic, is lefs deeply covered with cellular fubftance; and by lying towards the inner part of the arm, it is more thinly covered with the tendinous expanfion of the biceps mufcle than either of the others. From thefe circumftances, the operation is always attended with lefs pain when done in this vein than in any of the others.

In very corpulent people, it fometimes happens that all the larger veins lie fo deep as not to be difcovered by the eye; but when they are diftinctly felt by the finger, even although they cannot be feen, they may be always opened with freedom. In a few inftances, however, they can neither be diftinguifhed by the eye nor by the finger: in fuch a fituation, as they may in general be met with about the wrift or on the back-part of the hand, the ligature fhould be removed from the upper part of the arm; and being applied about half way between the elbow and wrift, the veins below will thereby be brought into view; and wherever a vein can be evidently obferved, there can be no danger in having recourfe to the operation.

Venefection in different parts of the body.

There is only one vein of the neck, viz. the pofterior external jugular, which can eafily be brought fo much into view as to be with propriety opened; and even this lies deeply covered with parts, not only with the fkin and cellular fubftance, but with the fibres of the platifma myoides mufcle; fo that a confiderable degree of preffure becomes neceffary in order to raife it to any height. With a view to produce this, the operator's thumb is commonly advifed to be placed upon the vein, fo as to comprefs it effectually about an inch or an inch and a half below where the opening is to be made. This, however, feldom proves fufficient for the purpofe, as the blood, on being ftopped in its progrefs through this branch, eafily finds a paffage to the other veins; fo that unlefs the principal vein on the other fide of the neck is alfo compreffed, the vein to be opened can never be fully diftended. In order to effect this, a firm comprefs of linen fhould be applied on the largeft vein on the oppofite fide of the neck; and an ordinary garter, or any other proper ligature, being laid directly over it, fhould be tied with a firm knot below the oppofite arm-pit; taking care to make fuch a degree of preffure, as to put an entire ftop to the circulation in the vein, which in this way may be eafily effected without producing any obftruction to the patient's breathing. But to prevent every inconvenience of this kind, fee an inftrument contrived for the purpofe, Plate CCCCLXXXVII. *fig.* 9.

Venefection in the neck.

This being done, and the patient's head properly fupported, the operator, with the thumb of his left hand, is now to make a fufficient preffure upon the vein to be opened; and with the lancet in his right hand is to penetrate at once into the vein; and before withdrawing the inftrument, an orifice fhould be made large enough for the intended evacuation. It may be proper to obferve, that a more extenfive opening ought always to be made here than is neceffary in the arm, otherwife the quantity of blood is generally procured with difficulty: and befides, there is not the fame neceffity for caution on this point here that there is in the arm; for it feldom or never happens that any difficulty occurs in this fituation, in putting a ftop to the blood after the preffure is removed from the veins; all that is commonly neceffary for this purpofe being a flip of adhefive plafter without any bandage whatever.

In order to bring the vein more clearly into view, fo as afterwards to be able to open it with more exactnefs, it has been recommended, that the fkin, cellular fubftance, and mufcular fibres covering the vein, fhould be previoufly divided with a fcalpel before attempting to pufh the lancet into it. There is not, however, any neceffity for this precaution, as it rarely happens that any difficulty is experienced in procuring a free difcharge of blood by opening the vein and teguments at once in the manner directed. And it is here, as in every inftance where it is neceffary to take blood by a lancet, if it is not done at once, the patient is much difappointed, and is fure to attribute the failure entirely to a fault in the operator.

Venefection in the ankle and feet.

When blood is to be difcharged from the veins of the ankle or feet, the ligature being applied a little above the ankle-joint, all the branches of the vena faphena, both in the infide and outfide of the foot, come at once into view; and as this vein lies everywhere very fuperficial, being in general covered with fkin only, wherever a proper

per vein appears conſpicuouſly it may with ſafety be opened.

With a view to encourage the diſcharge of blood, it has been a conſtant practice in blood-letting, in theſe veins, to dip the feet into warm water immediately on the orifice being made. But this is a very inaccurate method of proceeding, as the quantity of blood taken in this manner can never be aſcertained with preciſion; for the blood being all mixed with the water, the operator can never be in any degree certain as to this point: and beſides, there does not appear to be any neceſſity for this aſſiſtance; for when the compreſſion of the ſuperior part of the veins is made effectual, and the orifice is of a proper ſize, there is ſeldom more difficulty in obtaining a full diſcharge of blood from the veins of theſe parts than from any other veins of the body.

On removing the ligature, the diſcharge is generally ſtopped at once; ſo that a piece of adheſive plaſter applied over the orifice anſwers all the purpoſe of a bandage. The arm, neck, and ankles are the parts from whence blood is uſually taken by veneſection; but on ſome occaſions, where the contiguous parts have been particularly affected, it has been thought adviſable to perform veneſection in other places.

When veneſection is to be performed in the veins called *ranulæ* under the tongue, the apex of the tongue is to be elevated, and the vein on each ſide opened, becauſe the opening of one only will hardly ever diſcharge blood enough. After a ſufficient quantity has been diſcharged, ſome cold aſtringent fluid taken into the mouth will generally ſtop the hemorrhagy.

The vena dorſalis penis, which runs along the back or upper ſide of this member, being generally pretty much diſtended, and conſpicuous in an inflammation of this part, may be opened about the middle or back part of the penis; and a ſufficient quantity of blood be diſcharged proportionable to the urgency of the ſymptoms. This being done, apply a compreſs and bandage proper for the penis. The arteries and nerves which lie on each ſide of the vein are to be avoided: nor ought the bandage to be too tight, otherwiſe the inflammation and other ſymptoms may turn out worſe than before.

When it is found neceſſary to diſcharge blood in this manner from the penis, the veins can be eaſily brought into view, by producing an accumulation of their contents in the ſame manner as in other parts of the body, through the intervention of a ligature: but in the tongue, in the hemorrhoidal veins about the anus, and other parts where compreſſion cannot be applied, all that the ſurgeon can do, is to make an orifice of a proper ſize in that part of the vein which ſhows itſelf moſt evidently; and if a ſufficient diſcharge of blood is not thus produced, as there is no other method of effecting it, immerſing the parts in warm water may in ſuch circumſtances be a very neceſſary meaſure.

There are ſeveral ways of performing the operation of blood-letting in the eyes. We ſhall here only relate the chief: Firſt, the patient is to be ſeated conveniently on the bed-ſide or on a chair, with his head held in a proper poſture by an aſſiſtant; which done, the ſurgeon makes a tranſverſe inciſion with a lancet upon the turgid ſmall veſſels in the corners of the eye, ſo as to open them or cut them quite acroſs. Some uſe a ſmall pair of ſciſſars, inſtead of a lancet, to divide the veſſels; but in uſing either of them, the eye-lids muſt be ſeparated from each other by the fingers of one hand, while the veſſels are cut by inſtruments held in the other. Some, again, elevate the ſmall turgid veſſels with a crooked needle before they divide them, the eye-lids being in the mean time held aſunder by an aſſiſtant. The ſmall veſſels being thus opened or divided, their diſcharge of blood ſhould be promoted by fomentations of warm water frequently applied to the eye by means of a ſponge or ſoft linen rags. Arteriotomy.

Among other methods that have been propoſed for ſcarifying the blood-veſſels of the eye, the beards of rough barley were at one period much extolled, and are ſtill employed by ſome individuals. By drawing them over the ſurface of the eye, in a direction contrary to the ſharp ſpiculæ with which they are furniſhed, a conſiderable diſcharge of blood is thereby produced: But the pain attending this operation is exquiſite; and as it does not poſſeſs any ſuperior advantage to the method with the lancet, it is now falling into general diſuſe.

Sect. III. *Of Arteriotomy.*

Whatever particular advantages may in theory have been expected from arteriotomy, and however ſome of its ſupporters may have recommended it, not only as being in many inſtances preferable to veneſection, but as an operation perfectly ſafe even in veſſels of conſiderable ſize; yet the moſt ſtrenuous friends to the practice have ſhrunk from any real attempt of this kind on the larger arteries. Inſtances have no doubt occurred of large arteries having been opened without any danger enſuing; but theſe are ſo exceedingly rare, that no practitioner of experience will, from that conſideration, be induced coolly to proceed to open any artery of importance. The ſmaller branches of arteries may indeed be opened with great ſafety, when they are not deeply covered, and eſpecially when they lie contiguous to bones; but in any of the larger arteries, the attempt muſt be always attended with ſo much hazard, and the advantages to be expected from it, in preference to veneſection, are apparently ſo trifling, as muſt in all probability prevent it from ever being carried into execution. 142 Arteriotomy ſeldom practiſed.

There are very few arteries, therefore, which, with any propriety, can be opened: the different branches of the temporal are the only arteries indeed from whence blood, in ordinary practice, is ever taken; for although the opening of ſome other branches of arteries has by ſome been propoſed, yet they are ſituated in ſuch a manner that they either cannot be readily come at, or being in the neighbourhood of ſo large nerves, the opening of them might be attended with bad conſequences. 143 Arteries uſually opened.

In performing this operation on any of the temporal branches, if the artery lies ſuperficial, it may be done with one puſh of the lancet, in the ſame manner as was directed for veneſection: but when the artery lies deeply covered with cellular ſubſtance, it is always neceſſary to lay it fairly open to view, before making the orifice with the lancet: for in all the ſmaller arteries, when they are cut entirely acroſs, there is little chance of being able to procure any conſiderable quantity of blood from them; as, when divided in this manner, they are ſure to retract conſiderably within the ſurrounding parts, which commonly puts a ſtop to all farther evacuation. 144 Method of performing the operation.

Some degree of nicety is alſo neceſſary in making the opening into the artery of a proper oblique direction, neither quite acroſs nor directly longitudinal; for a longitudinal opening never bleeds ſo freely, either in an artery or in a vein, as when its direction is ſomewhat oblique.

If the opening has been properly made, and if the artery is of any tolerable ſize, it will at once diſcharge very freely without any compreſſion; but when the evacuation does not go on ſo well as could be wiſhed, the diſcharge may be always aſſiſted by compreſſing the artery immediately above the orifice, between it and the correſponding veins. The quantity of blood being thus diſcharged, it will commonly happen, that a very ſlight compreſſion on theſe ſmaller arteries will ſuffice for putting a ſtop to the evacuation: and

Topical Bleeding.

whatever preſſure is found neceſſary, may be here applied in the ſame manner as was directed in venæſection.

It happens, however, in ſome inſtances, that this does not ſucceed, the orifice continuing to burſt out from time to time, ſo as to be productive of much diſtreſs and inconvenience.

145 Methods of ſtopping the blood

In this ſituation there are three different methods by which we may with tolerable certainty put a ſtop to the further diſcharge of blood. 1ſt, If the artery is ſmall, as all the branches of the temporal arteries commonly are, the cutting it entirely acroſs, exactly at the orifice made with the lancet, by allowing it to retract within the ſurrounding parts, generally gives an immediate ſtop to the diſcharge. 2d, When that is not conſented to, we have it always in our power to ſecure the bleeding veſſel with a ligature, as we would do an artery accidentally divided in any part of the body. And, laſtly, if neither of theſe methods is agreed to by the patient, we can, by means of a conſtant regular preſſure, obliterate the cavity of the artery at the place where the operation has been performed, by producing the accretion of its ſides. Different bandages have been contrived for compreſſing the temporal artery; but none of them anſwer the purpoſe ſo eaſily and ſo effectually as the one figured in Plate CCCCLXXXVII. fig. 10. This method is more tedious; but to timid patients it generally proves more acceptable than either of the other two.

Sect. IV. *Of Topical Bleeding.*

When, either from the ſeverity of a local fixed pain, or from any other cauſe, it is wiſhed to evacuate blood directly from the ſmall veſſels of the part affected, inſtead of opening any of the larger arteries or veins, the following are the different modes propoſed for effecting it, viz. by means of leeches; by ſlight ſcarifications with the ſhoulder or edge of a lancet; and, laſtly, by means of an inſtrument termed a *ſcarificator*, (Plate CCCCLXXXVII. fig. 11.); in which ſixteen or twenty lancets are commonly placed, in ſuch a manner, that, when the inſtrument is applied to the part affected, the whole number of lancets contained in it are, by means of a ſtrong ſpring, puſhed ſuddenly into it, to the depth at which the inſtrument has been previouſly regulated. This being done, as the ſmaller blood-veſſels only by this operation are ever intended to be cut, and as theſe do not commonly diſcharge freely, ſome means or other become neceſſary for promoting the evacuation.

146 Method of blooding with the ſcarificator

147 And cupping-glaſſes.

Various methods have been propoſed for this purpoſe. Glaſſes fitted to the form of the affected parts, with a ſmall hole in the bottom of each, were long ago contrived; and theſe being placed upon the ſcarified parts, a degree of ſuction was produced by a perſon's mouth ſufficient for nearly exhauſting the air contained in the glaſs: and this accordingly was a ſure enough method of increaſing the evacuation of blood to a certain extent. But as this was attended with a good deal of trouble, and beſides did not on every occaſion prove altogether effectual, an exhauſting ſyringe was at laſt adapted to the glaſs: which did indeed anſwer as a very certain method of extracting the air contained in it; but the application of this inſtrument for any length of time is very troubleſome, and it is difficult to preſerve the ſyringe always air-tight.

The application of heat to the *cupping-glaſſes*, repreſented in Plate CCCCLXXXVII. fig. 12. has been found to rarefy the air contained in them to a degree ſufficient for producing a very conſiderable ſuction. And as the inſtrument in this ſimple form anſwers the purpoſe in view with very little trouble to the operator, and as it is at all times eaſily obtained, the uſe of the ſyringe has therefore been laid aſide.

There are different methods adopted for thus applying heat to the cavity of the glaſs. By ſupporting the mouth of it for a few ſeconds above the flame of a taper, the air may be ſufficiently rarefied; but if the flame is not kept exactly in the middle, but is allowed to touch either the ſides or bottom of the glaſs, it is very apt to make it crack. A more certain, as well as an eaſier, method of applying the heat, is to dip a piece of ſoft bibulous paper in ſpirit of wine; and having ſet it on fire, to put it into the bottom of the glaſs, and, on its being nearly extinguiſhed, to apply the mouth of the inſtrument directly upon the ſcarified part. This degree of heat, which may be always regulated by the ſize of the piece of paper, and which it is evident ought to be always in proportion to the ſize of the glaſs, if long enough applied, proves always ſufficient for rarefying the air very effectually, and at the ſame time, if done with any manner of caution, never injures the glaſs in the leaſt.

The glaſs having been thus applied, if the ſcarifications have been properly made, they inſtantly begin to diſcharge freely: and ſo ſoon as the inſtrument is nearly full of blood, it ſhould be taken away; which may be always eaſily done by raiſing one ſide of it, ſo as to give acceſs to the external air. When more blood is wiſhed to be taken, the parts ſhould be bathed with warm water; and being made perfectly dry, another glaſs, exactly the ſize of the former, ſhould be inſtantly applied in the very ſame manner: and thus, if the ſcarificator has been made to puſh to a ſufficient depth, ſo as to have cut all the cutaneous veſſels of the part, almoſt any neceſſary quantity of blood may be obtained. It ſometimes happens, however, that the full quantity intended to be diſcharged cannot be got at one place. In ſuch a caſe, the ſcarificator muſt be again applied on a part as contiguous to the other as poſſible; and this being done, the application of the glaſſes muſt alſo be renewed as before.

When it is wiſhed to diſcharge the quantity of blood as quickly as poſſible, two or more glaſſes may be applied at once on contiguous parts previouſly ſcarified; and, on ſome occaſions, the quantity of blood is more quickly obtained by the cupping-glaſſes being applied for a few ſeconds upon the parts to be afterwards ſcarified. The ſuction produced by the glaſſes may poſſibly have ſome influence in bringing the more deep-ſeated veſſels into nearer contact with the ſkin, ſo that more of them will be cut by the ſcarificator.

A ſufficient quantity of blood being procured, the wounds made by the different lancets ſhould be all perfectly cleared of blood; and a bit of ſoft linen or charpie, dipped in a little milk or cream, applied over the whole, is the only dreſſing that is neceſſary. When dry linen is applied, it not only creates more uneaſineſs to the patient, but renders the wounds more apt to feſter than when it has been previouſly wetted in the manner directed.

Dry cupping conſiſts in the application of the cupping-glaſſes directly to the parts affected, without the uſe of the ſcarificator. By this means a tumor is produced upon the part; and where any advantage is to be expected from a determination of blood to a particular ſpot, it may probably be more eaſily accompliſhed by this means than by any other. Dry cupping.

When the part from which it is intended to produce a local evacuation of this kind is ſo ſituated, that a ſcarificator and cupping-glaſſes can be applied, this method is greatly preferable to every other; but in inflammatory affections of the eye, of the noſe, and of other parts of the face, &c. the ſcarificator cannot be properly applied directly to the parts affected. In ſuch inſtances, leeches are commonly had Ap... tio... lec...

had recourfe to, as they can be placed upon almoft any fpot from whence we would wifh to difcharge blood.

In the application of thefe animals, the moft effectual method of making them fix upon a particular fpot, is to confine them to the part by means of a fmall wine-glafs. Allowing them to creep upon a dry cloth, or upon a dry board, for a few minutes before application, makes them fix more readily; and moiftening and cooling the parts on which they are intended to fix, either with milk, cream, or blood, tends alfo to caufe them adhere much more fpeedily than they otherwife would do. So foon as the leeches have feparated, the ordinary method of promoting the difcharge of blood, is to cover the parts with linen cloths wet in warm water. In fome fituations, this may probably be as effectual a method as any other; but wherever the cupping-glaffes can be applied over the wounds, they anfwer the purpofe much more effectually.

Chap. IX. *Of Iffues.*

Issues are a kind of artificial ulcers formed in different parts of the body with a view to procure a difcharge of purulent matter, which is frequently of advantage in different diforders.

Practitioners were formerly of opinion that iffues ferved as drains to carry off the noxious humours from the blood, and therefore they placed them as near the affected part as poffible. But as it is now known that they prove ufeful merely by the quantity of matter which they afford, they are generally placed where they will occafion the leaft inconvenience. The moft proper parts for them are, the nape of the neck; the middle, outer, and fore part of the humerus; the hollow above the inner fide of the knee; or either fide of the fpine of the back; or between two of the ribs; or wherever there is a fufficiency of cellular fubftance for the protection of the parts beneath: they ought never to be placed over the belly of a mufcle; nor over a tendon, or thinly covered bone; nor near any large blood-veffel.

The iffues commonly ufed are, the blifter-iffue, the pea-iffue, and the feton or cord.

When a blifter-iffue is to be ufed, after the blifter is removed, a difcharge of matter may be kept up by dreffing the part daily with an ointment mixed with the powder of cantharides. If the difcharge be too little, more of the powder may be ufed; if too great, or if the part be much inflamed, the iffue ointment may be laid afide, and the part dreffed with bafilicon, or with Turner's cerate, till the difcharge be diminifhed and the inflammation abated. It is moft proper fometimes to ufe the iffue ointment and a mild one alternately.

A pea-iffue is formed either by making an incifion with a lancet, or by cauftic, large enough to admit one or more peas; though fometimes inftead of peas, kidney-beans, Gentian root, or orange-peas, are ufed. When the opening is made by an incifion, the fkin fhould be pinched up and cut through, of a fize fufficient to receive the fubftance to be put into it. But when it is to be done by cauftic, the common cauftic or lapis infernalis of the fhops anfwers beft: it ought to be reduced to a pafte with a little water or foft foap, to prevent it from fpreading; and adhefive plafter, with a fmall hole cut in the centre of it, fhould be previoufly placed, and the cauftic pafte fpread upon the hole in the centre. Over the whole an adhefive plafter fhould be placed to prevent any cauftic from efcaping. In ten or twelve hours, the whole may be removed, and in three or four days the efchar will feparate, when the opening may be filled with peas, or any of the other fubftances already mentioned.

Sutures.

153 The feton.

The feton is ufed where a large quantity of matter is wanted, and efpecially where it is wifhed for from deep feated parts. It is frequently ufed in the back of the neck for difeafes of the head or eyes, or between two of the ribs in affections of the breaft.

When the cord, which is to be made of threads of cotton or filk, is to be introduced, the parts at which it is to enter and pafs out fhould be previoufly marked with ink, and a fmall part of the cord being befmeared with fome mild ointment, and paffed through the eye of the feton-needle, Plate CCCCLXXXVII. fig. 13. the part is to be fupported by an affiftant, and the needle paffed fairly through, leaving a few inches of the cord hanging out. The needle is now to be removed and the part dreffed. By this method matter is produced in quantity proportioned to the degree of irritation applied; and this can be increafed or diminifhed by covering the cord daily before it is drawn with an irritating or mild ointment.

Chap. X. *Of Sutures and Ligatures of Arteries.*

Sect. I. *Of Sutures.*

The intention of futures is to unite parts which have been divided, and where the retraction of the lips of the wound has been confiderable. The futures in ordinary ufe at prefent, among furgeons, are the interrupted, the quilled, and the twifted. Befides thefe futures, adhefive plafters are ufed for uniting the lips of wounds, which have been termed the *falfe* or *dry* future, in oppofition to the others which have obtained the name of *true* or *bloody*. The true future is ufed in cafes of deep wounds, while the falfe is employed in thofe of a fuperficial nature.

154 Of the interrupted future.

The interrupted future is made as follows. The wound being emptied of the grumous blood, and the affiftant taking care that the lips of it lie quite even, the furgeon is carefully to carry the needles from the bottom outwards; ufing the caution of making them come out far enough from the edge of the wound, which will not only facilitate the paffing the ligature, but will alfo prevent it from cutting through the fkin and flefh; as many more ftitches as may be required will be only repetitions of the fame procefs. The threads being all paffed, let thofe be firft tied which are in the middle of the wound: though, if the lips are held carefully together all the while, as they fhould be, it will be of no great confequence which is done firft. The moft ufeful kind of knot is a fingle one firft, and then a flip-knot, which may be loofened upon any confiderable inflammation taking place. If a violent inflammation fhould fucceed, loofening the ligature only will not fuffice; it muft be cut through and drawn away, and the wound be treated afterwards without any future. When the wound is fmall, the lefs it is difturbed by dreffing the better; but in large ones, there will fometimes be a confiderable difcharge; and if the threads be not cautioufly carried through the bottom of it, abfceffes will frequently enfue from the matter being pent up underneath, and not finding iffue. If no accident happen, after the lips are firmly agglutinated, the ligatures are to be removed, and the orifices which they leave dreffed.

It will readily be underftood, that the ftrength of the ligature and fize of the needle ought always to be proportionable to the depth of the fore and retraction of the parts. The proper form of needles is reprefented in Pl. CCCCLXXXVII. fig. 14.

It muft likewife be remembered, that during the cure the future muft be always affifted by the application of bandage, if poffible, which is frequently of the greateft importance; and that fort of bandage with two heads, and a flit in the middle,

Sutures. middle, which is by much the best, will in most cases be found practicable.

155 Of the quilled suture. In deep wounds, attended with much retraction, it is always a necessary precaution, to assist the operation of the ligatures by means of bandages, so applied as to afford as much support as possible to the divided parts: But even with every assistance of this nature, it now and then happens, that the divided parts cannot be kept together, retraction occurs to a greater or lesser degree, and the ligatures of course cut asunder the soft parts they were at first made to surround.

With a view to prevent this receding of the teguments and other parts, it was long ago proposed to add to the interrupted suture what was supposed would afford an additional support, viz. quills, or pieces of plaster rolled up into the form of quills; one of which being placed on each side of the wound, the double of the ligature is made to include the one, and the knot to press directly upon the other, instead of being made immediately on the edges of the sore, as was directed for interrupted sutures.

It is at once evident, however, that the ligatures must here make the same degree of pressure on the parts through which they pass as they do in the interrupted suture; and this being the case, it is equally obvious, that the interposition of these substances cannot be of any use. This suture is accordingly now very rarely practised, and it is probable that it will be soon laid entirely aside.

156 Of the twisted suture. By the term *twisted suture*, is meant that species of ligature by which parts, either naturally or artificially separated, are united together, by means of strong threads properly twisted round pins or needles pushed through the edges of the divided parts.

157 Uses to which it may be put. This suture is commonly employed for the purpose of uniting the parts in cases of hare-lip; and this indeed is almost the only use to which it has been hitherto applied: But it may with great advantage be put in practice in a variety of other cases, particularly in all artificial or accidental divisions either of the lips or cheeks; and in every wound in other parts that does not run deep, and in which sutures are necessary, this suture is preferable to the interrupted or any other. The pins made use of for twisting the threads upon ought to be made of a flat form, so as not to cut the parts through which they pass so readily as the ligatures employed in the interrupted suture. And thus one great objection to the latter is very effectually obviated: for every practitioner must be sensible of this being the most faulty part of the interrupted suture, that when muscular parts are divided so as to produce much retraction, the ligatures employed for retaining them almost constantly cut them through before a reunion is accomplished; whereas the flatness of the pins used in the twisted suture, and upon which the whole pressure produced by the ligatuers is made to rest, proves in general a very effectual preventative against all such occurrences.

The pins used in this operation are represented in Plate CCCCLXXXVII. fig. 15. They are commonly made of gold or silver; and in order to make them pass with greater ease, steel points are added to them. They are sometimes used, however, of gold or silver alone.

158 Method of employing the twisted suture. The manner of performing this operation is as follows. The divided parts intended to be reunited, must, by the hands of an assistant, be brought nearly into contact; leaving just as much space between the edges of the sore as to allow the surgeon to see that the pins are carried to a proper depth. This being done, one of the pins must be introduced through both sides of the wound, by entering it on one side externally, pushing it forwards and inwards to within a little of the bottom of the wound, and afterwards carrying it outwardly through the opposite side, to the same distance from the edge of the sore that it was made to enter at on the other.

The distance at which the needle ought to enter from the edge of the sore must be determined by the depth of the wound, and by the degree of retraction produced in the divided parts. In general, however, it is a proper regulation, in deep wounds, to carry the pins nearly to the same distance from the side of the sore as they are made to penetrate in depth: And whatever the deepness of the wound may be, the pins ought to pass within a very little of its bottom: otherwise the parts which lie deep will run a risk of not being united; a circumstance which must always give rise to troublesome collections of matter.

The first pin being passed in this manner very near to one end of the sore, and the parts being still supported by an assistant, the surgeon, by means of a firm waxed ligature, passed three or four times round and across the pin, so as nearly to describe the figure of 8, is to draw the parts through which it has passed into immediate and close contact: and the thread being now secured with a loose knot, another pin must be introduced in the same manner at a proper distance from the former; and the thread with which the other was fixed being loosed, and in the same manner carried round this pin, others must be introduced at proper distances along the whole course of the wound; and the same ligature ought to be of a sufficient length for securing the whole.

The number of pins to be used must be determined entirely by the extent of the wound. Whenever this suture is practised, a pin ought to be introduced very near each end of the wound, otherwise the extremities of the sore are apt to separate so as not to be afterwards easily reunited. In large wounds, if the pins are introduced at the distance of three quarters of an inch from one another, it will in general be found sufficient; but in cuts of smaller extent a greater number of pins become necessary in proportion to the dimensions of the sores. Num[ber of] pins [to] use.

Thus in a wound of an inch and half in length, three pins are absolutely requisite; one near to each end, and another in the middle of the sore: whereas five pins will always be found fully sufficient for a wound of three inches and a half in extent, allowing one to be within a quarter of an inch of each extremity of the wound, and the others to be placed along the course of the sore at the distance of three quarters of an inch from one another.

The pins being all introduced and secured in the manner directed, nothing remains to be done, but to apply a piece of lint wet with mucilage all along the course of the wound, with a view to exclude, as effectually as possible, every access to the external air.

When the pins remain long, they generally do harm, by the unnecessary irritation and consequent retraction of parts with which they are always attended; and if they are not continued for a sufficient length of time, that degree of adhesion is not produced between the divided parts which is necessary for their future retention; so that the effect of the operation comes to be in a great measure, if not entirely, lost.

In wounds of no great depth, for instance of three quarters of an inch or so, a sufficient degree of adhesion always takes place in the space of five days; and six, or at most seven days, will generally be found sufficient for wounds of the greatest depth. But with respect to this circumstance, it must always be understood, that the patient's state of health must have a considerable influence on the time necessary for producing adhesion between divided parts.

When the pins are withdrawn, the uniting bandage may be

be applied with great advantage; but as slips of leather spread with ordinary glue, when applied to each side of the cicatrix, may, by means of ligatures properly connected with them, be made to answer the purpose more effectually, this mode of supporting the parts ought of course to be preferred.

Sect. II. *Of the Ligature of Arteries.*

When a surgeon is called immediately to a wound of any great artery of a limb, he should clap the point of his finger upon the wounded artery, or make his assistant hold it; cut the wound so far open as to see the artery fairly; draw it out if it be cut across, and have shrunk among the flesh; or tie it like the artery of the arm in aneurism by passing ligatures under it. When, however, the wound happens in such situations that we cannot command the blood, it is better to close the lips of the wound, and try to make them adhere by means of a very steady compress and bandage. Thus an aneurism will form; the operation for the cure of which shall be afterwards described.

When accidents of this nature occur in any of the extremities, and where pressure can be made with ease on the superior part of the artery, we are possessed of an instrument which never fails to put a stop to all further loss of blood: we mean the tourniquet. See Plate CCCCLXXXVII. fig 16.

The tourniquet has undergone many improvements; but the one here represented is considered as the best. By means of it the blood in any limb is very easily and effectually commanded; and as it grasps the whole member equally, all the collateral branches, as well as the principal arteries, are equally compressed by it. It has this material advantage too over every other instrument of this kind, that, when properly applied, a single turn, or even half a turn, of the screw, is sufficient for producing either a flow of blood, or for putting a total stop to it. The manner of using it is as follows.

Let a cushion of three inches in length by one inch and half in diameter be prepared of a linen roller, tolerably firm, but not so hard as to render pressure produced by it very painful. This being placed upon the course of the principal artery of the limb, is to be firmly secured in that situation by one or two turns of a circular roller, of the same breadth with the cushion itself.

The instrument, with the strap connected with it, being now placed upon the limb, with the handle of the screw on the opposite side of the member to the cushion upon the artery, the strap is to be carried round the limb directly over the cushion, and to be firmly connected on the other side of the buckle. In thus connecting the strap and buckle together, particular attention is necessary in doing it with great firmness, so as that the screw may afterwards operate with as much advantage as possible in producing a sufficient degree of pressure. When proper attention is paid to this circumstance, a single turn of the screw proves sufficient for putting an entire stop to the circulation of blood in the limb: but when the strap has not originally been made very tight, several turns of the screw become necessary; an occurrence which may be always very easily prevented, and which, when not attended to, frequently proves very embarrassing in the course of an operation.

Various methods have been invented for securing arteries by means of ligatures. The practice till lately in ordinary use was, by means of a curved needle, to pass a ligature of sufficient strength round the mouth of the bleeding vessel, including a quarter of an inch all round of the surrounding parts, and afterwards to form a knot of a proper tightness upon the vessel and other parts comprehended in the noose. But this method was found to give so much pain, and in some cases to be attended with such violent convulsions, not only in the part chiefly affected, but of the whole body, that the best practitioners have thought proper to reject it, and to tie up the blood-vessels by themselves; for it is now well known that even very small arteries are possessed of much firmness; and that even in the largest arteries a slight degree of compression is sufficient not only for restraining hemorrhagy, but for securing the ligature on the very spot to which it is first applied.

Ligature of Arteries.

In order to detect the arteries to be tied, the tourniquet, with which they are secured, must be slackened a little by a turn or two of the screw; and the moment the largest artery of the sore is discovered, the surgeon fixes his eye upon it, and immediately restrains the blood again by means of the tourniquet. An assistant now forms a noose on the ligature to be made use of; and this noose being put over the point of the tenaculum, Plate CCCCLXXXVII. fig. 17. the operator pushes the sharp point of the instrument through the sides of the vessel, and at the same time pulls so much of it out, over the surface of the surrounding parts, as he thinks is sufficient to be included in the knot which the assistant is now to make upon the artery. In forming this ligature a single knot moderately drawn, and over it another single knot, is perfectly sufficient.

163 With the crooked needle.

When from the deepness of a wound, or from any other cause, some particular artery cannot be properly secured by the tenaculum; in this case there is a necessity of employing the crooked needle, and the following is the method of using it.

A needle of the shape represented Pl. CCCCLXXXVII. fig. 14. armed with a ligature of a size proportioned to itself and to the vessel to be taken up, is to be introduced at the distance of a sixth or eighth part of an inch from the artery, and pushed to a depth sufficient for retaining it, at the same time that it is carried fully one half round the blood-vessel. It must now be drawn out; and being again pushed forward till it has completely encircled the mouth of the artery, it is then to be pulled out; and a knot to be tied of a sufficient firmness, as was already directed when the tenaculum is used.

Chap. XI. *Of Aneurisms.*

164 Definition.

The term *Aneurism* was originally meant to signify a tumor formed by the dilatation of the coats of an artery; but by modern practitioners it is made to apply not only to tumors of this kind, but to such as are formed by blood effused from arteries into the contiguous parts. There are three species; the true or encysted, the false or diffused, and the varicose aneurism.

165 The true or encysted aneurism.

The *true* or *encysted* aneurism, when situated near the surface of the body, produces a tumor at first small and circumscribed; the skin retains its natural appearance; when pressed by the fingers, a pulsation is evidently distinguished; and with very little force the contents of the swelling may be made to disappear; but they immediately return upon removing the pressure. By degrees the swelling increases, and becomes more prominent; but still the patient does not complain of pain: on pressure the tumor continues of an equal softness, and is compressible. After this the swelling becomes large, the skin turns paler than usual, and in more advanced stages œdematous: the pulse still continues; but parts of the tumor become firm from the coagulation of the contained blood, and yield little to pressure; at last the swelling increases in a gradual manner, and is attended with a great degree of pain. The skin turns livid, and has a gangrenous appearance. An oozing of bloody

Aneurifms. bloody ferum oozes from the integuments; and, if a real mortification do not take place, the skin cracks in different parts; and the artery being now deprived of the usual resistance, the blood bursts out with such force as to occasion the almost immediate death of the patient. Thus the disease terminates in the large cavities of the body; but in the extremities we can, by means of the tourniquet, prevent the sudden termination of the disease.

When affections of this kind happen in the larger arteries, the effects produced upon the neighbouring parts are often surprising: the soft parts not only yield to a great extent, but even the bones frequently undergo a great degree of derangement.

166 The false or diffused aneurism.

The *false* or *diffused* aneurifm confifts in a wound or rupture in an artery, producing, by the blood thrown out of it, a fwelling in the contiguous parts. It is moft frequently produced by a wound made directly into the artery.

The following is the ufual progrefs of the diforder. A tumor, about the fize of a horfe-bean, generally rifes at the orifice in the artery foon after the difcharge of the blood has been ftopped by compreffion. At firft it is foft, has a ftrong degree of pulfation, and yields a little to preffure, but cannot be made entirely to difappear; for here the blood forming the tumor being at reft, begins to coagulate. If not improperly treated by much preffure, it generally remains nearly of the fame fize for feveral weeks. The enlargement however proceeds more rapidly in fome cafes than in others. Inftances have occurred of the blood being diffufed over the whole arm in the fpace of a few hours; while, on the contrary, fwellings of this kind have been many months, nay even years, in arriving at any confiderable fize.

As the tumor becomes larger, it does not, like the true aneurifm, grow much more prominent, but rather fpreads and diffufes itfelf into the furrounding parts. By degrees it acquires a firm confiftence; and the pulfation, which was at firft confiderable, gradually diminifhes, till it is fometimes fcarcely perceptible. If the blood at firft thrown out proceed from an artery deeply feated, the fkin preferves its natural appearance till the diforder is far advanced: but when the blood gets at firft into contact with the fkin, the parts become inftantly livid, indicating the approach of mortification: and a real fphacelus has fometimes been induced. The tumor at firft produces little uneafinefs; but as it increafes in fize, the patient complains of fevere pain, ftiffnefs, numbnefs, and immobility of the whole joint; and thefe fymptoms continuing to augment, if the artery be large, and affiftance not given, the teguments at laft burft, and death muft enfue.

167 Varicofe aneurifm.

When an artery is punctured through a vein, as in bloodletting at the arm, the blood generally rufhes into the yielding cellular fubftance, and there fpreads fo as to fhut the fides of the vein together. But in fome inftances where the artery happens to be in contact with the vein, the communication opened has been preferved; and the vein not being fufficiently ftrong for refifting the impulfe of the artery, muft confequently be dilated. This is a varicofe aneurifm. It was firft accurately defcribed by Dr Hunter, and fince that time has been frequently obferved by different practitioners. Here the fwelling is entirely confined to the veins. Soon after the injury the vein immediately communicating with the artery begins to fwell, and enlarge gradually. If there be any confiderable communications in the neighbourhood, the veins which form them are alfo enlarged. The tumor difappears upon preffure, the blood contained in it being chiefly pufhed forwards in its courfe towards the heart; and when the tumor is large, there is a fingular tremulous motion, attended with a perpetual hiffing noife, as if air was paffing into it through a fmall aperture. Aneu-

If a ligature be applied upon the limb immediately below the fwelling, tight enough to ftop the pulfe in the under part of the member, the fwelling difappears by preffure, but returns immediately upon the preffure being removed. If, after the fwelling is removed by preffure, the finger be placed upon the orifice in the artery, the veins remain perfectly flaccid till the preffure is taken off. If the trunk of the artery be compreffed above the orifice fo as effectually to ftop the circulation, the tremulous motion and hiffing immediately ceafe; and if the veins be now emptied by preffure, they remain fo till the compreffion upon the artery be removed. If the vein be compreffed a little above, as well as below the tumor, all the blood may generally, though not always, be pufhed through the orifice into the artery; from whence it immediately returns on the preffure being difcontinued.

When the difeafe has continued long, and the dilatation of the veins has become confiderable, the trunk of the artery above the orifice generally becomes greatly enlarged, while that below becomes proportionably fmall; of confequence the pulfe in the under part of the member is always more feeble than in the found limb of the oppofite fide.

The caufes producing aneurifms, in general, are a natural difeafe of the arteries. Thus a partial debility of their coats may readily produce the difeafe; or they may arife, efpecially in the internal parts of the body, from great bodily exertions. They are likewife produced by wounds of the coats of the arteries, as now and then happens in bloodletting at the arm; or from acrid matter contained in a neighbouring fore; or from the deftruction of furrounding parts, by which the natural fupport is removed. Cauf aneur

Aneurifms have frequently been miftaken for abfceffes and other collections of matter, and have been laid open by incifion; on which account great attention is fometimes required to make the proper diftinction. In the commencement of the difeafe the pulfation in the tumor is commonly fo ftrong, and other concomitant circumftances fo evidently point out the nature of the diforder, that little or no doubt refpecting it can ever take place; but in the more advanced ftages of the difeafe, when the fwelling has become large and has loft its pulfation, nothing but a minute attention to the previous hiftory of the cafe can enable the practitioner to form a judgment of its nature. Diag

Aneurifms may be confounded with foft encyfted tumors, fcrophulous fwellings, and abfceffes fituated fo near to an artery as to be affected by its pulfation. But one fymptom, when connected with ftrong pulfation, may always lead to a certain determination that the fwelling is of the aneurifmal kind, viz. the contents of the tumor being made eafily to difappear upon preffure, and their returning on the compreffion being removed. The want of this circumftance, however, ought not to convince us that it is not of that nature; for it frequently happens, efpecially in the advanced ftages of aneurifms, that their contents become fo firm that no effect is produced upon them by preffure. Hence the propriety, in doubtful cafes, of proceeding as if the difeafe was clearly of the aneurifmal kind.

In the prognofis, three circumftances are chiefly to be attended to; the manner in which the difeafe appears to have been produced, the part of the body in which the fwelling is fituated, and the age and habit of the body of the patient. Prog

If an aneurifm has come forward in a gradual manner, without any apparent injury done to the part, and not fucceeding any violent bodily exertion, there will be reafon to fuppofe

suppose that the disease depends upon a general affection either of the trunk in which it occurs, or of the whole arterious system. In such cases art can give little assistance; whereas if the tumor has succeeded an external accident, an operation may be attended with success.

In the varicose aneurism a more favourable prognosis may generally be given than in either of the other two species. It does not proceed so rapidly: when it has arrived at a certain length, it does not afterwards acquire much additional size; and it may be sustained without much inconvenience for a great number of years. As long as there is reason to expect this, the hazard which almost always attends the operation ought to be avoided.

In the second volume of the London Medical Observations, two cases are related by Dr Hunter of the varicose aneurism. One of them at that time was of 14 years standing, and the other had subsisted for five years, without there being any necessity for an operation. And in vol. iii. of the same work a similar case of five years duration is related by Dr Cleghorn.

In a letter afterwards from Dr Hunter to Mr Benjamin Bell, the Doctor says, "The lady in whom I first observed the varicose aneurism is now living at Bath in good health, and the arm is in no sense worse, although it is now 35 years since she received the injury:" and the Doctor farther observes, that he never heard of the operation being performed for the varicose aneurism which was known to be such.

Mr Bell says, he was informed by Dr William Cleghorn of Dublin, that the case of varicose aneurism, related in the 3d volume of the London Medical Observations, remained nearly in the same state as at the time that account of it was made out, which included a period of at least 20 years; only that the veins were rather more enlarged. The patient recovered, and the limb became nearly as strong and serviceable as the other. Mr Pott also met with three different instances of this species of aneurism; and observes, that the operation never became necessary in any of them.

Among other instances of varicose aneurism which have appeared here, a young man from Paisley was examined several years ago by different surgeons of this place. The disease was very clearly marked, and no operation was advised. He was afterwards found serving in the navy, where he underwent great fatigue without any inconvenience from the aneurism, though then of 13 years standing.

But though this aneurism, when it has arrived at a certain size, commonly remains stationary, and may be borne without much inconvenience for a long time, this is not always the case; for some instances have occurred, where the disease was attended with great uneasiness, and where the operation was performed with much difficulty.

In judging further of the probable event of aneurisms in general, the situation of the tumor next requires attention. When it is so situated that no ligature or effectual compression can be applied for stopping the circulation in the part, if the artery be large, there would be the greatest danger in opening it. In this case therefore the most fatal consequences are to be apprehended.

When aneurisms are situated near the upper parts of the extremities, surgeons have been hitherto doubtful whether, after tying up the humeral or femoral arteries, the lower parts of the limb would be supplied with blood; and tho' several successful instances of performing that operation have been published, the success has been pretty generally ascribed to unusual branching of the great arteries of those patients, on whom the operation was performed, above the aneurism. Mr John Bell, however, in his late very ingenious and important *Discourses on Wounds*, has proved, to our satisfaction at least, that the inosculations which take place between the internal iliac and the arteries of the leg, by means of the glutæal arteries and the profunda femoris, are in every case sufficient to supply nourishment to the limb; that the same is the case in the arm; and that therefore in every aneurism, even of the humeral or femoral artery, we ought to perform the operation. Several instances of success are there related; among others, an operation performed by Mr J. Bell himself, which, as it is perhaps the greatest that has hitherto been performed, we shall here abridge for the gratification of our readers. A leech-catcher fell as he was stepping out of a boat; and a pair of long-pointed scissars pierced his hip exactly over the sciatic notch, where the great iliac artery comes out from the pelvis. The artery bled furiously: the patient fainted. The surgeon easily stopt up the wound, as it was very narrow and deep, and healed it. A great tumor soon formed. The man travelled from the north country in six weeks to the Edinburgh infirmary, with a prodigious tumor of the hip, the thigh rigidly contracted, the ham bent, the whole leg shrunk and cold and useless. There was no pulsation nor retrocession of blood on pressure; but the distention was attended with great pain, and the man was extremely anxious to have an operation performed. Though there was little doubt of its being aneurism, it might be a great abscess. It was resolved therefore to make a small incision, and just touch the bag with the point of a lancet, and if it contained blood, a full consultation was to be called. Mr Bell accordingly made an incision two inches and an half in length; the great fascia formed the coat of the tumor, and under it were seen the fibres of the great glutæus muscle. As soon as it was opened at one point, great clots of blood came out; and Mr Bell, after being certain that it was an aneurism of the great artery of the thigh, closed up the wound with a tent-like compress, put the patient to bed, and a pupil held his hand on the hip. This was done at one o'clock; at four the consultation met, and the operation was performed. On making an incision eight inches long, the blood was thrown out with a whishing noise, and with such impetuosity, that the assistants were covered with it. In a moment twenty hands were about the tumor, and the bag was filled with sponges and cloths of all kinds; the blood, however, still made its way; and the man who had supported himself on his elbow, fell down; his arms and head hung down, he uttered two or three heavy groans, and they thought him dead. At that critical moment Mr Bell ran the bistoury upwards and downwards, and at once made the wound two feet long; thrust his hand to the bottom of the tumor, felt the warm jet of blood, put his finger on the mouth of the artery, the pulse of which he felt distinctly; which first assured him that the man was alive. The artery was then tied; and when Mr Bell lifted up his finger, it was discovered to be the posterior iliac; that it had been cut fairly across, and had bled with open mouth. The patient was so low, that after dressing the wound, they were obliged to bring in a bed, and leave him to sleep in the operation room. He was cured of this great wound in less than seven months, and afterwards recovered the use of his leg completely.

Aneurisms. Part I. Sect. 2.

172 Remarkable aneurism.

In every case of aneurism, the use of pressure has been indiscriminately recommended, not only in the incipient period of the disease, but even in its more advanced stages.

173 Effects of pressure in aneurisms.

In the diffused or false aneurism, as pressure cannot be applied to the artery alone, without at the same time affecting the refluent veins; and as this, by producing an increased resistance to the arterial pulsations, must force an additional quantity of blood to the orifice in the artery—no advantage is

Aneurism. is to be expected from it, though it may be productive of mischief.

In the early stages of encysted aneurism, while the blood can be yet pressed entirely out of the sac into the artery, it often happens, by the use of a bandage of soft and somewhat elastic materials, properly fitted to the part, that much may be done in preventing the swelling from receiving any degree of increase; and on some occasions, by the continued support thus given to the weakened artery, complete cures have been at last obtained. In all such cases, therefore, particularly in every instance of the varicose aneurism, much advantage may be expected from moderate pressure.

But pressure, even in encysted aneurism, ought never to be carried to any great length; for tight bandages, by producing an immoderate degree of reaction in the containing parts to which they are applied, instead of answering the purpose for which they were intended, have evidently the contrary effect. Indeed the greatest length to which pressure in such cases ought to go, should be to serve as an easy support to the parts affected, and no farther.

174 Method of performing the operation for aneurism.

In performing the operation for aneurism, the first step ought to be to obtain a full command of the circulation in the inferior part of the member by means of the tourniquet. This being done, the patient should be so placed, that the diseased limb, on being stretched on a table, is found to be of a proper height for the surgeon; who, as the operation is generally tedious, ought to be seated. The limb being properly secured by an assistant, the operator is now with the scalpel, Plate CCCCLXXXVII. fig. 18. to make an incision through the skin and cellular substance along the whole course of the tumor; and as freedom in the remaining parts of the operation is here a matter of much importance, it is even of use to carry this external incision half an inch or so both above and below the farthest extremities of the swelling.

All the effused blood ought then to be wiped off by means of a sponge; and the softest part of the tumor being discovered, an opening ought there to be made into it with the lancet, Plate CCCCLXXXVII. fig. 19. large enough for admitting a finger of the operator's left-hand. This being done, and the finger introduced into the cavity of the tumor, it is now to be laid open from one extremity to the other, by running a blunt-pointed bistoury, Plate CCCCLXXXVII. fig. 20. along the finger from below upwards, and afterwards from above downwards, so as to lay the whole cavity fairly open.

The cavity of the tumor being thus laid freely open, all the coagulated blood is to be taken out by the fingers of the operator, together with a number of tough membranous filaments commonly found here. The cavity of the tumor is now to be rendered quite dry, and free from the blood which, on the first opening of the swelling, is discharged into it from the veins in the inferior part of the member: the tourniquet is then to be slackened to discover, not only the artery itself, but the opening into it, from whence the blood collected in the tumor has been all along discharged.

175 Method of securing the wound of the artery.

This being done, the next point to be determined is the manner of securing this opening into the artery, so as to prevent in future any farther effusion of blood. Various means have been proposed for accomplishing this; but the effects of all of them may be comprehended under the three following heads.

176 By astringents,

1. The effects of ligature upon a large artery having on some occasions proved fatal to the inferior part of the member, it was long ago proposed, that so soon as the opening into the artery has been discovered, instead of applying a ligature round it, which for certain is to obliterate its cavity entirely, a piece of agaric, vitriol, alum, or any other astringent substance, should be applied to the orifice, in order if possible to produce a reunion of its sides.

177 Or by sutures,

2. Upon the same principle with the preceding, viz. that of still preserving the circulation in the artery, it was several years ago proposed by an eminent surgeon of Newcastle, Mr Lambert, that the orifice in the artery should be secured by means of the twisted suture. A small needle being pushed through the edges of the wound, they are then directed to be drawn together by a thread properly twisted round the needle, as was formerly directed when treating of sutures.

178 Improper.

Strong objections, however, occur to both of these methods. In the first place, no astringent application with which we are acquainted is possessed of such powers as to deserve much confidence. In almost every instance in which they have been used, the hemorrhagy has recurred again and again, so as to prove very distressing, not only to the patient, but to the practitioner in attendance; little or no attention is therefore to be paid to remedies of this kind in ordinary practice.

Mr Lambert's method of stitching the orifice in the artery is certainly a very ingenious proposal; and would in all probability, at least in most instances, prove an effectual stop to all farther discharge of blood: but as we have yet only one instance of its success, little can be said about it. Two material objections, however, seem to occur to this practice. One is, that in the operation for the aneurism, in almost every instance, a very few only excepted, the artery lies at the back-part of the tumor; so that when all the collected blood is removed, there is such a depth of wound, that it must be always a very difficult matter, and on many occasions quite impracticable, to perform this nice operation upon the artery with that attention and exactness which, in order to ensure success, it certainly requires. But there is another very material objection. By introducing a needle through the sides of the orifice, and drawing these together by a ligature, the cavity of the artery must undoubtedly be at that point much diminished. Indeed Mr Lambert, in his account of the case in which this operation was performed, acknowledges that the diameter of the artery was thereby diminished. Now the passage of the blood being thus contracted at one point, the impulse upon that particular part must be very considerable: So that the very remedy employed for the cure of one species of aneurism, will in all probability prove a very powerful agent in inducing another; for the blood being thus obstructed in its usual course, there will be no small danger incurred of a dilatation being produced immediately above this preternatural stricture.

3. Neither of the methods we have yet been considering being found eligible for securing the orifice in the artery, we shall now proceed to describe the ordinary manner of performing this operation; which consists in obliterating the arterial cavity entirely by means of ligatures.

179 Method of doing it by ligature.

The artery being laid bare in the manner directed, and all the coagulated blood being carefully removed from the cavity of the tumor, on the tourniquet being now slackened so as to bring the orifice in the artery into view, a small probe curved at the extremity is to be introduced at the opening, in order to raise the artery from the neighbouring parts, so as that the surgeon may be enabled with certainty to pass a ligature round it, without comprehending the contiguous nerves, which in general run very near to the large blood-vessels of a limb. By this precaution the nerves may be always avoided; and by doing so, a great deal of mischief may be prevented, which otherwise might supervene. When the disorder is situated either in the ham, or in the usual part of blood-letting in the arm, bending the joints of

the knee or of the elbow, as it relaxes the artery a little, renders this part of the operation more eaſily effected than when the limbs are kept fully ſtretched out.

The artery being thus gently ſeparated from the contiguous parts, a firm waxed ligature muſt be paſſed round it, about the eighth part of an inch or ſo above the orifice, and another muſt in the ſame manner be introduced at the ſame diſtance below it.

The ligatures being both finiſhed in the manner directed, the tourniquet is now to be made quite looſe; and if no blood is diſcharged at the orifice in the artery, we may then reſt ſatisfied that the operation is ſo far properly completed.

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The wound is now to be lightly covered with ſoft lint, with a pledgit of any emollient ointment over the whole; and a compreſs of linen being applied over the dreſſings, all the bandage in any degree requiſite is two or three turns of a roller above and as many below the centre of the wound, making it preſs with no more tightneſs than is abſolutely neceſſary for retaining the application we have juſt now mentioned.

The patient being now put into bed, the member ſhould be laid in a relaxed poſture upon a pillow, and ought to be ſo placed as to create the leaſt poſſible uneaſineſs from the poſture in which it is laid.

As the operation for the aneuriſm is always tedious, and produces much pain and irritation, a full doſe of laudanum ſhould be given immediately on the patient being got into bed. In order to diminiſh ſenſibility during ſome of the more capital operations, different trials have been made of opiates given an hour or ſo before the operation. On ſome occaſions this proved evidently very uſeful; but in others it ſeemed to have the contrary effect; particularly in weak nervous conſtitutions, in which with any doſes, however ſmall, they appeared to be rendered more irritable and more ſuſceptible of pain, than if no opiate had been given. Immediately after this operation, however, an opiate ought to be exhibited, to be repeated occaſionally according to the degrees of pain and reſtleſſneſs.

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In ſome few caſes of aneuriſm, it has happened that the pulſe in the under part of the member has been diſcovered immediately after the operation. This, however, is a very rare occurrence: For as this diſorder is ſeldom met with in any other part than at the joint of the elbow as a conſequence of blood-letting, and as it rarely happens that the brachial artery divides till it paſſes an inch or two below that place, the trunk of this artery is therefore moſt frequently wounded; and when, accordingly, the ligature, in this operation, is made to obliterate the paſſage of almoſt the whole blood which went to the under part of the arm, there cannot be the leaſt reaſon to expect any pulſation at the wriſt, till in a gradual manner the anaſtomoſing branches of the artery have become ſo much enlarged as to tranſmit ſuch a quantity of blood to the inferior part of the member as is ſufficient for acting as a ſtimulus to the larger branches of the artery.

Immediately after the operation, the patient complains of an unuſual numbneſs or want of feeling in the whole member; and as it generally, for a few hours, becomes cold, it is therefore right to keep it properly covered with warm ſoft flannel; and in order to ſerve as a gentle ſtimulus to the parts below, moderate frictions appear to be of uſe. In the ſpace of ten or twelve hours from the operation, although the numbneſs ſtill continues, the heat of the parts generally begins to return; and it frequently happens, in the courſe of a few hours more, that all the inferior part of the member becomes even preternaturally warm.

Immediately after this operation, the want of feeling in the parts is often very great; and in proportion as the circulation in the under part of the member becomes more conſiderable, the degree of feeling alſo augments. If we could ſuppoſe the nerves of the parts below to be always included in the ligature with the artery, that numbneſs which ſucceeds immediately to the operation might be eaſily accounted for; but it has been alſo known to happen when nothing but the artery was ſecured by the ligature. Aneuriſm.

In the mean time, the patient being properly attended to as to regimen, by giving him cordials and nouriſhing diet when low and reduced, and confining him to a low diet if his conſtitution is plethoric, the limb being ſtill kept in an eaſy relaxed poſture, towards the end of the fourth or fifth day, ſometimes much ſooner, a very weak feeble pulſe is diſcovered in the under part of the member, which becoming ſtronger in a gradual manner, the patient in the ſame proportion recovers the uſe and feeling of the parts.

So ſoon as there is an appearance of matter having formed freely about the ſore, which will ſeldom happen before the fifth or ſixth day, an emollient poultice ſhould be applied over it for a few hours, in order to ſoften the dreſſings, which may be then removed. At this time the ligatures might be taken away; but as their continuance for a day or two longer can do no harm, it is better to allow them to remain till the ſecond or third dreſſing, when they either drop off themſelves, or may be taken away with perfect ſafety. The dreſſings, which ſhould always be of the ſofteſt materials, being renewed every ſecond or third day according to the quantity of matter produced, the ſore is in general found to heal very eaſily; and although the patient may for a conſiderable time complain of great numbneſs and want of ſtrength in the whole courſe of the diſeaſed limb, yet in moſt inſtances a very free uſe of it is at laſt obtained.

182 Hemorrhagies often ſucceed the operation.

Very often after the artery ſeems to be ſecured it gives way, and fatal hemorrhagies enſue; nor is the patient free from this danger for a great length of time. In one of Mr Hunter's operations the artery gave way on the 26th day. It is to this difficulty of procuring adheſion between the ſides of the artery that a great part of the danger of this operation is to be aſcribed.

Chap. XII. *Of Affections of the Brain from External Violence.*

183 Symptoms of compreſſion of the brain.

When the brain is compreſſed, a ſet of ſymptoms enſue extremely dangerous, though ſometimes they do not make their appearance till after a conſiderable interval. But at whatever time they appear, they are uniformly of the ſame kind, and are in general as follow: drowſineſs, giddineſs, and ſtupefaction, dimneſs of ſight, dilatation of the pupil; and, where the injury done to the head is great, there is commonly a diſcharge of blood from the eyes, noſe, and ears. Sometimes the fractured bone can be diſcovered through the integuments, at others it cannot. There is an irregular and oppreſſed pulſe, and ſnoring or apoplectic ſtertor in breathing. There is likewiſe nauſea and vomiting, with an involuntary diſcharge of fæces and urine. Among the muſcles of the extremities and other parts, there is loſs of voluntary motion, convulſive tremors in ſome parts of the body, and palſy in others, eſpecially in that ſide of the body which is oppoſite to the injured part of the head.

Some of the milder of theſe ſymptoms, as vertigo, ſtupefaction, and a temporary loſs of ſenſibility, are frequently induced by ſlight blows upon the head, but commonly ſoon diſappear, either by reſt alone, or by the means to be afterwards pointed out. But when any other ſymptoms enſue, ſuch as dilatation of the pupils, and eſpecially when much blood is

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diſcharged from the eyes, noſe, and ears, and that there is an involuntary diſcharge of fæces and urine, it may be reaſonably concluded that compreſſion of the brain is induced.

The cavity of the cranium, in the healthy and natural ſtate, is every where completely filled by the brain; whatever therefore diminiſhes that cavity, will produce a compreſſion of the brain.

184
Cauſes of theſe.

The cauſes producing ſuch a diminution may be of various kinds, as fracture and depreſſion of the bones of the cranium; the forcible introduction of any extraneous body into the cavity of the cranium; effuſion of blood, ſerum, pus, or any other matter; the thickneſs of the bones of the cranium in certain diſeaſes, as in lues venerea, rickets, or ſpina ventoſa; or water collected in hydrocephalous caſes. The firſt ſet of cauſes ſhall be conſidered in their order. The four laſt mentioned belong to the province of the phyſician, and have been conſidered in a former part of this Work.

Sect. I. *Of Fracture and Depreſſion of the Cranium producing Compreſſion of the Brain.*

Fractures of the cranium have been differently diſtinguiſhed by different authors; but it ſeems ſufficient to divide them into thoſe attended with depreſſion, and thoſe which are not ſo.

In fracture and depreſſion of the cranium, the treatment ought to be,—to diſcover the ſituation and extent of the fracture;—to obviate the effects of the injury done to the brain, by raiſing or removing all the depreſſed parts of the bone;—to endeavour to complete the cure by proper dreſſings, and attention to the after treatment.

185
Method of diſcovering the ſituation of fractures of the cranium.

When the teguments correſponding to the injury done to the bone are cut or lacerated, and, as is ſometimes the caſe, entirely removed, the ſtate of the fracture is immediately diſcovered; but when the integuments of the ſkull remain entire, even though the general ſymptoms of fracture be preſent, there is ſometimes much difficulty in aſcertaining it. When, however, any external injury appears, particularly a tumor from a recent contuſion, attended by the ſymptoms already deſcribed, there can be no doubt of the exiſtence of a fracture. But it ſometimes happens that compreſſion exiſts without the ſmalleſt appearance of tumor. In ſuch caſes, the whole head ought to be ſhaved, when an inflammatory ſpot may frequently be obſerved. Sometimes the place of the fracture has been diſcovered by the patient applying the hand frequently on or near ſome particular part of the head.

When the ſymptoms of a compreſſed brain are evidently marked, no time ought to be loſt in ſetting about an examination of the ſtate of the cranium, wherever appearances point out, or even lead us to conjecture, in what part a fracture may be ſituated. For this purpoſe an inciſion is to be made upon the ſpot through the integuments to the ſurface of the bone, which muſt be ſufficiently expoſed to admit of a free examination.

Some authors have recommended a crucial inciſion; others one in form of the letter T; while many adviſe a conſiderable part of the integuments to be entirely removed. But as it is more agreeable to the preſent mode of practice to ſave as much of the ſkin as poſſible, a ſimple inciſion is generally preferred, unleſs the fracture run in different directions, and then the inciſion muſt vary accordingly. It will frequently happen, that a conſiderable part of the integuments muſt be ſeparated from the ſkull, in order to obtain a diſtinct view of the full extent of the fracture; but no part of the integuments is to be entirely removed.

When blood-veſſels of any conſiderable ſize are divided, either before or in time of the examination, they ought to be allowed to blood freely, as in no caſe whatever is the loſs of blood attended with more advantage than the preſent. When, however, it appears that the patient has loſt a ſufficient quantity, the veſſels ought to be ſecured.

After the integuments have been divided, if the ſkull be found to be fractured and depreſſed, the nature of the caſe is rendered evident; but even where there is no external appearance of fracture, tumor, diſcoloration, or other injury, if the patient continue to labour under ſymptoms of a compreſſed brain, if the pericranium has been ſeparated from the bone, and eſpecially if the bone has loſt its natural appearance, and has acquired a pale white or duſky yellow hue, the trepan ought to be applied without heſitation at the place where theſe appearances mark the principal ſeat of the injury.

Again, although no mark either of fracture or of any diſeaſes underneath ſhould appear on the outer table of the bone, yet there is a poſſibility that the inner table may be fractured and depreſſed. This indeed is not a common occurrence, but it happens probably more frequently than ſurgeons have been aware of; and where it does happen, the injury done to the brain is as great, and attended with as much danger, as where the whole thickneſs of the bone is beat in. The application of the trepan is therefore neceſſary.

But if, after the application of the trepan, it happens that no mark of injury appears either in the outer or inner table in that part, or in the dura mater below it, and that the ſymptoms of a compreſſed brain ſtill continue, a fracture in ſome other part is to be ſuſpected; or that kind of fracture termed by practitioners *counter fiſſure*, where the ſkull is fractured and ſometimes depreſſed on the oppoſite ſide to, or at a diſtance from, the part where the injury was received. This is fortunately not a very frequent occurrence, and has even been doubted by ſome; but different inſtances of it have, beyond all queſtion, been found. If therefore the operation of the trepan has been performed, and no fracture is diſcovered, no extravaſation appears on the ſurface of the brain; and if blood-letting and other means uſually employed do not remove the ſymptoms of compreſſion, the operator is to ſearch for a fracture on ſome other part. The whole head ſhould again be examined with much accuracy; and, by preſſing deliberately but firmly over every part of it, if the ſmalleſt degree of ſenſibility remains, the patient will ſhow ſigns of pain, either by moans or by raiſing his hands, when preſſure is made over the fractured part. In this way fractures have been frequently detected, which might otherwiſe have been concealed.

18[6]
Meth[od of] ele[va]ting [depreſ]ſed p[ortions] of the [cran]ium.

Having now conſidered every thing preparatory to the operation of the trepan, we ſhall next point out the means beſt adapted for the removal or elevation of a depreſſed portion of the bone.

The firſt thing to be done is, after ſhaving the head, to make an inciſion as deep as the bone, and directly upon the courſe of the fracture.

The patient ought to be laid on a table, with a mattreſs under him, while his head is placed upon a pillow, and ſecured by an aſſiſtant. When the extent of the fracture has been determined, and the bleeding from the inciſion ſtopped, the depreſſed bone is now to be elevated; but previous to this it is neceſſary to ſearch for detached pieces. Should any be found, they ought to be removed by a pair of forceps adapted to this purpoſe. By the ſame inſtrument any ſplinters of bone which may have been beaten in may be removed; but when a part of the bone is beaten in beyond the level of the reſt of the cranium, as much of the pericranium is then to be removed by a raſpatory, Plate CCCCLXXXVIII. fig. 21. as will allow the trephine, Plate CCCCLXXXVIII. fig. 22. to be applied; or, if the operator incline, for the ſake of diſpatch, he may uſe the trepan, Plate

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Plate CCCCLXXXVIII. fig. 23. and 24.; or the operation may be begun and finished with the trephine, while the trepan may perform the middle and principal part of the work. This part of the work is begun by making a hole with the perforator (fig. 24.), which is screwed on to the lower end of fig. 23. deep enough to fix the central pin of the trephine, in order to prevent the saw from slipping out of its central course, till it has formed a groove sufficiently deep to be worked steadily in; and then the pin is to be removed. If the bone be thick, the teeth of the saw must be cleaned now and then by the brush (fig. 25.) during the perforation, and dipped in oil as often as it is cleaned, which will considerably facilitate the motion, and render it more expeditious; making it at the same time much less disagreeable to the patient, if he possess his senses. That no time may be lost, the operator ought to be provided with two instruments of the same size, or at least to have two heads which can be readily fitted to the same handle.

After having made some progress in the operation, the groove ought to be frequently examined with a pick-tooth, or some such instrument, in order to discover its depth; and if one side happen to be deeper than the other, the operator ought to press more on that side which is shallowest. Precautions are more particularly necessary when the operation is performed upon a part of the skull which is of an unequal thickness, especially after the instrument has passed the diploe. And though it be said by writers in general that the instrument may be worked boldly till it comes at the diploe (which is generally known by the appearance of blood), yet the operator should be upon his guard in this point, examining from time to time if the piece be loose, lest thro' inadvertence the dura mater be wounded; for in some parts of the skull there is naturally very little diploe, and in old subjects scarcely any. It ought likewise to be remembered, that the skulls of children are very thin. When the piece begins to vacillate, it ought to be snapped off with the forceps (fig. 26.), or levator (fig. 26. *a*); for the sawing ought by no means to be continued till the bone be cut quite through, otherwise the instrument may plunge in upon the brain, or at least injure the dura mater. If the inner edge of the perforation be left ragged, it is to be smoothed with the lenticular (fig. 28. *b*), to prevent it from irritating the dura mater. Particular care is to be taken in using the instrument, lest it should press too much upon the brain.

The next step is to raise the depressed part of the bone with the levator, or to extract the fragments of the bone, grumous blood, or any extraneous body. After this, if there appear reason to apprehend that blood, lymph, or matter, is contained under the dura mater, it ought to be cautiously opened with a lancet, endeavouring to avoid the blood-vessels running upon it, or lying immediately under it.

When the trepan is to be used on account of a fissure in which the bone will not yield, the instrument should be applied so as to include part of it, if not directly over it, as it is most probable that the extravasated fluid will be found directly under it. And when the fissure is of great extent, it may be proper to make a perforation at each end, if the whole can be conveniently brought into view; and in some cases several perforations may become necessary.

When it is proposed to make several perforations to remove depressed fragments of the bone which are firmly fixed, and having the internal surface larger than the external, or to raise them sufficiently, it is necessary to apply the trepan as near the fractured parts as possible; making the perforations join each other, to prevent the trouble of cutting the intermediate spaces.

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When the skull is injured over a suture, and it is not thought advisable to use the trepan, a perforation ought to be made on each side of the suture, especially in young subjects, in whom the dura mater adheres more strongly than in adults; because there cannot be a free communication between the one side and the other, on account of the attachment of that membrane to the suture.

187
Treatment of the patient after the operation.

After the elevation of the depressed pieces, or the removal of those which are quite loose, the extraction of extraneous bodies, and the evacuation of extravasated fluids, &c. the sore is to be dressed in the lightest and easiest manner: all that is necessary being to apply a pledget of fine scraped lint, covered with simple ointment, to that part of the dura mater which is laid bare by the trepan, or otherwise; after which the edges of the scalp are to be brought together or nearly so, and another pledget laid along the whole course of the wound; a piece of fine soft linen is to be laid over all, and the dressings may be retained in their place by a common night-cap applied close to the head, and properly fixed.

The patient is to be placed in as easy a position in bed as possible, with his head and shoulders elevated a little more than ordinary. If the operation be attended with success, the patient will soon begin to show favourable symptoms; he will soon show signs of increasing sensibility, and the original bad symptoms will gradually disappear. After this he ought to be kept as quiet as possible; proper laxatives are to be administered, and such as may be least of a nauseating nature. His food ought to be simple and easy of digestion, and his drink of the most diluent kind. If he complain of the wound being uneasy, an emollient poultice should be immediately applied, and renewed three or four times in the twenty-four hours. By these means there will commonly be a free suppuration from the whole surface of the sore.

Every time the wound is dressed, the purulent matter ought to be wiped off from it with a fine warm sponge; and if any degree of sloughiness take place on the dura mater or parts adjacent, it will then be completely separated. Granulations will begin to form, which will continue to increase till the whole arise to a level with the surface of the cranium. The edges of the sore are now to be dressed with cerate straps, and the rest of it covered with fine soft lint, kept gently pressed on by the night-cap properly tied. In this way the cure will go on favourably; luxuriance of granulations will commonly be prevented; the parts will cicatrize kindly; and as all the skin has been preserved in making the first incision, the cicatrix will be but little observed.

But things do not always proceed in this favourable manner. Sometimes in a few hours after the operation the patient is seized with a kind of restlessness, tossing his arms, and endeavouring to move himself in bed, while the symptoms of a compressed brain remain nearly the same as formerly. In this case, especially if the pulse be quick and strong, the patient ought to be bled freely, as there will be reason to suspect some tendency to inflammation in the brain. Sometimes, though the trepan has been properly applied, the symptoms are not relieved, on account of extravasated fluids collected internally under the dura mater, or between the pia mater and brain, or in the cavity of the ventricles. The danger in these cases will be in proportion to the depth of the collection. Particular attention therefore ought always to be paid to the state of the dura mater after the perforation has been made. If blood be collected below the dura mater, this membrane will be found tense, dark coloured, elastic, and even livid; in which case, an opening becomes absolutely necessary to discharge the extra-

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vasated fluid. Gentle scratches are to be made with a scalpel, till a probe (fig. 27.), or directory (fig. 28.), can be introduced; upon which the membrane is to be sufficiently divided in a longitudinal, and sometimes even in a crucial direction, till an outlet to the fluid be given.

After the dura mater has been cut in this manner, there is some danger of the brain protruding at the opening; but the danger from this is not equal to the bad effects arising from confined fluids compressing the brain.

188 Of Fungi.

A troublesome and an alarming appearance now and then follows the operation of the trepan; namely, the excrescences called *fungi*, formerly supposed to grow immediately from the surface of the brain, but which, in general, originate from the surface of the dura mater or cut edge of the bone granulating too luxuriantly.

It often happens that they possess little sensibility; and then the best method to prevent their rising to any great height is to touch them frequently with lunar caustic: but some cases occur where their sensibility is so great that they cannot be touched, unless they hang by a small neck; and then a ligature may be put round them, and tightened from time to time till they drop off, which will commonly be in the course of a few days. It seldom happens, however, that there is any occasion for applying such means for the removal of these tumors, for they generally fall off as the perforations of the bone fill up.

If they do not, as the connection between them and the brain will be then in a great measure intercepted, they may be with more safety removed, either by excision, by caustic, or by ligature.

The cure being thus far completed, only a small cicatrix will remain, and in general the parts will be nearly as firm as at first: but when much of the integuments have been separated or destroyed, as they are never regenerated, the bone will be left covered only by a thin cuticle, with some small quantity of cellular substance. When this is the case, the person ought to wear a piece of lead or tin, properly fitted and lined with flannel, to protect it from the cold and other external injuries.

This is the method now commonly practised in cases of compression; but it frequently happens, that instead of compression, such a degree of concussion takes place that no assistance from the trepan can be attended with any advantage; for the effects of concussion are totally different from those of compression, and therefore to be removed in a different manner.

Sect. II. *Of Concussion of the Brain.*

By concussion of the brain is meant such an injury, from external violence, as either disturbs or destroys its functions, without leaving behind it such marks as to allow its nature to be ascertained by dissection.

189 Symptoms of concussion of the brain.

Most of the symptoms attending compression of the brain occur also in concussion; but in a compressed state of the brain they are more permanent. There is no discharge of blood from the eyes, nose, or ears, which frequently happens in compression; and instead of that apoplectic stertor in breathing which accompanies compression, the patient seems to be in a sound and natural sleep. The pulse is irregular and slow in compression, and grows stronger and fuller by blood-letting; but in concussion it is weaker, being fast and equal, and sinks by blood-letting. There are besides convulsions in compressions, which are not observed in a state of concussion. The symptoms arising from concussion come on immediately after the injury is received. In the violent degrees of these the patient remains quite insensible; the pupils are much dilated, and do not contract though the eyes be exposed to the strongest light.

In more violent symptoms, especially when the patient is rendered insensible, it is extremely difficult to distinguish between concussion and depression; for symptoms which have been supposed to arise entirely from concussion have, after death, been found to be owing to extravasation or undiscovered fracture; and extravasation has been blamed, when, on dissection, not the least morbid appearance could be discovered.

Concussion of the Brain.

190 Treatment

In concussion the pulse will frequently sink and become feeble, even after the discharge of eight or ten ounces of blood: In doubtful cases, therefore, blood-letting should be practised with great caution. If the pulse become fuller and stronger after discharging a moderate quantity, if the blood appear sizy, and especially if the patient become more sensible, it may be concluded that the symptoms depend upon extravasation, depression of the skull, or some degree of inflammation; and as long as advantage seems to be derived from blood-letting, we may repeat it: but if, upon drawing a few ounces of blood, the pulse becomes feeble, and especially if along with this the patient become more weakly, we should immediately desist from any farther evacuation of blood; and in place of it we ought to give such remedies as may support and strengthen the patient: cordials ought to be given internally, and stimulants applied externally. Warm wine should be given in proportion to the degree of debility induced; the patient, who is apt, in this case, to become cold, should be kept warm by proper coverings; a blister ought to be put to all that part of the head in which the skin has not been injured; sinapis should be applied to the feet; gentle laxatives are useful, and should be regularly given, so as to keep the body open. If the patient cannot swallow wine in sufficient quantity, volatile alkali, ardent spirits, and other cordials of a stimulating kind, should be given. In concussions of the brain, Mr Bromefield has recommended the use of opiates, and several other practitioners agree with him; though some consider it as hurtful in the early stages of the disorder, and are of opinion that even wine and other cordials ought to be given with some degree of caution. Issues, or the frequent repetition of blisters to the different parts of the head and neck, by which an almost constant stimulus is preserved, are much recommended. When patients are recovering from accidents of this kind, a liberal use of bark, steel, and mineral waters, &c. have sometimes been of service. When the stomach is loaded, gentle vomits become necessary; and white vitriol is reckoned the best in such cases. When much languor, inactivity, and loss of memory continue, electricity long applied has been attended with advantage. This remedy, however, would be hurtful where any symptoms of compression or inflammation of the brain are present.

Sect. III. *Of Inflammation of the Membranes of the Brain, or of the Brain itself, from external Violence.*

191 Symptoms of inflammation of the brain and membranes.

Inflammation of the brain and of its membranes is attended with symptoms which occur in inflammations affecting other parts of the body, and from similar causes, and likewise with symptoms peculiar to the brain itself. This disorder differs essentially from concussion in its not appearing immediately; seldom till several days after the accident, and sometimes not till two, three, or more weeks, or even as many months, have elapsed; when the patient begins to feel an universal uneasiness over his head, attended with listlessness, some degree of pain in the part upon which the injury was inflicted, though of this there was perhaps no previous sensation. These symptoms gradually increase; the patient appears dull and stupid; there is now a sensation of fulness, as if the brain were girt or compressed; he complains of giddiness and of nausea, which sometimes terminate in vomiting; he is hot, and extremely uneasy; his sleep

ſleep is much diſturbed, neither natural ſleep nor that procured by opiates affording him relief; the pulſe is hard and quick; the face is fluſhed; the eyes inflamed, and unable to bear an expoſure to much light. Sometimes, where a wound of the head accompanies theſe ſymptoms, its edges become hard and ſwelled, and an eryſipelatous inflammation ſpreads quickly over the whole head, and eſpecially towards the forehead and eyelids, which frequently ſwell to ſuch a degree as to ſhut up the eyes entirely. This ſwelling is ſoft and painful to the touch; it receives the impreſſion of the finger, and frequently originates merely from the external wound; on which account the attending ſymptoms are commonly eaſily removed by the means beſt ſuited to eryſipelas of the parts. In a few inſtances, however, this ſymptom is likewiſe connected with, and ſeems to originate from, ſome affection of the dura mater. Its tendency is then of the moſt dangerous kind, and therefore requires the greateſt attention. Soon after theſe ſymptoms become formidable, the part which received the blow begins to put on a diſeaſed appearance. If the bone has been expoſed by the accident, it now loſes its natural complexion, becomes pale, white, and dry, either over its whole ſurface or in particular ſpots: but when the bone has not been denuded, nor the ſofter parts divided, but merely contuſed, they now ſwell, become puffy, and painful to the touch; and when the head is ſhaved, the ſkin over the part affected is redder than the reſt of the ſcalp; and if the ſwelled part be laid open, the pericranium will probably be found to be detached from the ſkull, and a little bloody fetid ichor will be obſerved between this membrane and the bone, which will be found diſcoloured in nearly the ſame manner as if it had been laid bare from the beginning.

By the application of proper remedies theſe ſymptoms are frequently entirely removed; but when neglected, or when they do not yield to the means employed, they conſtantly become worſe. Delirium enſues; the patient becomes extremely hot; and is at times ſeized with ſlight ſhiverings, which continue to increaſe and are attended with ſome degree of coma or ſtupor. The former ſymptoms now in a great meaſure diſappear; palſy of one ſide is ſoon followed by deep coma; the pupils are dilated; the urine and fæces are paſſed involuntarily; ſubſultus tendinum and other convulſions enſue; and death certainly follows, if the patient be not ſpeedily relieved.

Of the above ſymptoms, the firſt ſet point out the inflammatory, the other the ſuppurative, ſtage of the diſeaſe. The remedies which are uſeful in the one are highly improper in the other. During the inflammatory ſtage, blood-letting is the principal remedy; but this is improper after the ſuppurative ſymptoms appear, for then the trepan is the only thing that can give relief.

192 Method of cure. The indications of cure are; 1. To employ the moſt effectual means for preventing inflammation. 2. To endeavour to procure the reſolution of inflammation by general and topical remedies. 3. When the inflammation cannot be removed by reſolution, and when ſuppuration has taken place, to give a free vent to the matter. 4. If the affected parts be attacked with gangrene, to endeavour to remove it and obviate its effects.

193 Blood-letting, topical, &c. To anſwer the firſt indication, when the contuſion is conſiderable, blood-letting, both general and topical, ought to be employed, and to a conſiderable extent; the bowels ought to be kept open by the uſe of laxatives; a watery ſolution of ſaccharum ſaturni ſhould be applied to the part affected, and a low diet, with a total abſtinence from exerciſe, ought to be enjoined: but if theſe means fail, or, as frequently happens, the practitioner has not been called in ſoon enough for their proper application, and if inflammation have actually commenced, the ſecond indication ought to be then to be attended to. For this purpoſe, blood-letting, not from the feet according to the advice of old practitioners, but as near as poſſible to the part affected, is to be performed, by leeching, cupping, or ſcarifying with a lancet or ſcalpel.

When, inſtead of this, general blood letting is thought more adviſable, it is commonly recommended to open the external jugular vein, or the temporal artery; and the rule, with regard to the quantity to be evacuated, ought to be, to draw blood as long as the pulſe continues firm; ſo that, in violent caſes, taking away from 20 to 25 ounces at once will be found to anſwer the purpoſe better than to extract even a larger quantity, but at different intervals. A few hours afterwards, if the ſymptoms continue violent, it may be proper to diſcharge an additional quantity; but this muſt depend upon the ſtrength of the patient and the fulneſs of the pulſe.

Along with the liberal uſe of blood-letting, briſk purgatives ſhould be given. The bowels ſhould not merely be kept open; but in order to receive full advantage from the practice, a ſmart purging ſhould be kept up by repeated doſes of calomel, jalap, or ſome other neutral ſalt. Where the patient cannot ſwallow in ſufficient quantity, ſtimulating injections ſhould be frequently exhibited. 194 And purgatives.

A moiſt ſtate of the ſkin is uſeful in every caſe of inflammation, and ought therefore to be here particularly attended to. In general a mild perſpiration may be induced by applying warm fomentations to the feet and legs, and by laying the patient in blankets inſtead of linen. But when theſe means are inſufficient, diaphoretics or even ſudorifics may be given.

When much pain or reſtleſſneſs takes place, opiates ſhould be adminiſtered freely, which are now found to be attended with real advantage.

With reſpect to the external treatment of this diſorder, attention ſhould be paid to thoſe means which may moſt readily induce a free diſcharge of purulent matter from the ſeat of the injury. With this view, if the original accident be attended with a wound or diviſion of the integuments, as the lips of the ſore are commonly obſerved to be hard, painful, and dry, it ſhould be covered with pledgets ſpread with an emollient ointment, and warm emollient poultices laid over the whole; by which means, and eſpecially by a frequent renewal of the poultices, a free diſcharge of matter will commonly be induced, and the bad ſymptoms will generally be much mitigated, or entirely removed. 195 External treatment.

In caſes unattended with a diviſion of the integuments, as ſoon as it is ſuſpected that bad ſymptoms may ſupervene, the tumor ſhould be divided down to the pericranium; and if that membrane be found ſeparated from the bone, it ought likewiſe to be divided; and by inducing a ſuppuration in the way already mentioned, the inflammatory ſymptoms will probably be removed. As matter formed here is commonly of an acrid nature, and therefore apt to affect the bone, and by communication of veſſels the membranes under it, inſtead of waiting time till fluctuation be diſtinctly perceived, a free inciſion ſhould be made as ſoon as a tumor is obſervable. But this would be extremely improper in the treatment of tumors which immediately ſucceed to external injuries; for it often happens that ſuch tumors diſappear ſpontaneouſly, or by the uſe of aſtringent applications. It is only when a tumor attended with pain appears at a diſtant period upon the ſpot where the injury was received, that it ought to be opened as ſoon as perceived.

The next part of the practice regards the remedies to be uſed

Inflammation of the Brain, &c. used when the disorder has either proceeded to suppuration, or when, on a removal of a portion of the cranium, the dura mater is observed to be sloughy with a tendency to gangrene; and this includes the third and fourth indications of cure.

196
Treatment when suppuration has taken place.

The suppurative state of the disease is known by the inflammatory symptoms, instead of yielding to the remedies already advised, increasing in violence; and being succeeded by coma, dilatation of the pupils, a slow and full pulse, involuntary discharge of fæces and urine, palsy, and irregular convulsive motions, and especially when these symptoms are succeeded by fits of rigor and shivering.

The existence of matter within the cranium being ascertained, as no other remedy can be depended upon for removing it, the operation of the trepan should be immediately employed, and as many perforations ought to be made as may be sufficient for evacuating the matter. But if, after the skull is perforated, little or no matter appear between the bone and membranes; if the dura mater seem more tense than usual; this membrane is likewise to be opened, so as to give a free discharge to any matter which may be between the brain and its membranes.

When it is perceived that the dura mater has already become sloughy, with some tendency to gangrene, the greatest danger is to be dreaded. If mortification has commenced, there will be much reason to think that death will soon follow; but different instances have occurred of sloughs forming upon the dura mater, and of cures being made after these have separated. All that can be attempted is to keep the sores clean, to give a free discharge to the matter, to apply nothing but light easy dressings, and to give bark in as great quantities as the stomach can bear. If there be still some tendency to inflammation, the diet should be low and cooling, the patient should drink freely of whey or other diluent liquors, and the bowels should be kept moderately open: But if, on the contrary, the system be low and the pulse feeble, wine is the most effectual cordial.

Sect. IV. *Of Fissures, or simple Fractures of the Skull.*

The term is here meant to imply a mere division of one or both the tables of the skull, with or without a wound of the integuments, not attended with depression. Fractures of this kind are not dangerous as far as affects the skull only, for it frequently happens that extensive fissures heal without producing bad symptoms. But as they are frequently attended with effusions of blood or serum upon the brain or its membranes, or as they may tend to excite inflammation in these, they require particular attention.

When effusions occur, symptoms of compression immediately follow. The remedies best suited to this disease must then be applied; and the trepan is alone to be depended upon. The fissures should be traced through their whole extent, and a perforation made on the most depending part of each of them. If this be unsuccessful, the operation should be repeated along the course of the fissures as long as symptoms of a compressed brain continue; and as the effused matter will commonly be found contiguous to the fissures, they ought to be included in each perforation.

197
Methods of distinguishing fissures.

If the fissure be so large as to produce an obvious separation of the two sides of the bone, the nature of the case will be at once rendered evident; but where it is extremely small, there is difficulty in distinguishing it from the natural sutures, or from sutures surrounding small bones, which sometimes occur, and get the name of *ossa triquetra*. But this may be known by the firmer adhesion which always exists between the pericranium and sutures; whereas this membrane is always somewhat separated from that part of the bone where a fissure is formed. When the pericranium is separated by the accident for a considerable way from the surface of the bone, various means have been contrived for discovering the nature of the case; as pouring ink upon the part suspected to be fractured, which in case of a fracture cannot be wiped entirely off; or making the patient hold a hair or piece of catgut between his teeth, while the other extremity of it is drawn tense, which, when struck, is said to produce a disagreeable sensation in the fractured part. But such tests are little to be depended on; ink will penetrate the sutures; and the others are ineffectual, unless the fracture be extensive, and the pieces considerably separated from each other. The oozing of the blood from a fissure is a better mark. The ascertaining of this point, however, appears not very material; for unless alarming symptoms are present, although there should be a fissure, no operation is necessary; and if such symptoms occur, the bone ought to be perforated whether there be a fissure or not.

When a fissure is not attended with symptoms of a compressed brain, the trepan ought not to be applied, especially as the operation itself tends in some degree to increase inflammation of the part. The fissure should be treated merely as a cause which may induce inflammation. The patient should be blooded according to his strength; the bowels should be kept lax, and the sore treated with mild, easy dressing; and violent exertion should be avoided as long as there is any danger of inflammation occurring.

Wounds of the Eyelids and Eyeball.

Chap. XIII. *Diseases of the Eyes.*

Sect. I. *Of Wounds of the Eyelids and Eyeball.*

198
Treatment of wounds of the eyelids.

In cases of superficial wounds of the eyelids, it will be sufficient to bring the edges of the wounds together and retain them in their place by slips of adhesive plaster: but when a wound is deep, particularly when the tarsus is divided, it will be necessary to employ either the interrupted or the twisted suture, care being taken that the sutures be not carried through the inner membrane of the eyelid, otherwise the eye would be irritated and inflamed. After such an operation, the motion of both eyelids should be prevented as much as possible, else no union of the divided parts can be obtained. After the sutures are finished, the eyelids should be closed and covered with a pledget of emollient ointment, and over this should be laid a compress of soft lint, and one of a similar nature ought likewise to cover the sound eye; then a napkin should be made to press equally on both eyes, and be properly fixed. Inflammation should be guarded against, or, if already present, it must be removed in the manner directed under the article *Ophthalmia*, (see Medicine.) The sutures may be removed in about three days from their introduction, when the parts will commonly be found reunited.

When a portion of the eyelids is so much destroyed, or perhaps so completely removed, as to prevent the remaining parts from being brought together, without obstructing the motion of the eye, the best method will be to treat them with light easy dressings, trusting to nature for supplying the deficiency.

19[9]
Of wounds of the eyeball.

If the cornea be wounded, it will commonly be attended with partial or total blindness. If any of the other parts of the ball be wounded, the danger will generally be in proportion to the extent of the wound. The principal attention ought to be directed to the prevention or removal of inflammation. When pain occurs, it ought to be removed by opiates; and with these a strict antiphlogistic course is to be enjoined.

When the wound is large, and the humours completely evacuated

evacuated, blindness, with sinking of the eyeball, will almost always be the consequence; but in wounds of a small extent, by proper treatment, a cure may be made and the sight preserved.

Sect. II. *Of Diseases of the Eyelids.*

The eyelids are subject to be infested with tumors of different kinds, which frequently require the assistance of surgery. The first of these is the hordeolum or stye, which frequently grows on the edge of the eyelid, and is attended with heat, stiffness, and pain; and unless proper means be taken to prevent it, a suppuration is frequently the consequence. It may be considered as a common abscess seated in an obstructed sebaceous duct or gland. It may generally be removed by discutient applications. Should these prove ineffectual, it ought to be brought to suppurate by a small emollient poultice, when it will commonly heal of itself; but if it do not, it may be opened with the point of a lancet, that the matter may be discharged; and the part may be anointed afterwards with saturnine solution.

The eyelids are subject to encysted tumors, steatoms, warts, &c. which are to be treated like the same tumors when seated in other parts of the body; only in extirpating these tumors, should part of the eyelid be removed entirely, no dressings can be applied, as, however mild they may be, they would irritate and inflame the ball of the eye. All that can be done therefore, in such cases, is to lay the lips of the sore as nearly together as possible, and frequently to remove any matter that may form on it.

The eyelashes are sometimes so much inverted as to rub upon the eye and create much pain and inflammation. Various causes are assigned for this, such as the hairs themselves taking a wrong direction; inversion of the tarsus or cartilage of the eyelid; some cicatrix formed upon the skin of this part after wounds or abscesses; tumors pressing the hairs in upon the eye; and, finally, a relaxation of the external integuments.

The treatment of this disorder must depend much upon a knowledge of the cause. When it is owing to a derangement of the cilia themselves, if they have remained long in this state, it will be extremely difficult to make them recover their proper direction. They ought therefore to be pulled out by a pair of forceps, and the part washed with some astringent lotion; and if the new hairs appear to take a similar direction, which is very apt to happen, as soon as they are long enough they ought to be turned back upon the eyelid, and kept there for several days, or even weeks, by adhesive plaster. When the disease proceeds from a contraction of the orbicular muscles, the contracted part may be cut from the inner surface of the eyelid; in which place a cut commonly soon heals. If the cause proceed from a tumor or cicatrix, this must be removed before a cure can be expected; or if it be owing to relaxation of the skin, the parts ought to be bathed with some strong astringent. If this fail, the relaxed skin should be removed, and the part healed by the first intention. Sometimes the cilia of the upper eyelid are turned in on account of dropsical swelling in that place. When this happens, the water is to be evacuated by a few punctures with a lancet; but when such means fail, and when the disease is quite local, if vision be disturbed, a sufficient part of the skin ought to be removed with a scalpel, and a cure made by adhesive plaster or the twisted suture.

When the gaping eye takes place to any great degree, it is attended not only with much deformity and uneasiness, from a large portion of the lining of the eyelid being turned outwards, but likewise from too much of the eye being exposed. The disorder may arise from an enlargement of the eyeball, from dropsical swelling, or from the cicatrix of an old wound or abscess: hence it is frequently produced by the small-pox, burns, or scrophula; but more frequently by a laxity of the part in old age. Diseases of the Eyelids.

When the disorder is induced by an enlargement of the ball of the eye, nothing but a removal of this swelling can be effectual. If from dropsical swelling, when this is connected with general anasarca, the affection of the system must first be cured; but if it appear to be local, nothing answers so well as punctures. When it arises from a cicatrix, the skin should be divided, and the effects of inflammation guarded against. If it be owing to inflammation, the antiphlogistic course must be used; when it arises from old age, the eyes ought to be daily bathed with cold water, or some astringent and stimulant solution.

Concretion of the eyelids sometimes arises from a high degree of ophthalmia; in which case the eyelids are not only connected by their edges to each other, but now and then grow to the surface of the eyeball. A cohesion is sometimes observed also in children at birth. When the adhesion is slight, it may in general be removed by the end of a blunt probe; but when it is considerable, a cure can only be effected by a cautious dissection. If the eyelids on one side be sound, they will serve as a guide to direct the incision. The tarsi are carefully to be divided from each other; after which, if there be no other adhesions, the eyelids may be readily opened: But if they adhere to the eye, the operator is gently to pull and separate the eyelids, while the patient is desired to move the eye in the opposite direction. When this is effected, nothing is further necessary than to drop a little oil upon the eye, and cover the eyelids with soft lint spread with some cooling emollient ointment. The oil and ointment are frequently to be repeated, and every precaution taken to prevent inflammation and irritation. 203 Concretion of the eyelids.

Sect. III. *Of Specks, Films, or Excrescences on the Eye.*

Specks are sometimes formed upon the white part of the eye, but more frequently upon the cornea. In the former case they are seldom attended with much inconvenience, but in the latter they are often the cause of partial or total blindness. They are almost universally the consequence of inflammation, and seldom go much deeper than the tunica adnata. Two very different states of the disorder occur; the one from an effusion immediately under the outer layer of the cornea, and in this case the cornea does not appear to be raised; the other takes place from one or more little ulcers, which breaking, leave as many opaque spots in the centre, which are more elevated than the rest of the cornea: and the inconvenience attending either situation must always be in proportion to their extent and degree of opacity, or their vicinity to the pupil. When vision is little affected by them, they need scarcely be considered as an object of surgery; but whenever vision is materially impaired, remedies become necessary, and these should be such as are best suited for removing inflammation, promoting absorption, and restoring tone to the vessels. For the means adapted for removing inflammation, see Medicine, n° 175. 204 Of specks on the cornea.

Vessels running upon the surface of the eye into the speck are to be divided, and the eye frequently bathed with some refrigerant collyrium. By these means the simplest kind of specks, when recently formed, may generally be removed; but where they have been of long standing, their removal is attended with great difficulty. Where the speck is owing to an effusion of fluids between the layers of the cornea, and where it is not attended with any prominence, local applications are of little advantage, as it 205 Treatment.

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Specks, &c. in the Eye. is impoffible to remove the effufed matter without injuring the cornea; but confiderable benefit is derived from the ufe of fuch remedies as are moft effectual for promoting abforption; and with this view a gentle, long continued courfe of mercury, with purgatives occafionally, and iffues in the neck, are found to be the moft effectual remedies.

In the management of fpecks which are prominent upon the cornea, and where inflammation is removed and the opacity confiderable, if the cornea beneath be found, the removal of the difeafed part will leave it tranfparent and fit for vifion. The remedies proper for this purpofe are efcharotics or the knife. The former are applied in the form of a powder, an ointment, or a wafh; and thefe ought to be very finely prepared, otherwife they will be in danger of irritating and inflaming the eye; and they ought merely to be of fuch ftrength as the eye can eafily bear.

The applications fhould be long perfifted in and frequently repeated; and to make them ftill more ufeful, fome of the powders or ointments may be applied evening and morning, and the folution two or three times through the courfe of the day. To the remedies already mentioned cauftic is fometimes preferred. With this the centre of the fpeck is to be frequently touched, till the patient complain of confiderable pain, when pure water is to be applied by a pencil, or by dipping the eye in water, with the eyelids open, till the pain occafioned by the application of the cauftic be removed. The eye is then to be covered with compreffes moiftened in fome folution, and this frequently repeated. The cauftic to be repeated every fecond or third day, unlefs prevented by inflammation. When the furgeon choofes to employ the knife, which frequently may be more effectual, the eye is to be fixed by a fpeculum (fig. 29.), or levator (fig. 30.); the tumor is then to be cautioufly feparated by means of a fmall knife, and every attention paid to prevent inflammation. Thefe are the methods moft likely to be of fervice; and when properly managed, they will frequently remove fpecks, which otherwife would entirely deprive the patient of the ufe of the eye; though it is to be regretted that cafes frequently occur which baffle art.

226
Of the excrefcence called pterygium.

A membranous excrefcence, called *pterygium*, is frequently found upon the white part of the eye, which often fpreads over the cornea fo as entirely to deftroy vifion. It is fometimes owing to external injuries; at other times it arifes from a general difeafe of the fyftem, as lues venerea or fcrophula; but inflammation is always the more immediate caufe.

227
Method of removing excrefcences.

By a proper application of the remedies above mentioned affections of this kind may generally be prevented from becoming formidable; but when the reverfe takes place, and excrefcences begin to fpread over the cornea, other means muft be ufed. When the difeafed part is only flightly attached, it may be freely removed by a cut of the knife; but when this cannot be done without difficulty, it is better to deftroy the veffels by the extenfion of which this fubftance is chiefly formed. The manner of performing the operation in general is this: The patient being properly feated, the eyelids opened, and the eye fecured, the operator, with a fmall knife, makes a fcarification through the whole thicknefs of the excrefcence, entirely round, and at a little diftance from the circumference, by which the fource of nourifhment will be cut off; and, after the bleeding is abated, one or two incifions more may be made, in a fimilar manner, within the former. Some practitioners raife the excrefcence with a needle and ligature before the incifion is made; and, in fome cafes, this may be done with advantage, though not in others.

After the bleeding is over, the part is to be bathed two or three times a-day with a weak faturnine folution; and the operation may be repeated occafionally till the excrefcence is removed. In this way the operation commonly proves effectual; but inftances fometimes occur where, inftead of being ufeful, it increafes the difeafe. Whenever this happens, a palliative courfe is the only thing to be tried; and although it will not remove the diforder, it may commonly prevent the excrefcence from acquiring any additional fize. With this intention it ought to be frequently bathed with the folution laft mentioned, and afterwards covered with a cooling ointment. When the diforder cannot even be palliated, when vifion is deftroyed, and particularly when the pain attending it is fevere, there is reafon to fufpect cancer. In this cafe the eye ought to be extirpated, otherwife deeper parts may fuffer, and the life of the patient be endangered. The method of performing this operation will be afterwards pointed out.

Sect. IV. *Of Abfcefs in the Globe of the Eye.*

Though inflammation of the eye generally terminates by refolution, inftances fometimes occur in which an abfcefs enfues. This is owing either to improper treatment, or a bad habit of body which counteracts all remedies. The greateft danger attending thefe complaints is when they are fituated on the cornea, as the cicatrix left by them may deftroy vifion. When deep feated, a purulent matter is fometimes apt to be found in fome of the chambers of the eye, the ball becomes enlarged, the humours are difturbed, and neither the iris, pupil, nor lens can be diftinguifhed. In fome rare cafes again, after thefe appearances have continued fome time, the cornea burfts, part or whole of the humours are evacuated, and the iris protrudes in a thickened diftended ftate. This has now the appearance of an excrefcence, which is called *ftaphyloma* from a kind of refemblance to a grape. But under this term fome authors include all collections like thofe above defcribed. In moft inftances the cornea protrudes, but in others the tunica fclerotica or opaque part is affected with partial fwellings or protrufions.

While the difeafe is forming, befides the lofs of fight, the patient commonly feels great diftrefs in the eye and head, accompanied by fymptoms of fever. When no other diftrefs is experienced than the lofs of fight, the fwelling is but fmall, and contains chiefly a watery fluid. In the treatment, as vifion is feldom preferved, the principal thing is to abate the pain and remove deformity. There is another kind of abfcefs in the eye, termed *hypopyon*, where the matter is lodged in the fubftance of the coats. It is fometimes produced by external injuries, but more frequently from puftules of fmall-pox. If this termination cannot be prevented by the remedies mentioned in the article Medicine, n° 175, the matter muft be evacuated by an incifion into the eye, not regarding the humours, as vifion previous to this time is entirely deftroyed. The proper part is the cornea or the moft prominent part of the tumor.

A variety of this diforder fometimes, though rarely, happens, where the humours are abforbed; but ftill the fame external appearances are obferved. In this cafe the tumor is formed by a thickening of the coats, efpecially the iris. The only means of relief is extirpation of the prominent part by the ufe of the knife. After the contents of the eye have been difcharged, the parts are to be covered with a comprefs moiftened with a faturnine folution, and the antiphlogiftic courfe followed, till a cure is perfected, or at leaft inflammation removed. If the ulcers difcharge a thin acrid matter, they may be wafhed two or three times a day with a folution of corrofive fublimate, or of white vitriol, &c. Fungous excrefcences, fometimes confidered as a cancer of the eye, are apt to form in both thefe difeafes after the matter is evacuated; but they may be prevented from increafing

creaſing to a conſiderable ſize by burnt alum finely powdered, or by touching them occaſionally with lunar cauſtic.

Ulcers on the eye may ariſe from the ſame cauſes which produce ulcers on other parts of the body, as wounds, burns, &c; or they may ariſe from a general affection of the conſtitution, as lues or ſcrophula; but they are more immediately produced by inflammation. In the treatment therefore of ſuch diſeaſes, blood letting, bliſtering, laxative and cooling applications, as already deſcribed in the caſe of ophthalmia, are to be employed. When the inflammatory ſtate is removed, their management muſt be almoſt the ſame with that for ſimilar affections in other parts of the body. When the diſorder ariſes from an affection of the ſyſtem, the primary diſeaſe muſt be attended to before a cure can be performed. With reſpect to the ſores themſelves, if acrid matter be diſcharged, we muſt have recourſe to detergent ointments and waſhes before a cicatrix can be formed. When theſe have not the deſired effect, and when the ſore becomes ſoft and higher than the reſt of the eye, aſtringent applications are moſt efficacious. If excreſcences be preſent, theſe are to be removed by eſcharotics, or by the knife. In ſome rare inſtances excreſcences of a fungous nature are found to be connected with the interior parts of the eye, and become ſo prominent as even to reſt upon the cheek. When ſuch occur, nothing but the removal of the eye itſelf can effect a cure.

SECT. V. *Of Dropſical Swellings of the Eye.*

THE eye is ſometimes enlarged by an accumulation of the aqueous humour. The ſymptoms are, a ſenſe of fulneſs in the eyeball; by degrees the motions of the eyelids become impeded; viſion gradually becomes more and more imperfect, till at laſt the patient can only diſtinguiſh light from darkneſs. As the diſeaſe increaſes, the ball of the eye becomes greatly enlarged, and at this time the cornea begins to protrude; when, if a puncture be not made, the eye burſts and empties itſelf. This diſeaſe is apt to be confounded with ſtaphyloma. But in the dropſical ſwelling the patient is always ſenſible to the effects of light, and the pupil is obſerved to contract, which does not happen in ſtaphyloma. In the early ſtages of this diſeaſe viſion may be preſerved by puncturing the under edge of the cornea, and allowing the aqueous humour to paſs out by the anterior chamber; or by puncturing the tunica ſclerotica a little behind the iris, by which the fluid will paſs out by the poſterior chamber. The puncture may be made either with a lancet, pointed knife, or with a very ſmall flat trocar. The eye ought afterwards to be dreſſed with a compreſs made moiſt with a ſaturnine ſolution, guarding againſt exceſſive inflammation. When the uſe of the eye is ſomewhat recovered, tone may be reſtored to the parts, and a return of the diſeaſe as much as poſſible prevented, by frequently bathing the eye in aſtringent lotions; but where the cornea is deſtroyed, the ſight cannot be reſtored: We can then only diminiſh the ſize of the eye, and render it ſomewhat more comfortable to the patient.

Blood may be effuſed into the chambers of the eye from various cauſes, as in putrid diſeaſes, or in conſequence of inflammation, but moſt frequently from a rupture of the blood-veſſels induced by external injury. In whatever way it gets into the eye, it mixes with the aqueous humour, and renders it opaque. It is ſometimes taken up by the abſorbents; when it is otherwiſe, it ought to be diſcharged by a puncture.

A few inſtances have occurred where the blood has fallen to the under ſide of the eye, and remained there without mixing with the aqueous humour. In ſuch a ſituation it ought to be allowed to remain.

When a puncture is neceſſary, it is to be made in the ſame manner as in caſes of dropſy of the eye; only the opening may require to be ſomewhat larger, otherwiſe the blood may not paſs readily out. After the operation, nothing is neceſſary but to apply a compreſs of ſoft lint, moiſtened with a weak ſaturnine ſolution.

Protruſion of the eyeball beyond its Socket.

SECT. VI. *Of the Protruſion of the Eyeball beyond its Socket.*

THE eye may protrude in conſequence of external violence, or from tumors forming behind it, or on account of ſome of the ulcers, excreſcences, or dropſical ſwellings, already mentioned. When the eye is forced out of its ſocket by external violence, if the eyeball be not entirely ſeparated from the neighbouring parts, it ought to be freed from any extraneous matter which may adhere to it, and immediately replaced; and if the optic nerve be not quite divided, the uſe of the eye may be recovered. With a view to prevent or moderate inflammation, every part of the antiphlogiſtic regimen ought to be ſtrictly adhered to. If the protruſion is occaſioned by a tumor, the cure muſt depend upon the removal of this; and if the diſeaſe has advanced ſo far that the bones are become carious, they muſt likewiſe be ſeparated. But more frequently, inſtead of the bones becoming carious, they aſſume a gelatinous or rather cartilaginous nature. In ſuch a ſituation an operation could be of little advantage. The beſt method to prevent the bones from being ſo affected is an early performance of the operation.

A few inſtances have happened of the eye being puſhed from its ſocket by an enlargement of the lachrymal gland. When this occurs, if the enlargement be conſiderable, the ſtructure of the eye will moſt probably be ſo much injured that viſion will be deſtroyed; but inſtances have occurred of this gland, in the enlarged ſtate, having been removed without any injury being done to the eye.

SECT. VII. *Of Cancer of the Eye, and Extirpation of the Eyeball.*

212 Symptoms of cancer of the eye.

SCIRRHUS and cancer may ariſe from repeated inflammations of the eye, or from ſtaphyloma, or ſome of the other diſeaſes which frequently attack this organ. The ſymptoms are, an enlargement, hardneſs, and protruſion of the ball, with a red, fungous appearance, ſometimes diſcharging thick, yellow matter, but more frequently a thin acrid ichor. At firſt there is only a ſenſation of heat in the tumor: but this gradually increaſing, changes at laſt into darting pains, which likewiſe ſhoot through to the oppoſite ſide of the head. In this ſituation blood-letting, opiates, and emollient applications, may alleviate the pain. A hemlock poultice applied to the eye, and a waſh of lime-water, with a little opium diſſolved in it, and applied every time the poultice is renewed, gives ſome relief; but altho' the pain be moderated by theſe means, it does not prevent the diſeaſe from ſpreading, nor can any thing elſe but extirpation produce a radical cure.

213 Method of extirpating the eye.

After the diſeaſe is diſcovered to be cancerous, the operation ſhould be performed without delay, to prevent the parts in the neighbourhood, as well as the conſtitution at large, from ſuffering. In performing the operation, the patient ſhould be placed in a proper light, and the head ſupported by an aſſiſtant. If the eyelids are diſeaſed, they muſt be ſeparated along with the tumor; but where they are ſound, they ought to be carefully preſerved; and for this purpoſe they may be kept out of the way by two levators held by aſſiſtants. When the eyeball protrudes conſiderably, the operator may lay hold of it with his fingers; but if this be impracticable, a broad ligature ſhould be introduced through the centre of it, that it may be the more readily

readily removed from the orbit. Sometimes it will be necessary to enlarge the opening of the eyelids, by cutting the external angle to allow the eyeball to be more readily removed. The whole of the diseased parts are now to be separated by a knife bent so as to correspond with the sides of the orbit, guarding at the same time against wounding the periosteum or the bones of the orbit, which are commonly attached to them. The eye being in this manner extirpated, the hemorrhagy from the ocular arteries is to be suppressed by means of agaric, or by a bit of sponge; then over this is to be laid soft lint, with a napkin to cover the whole. After suppuration takes place, the dressings are to be removed, when a little lint, applied with an emollient pledget over it, will be sufficient as long as any matter is discharged. After the wound is healed, the deformity may be in some measure obviated by wearing an artificial eye; though it is chiefly in cases where part of the humours of the eye have been evacuated that this can be used with much propriety; for when the orbit is empty the artificial eye sinks too far into it.

Sect. VIII. *Of the Cataract.*

214 Symptoms of cataract. The ancients, and some of the modern writers, had a confused idea of the seat of the cataract; different authors placing it in different parts of the eye. It consists of an affection of the crystalline lens or of its capsule, by which the rays of light are prevented from falling upon the retina; and is therefore the same disease with the glaucoma of the ancients. It commonly begins with a dimness of sight; and this generally continues a considerable time before any opacity can be observed in the lens. As the disease advances the opacity becomes sensible, and the patient imagines there are particles of dust or motes upon the eye, or in the air. This opacity gradually increases till the person either becomes entirely blind, or can merely distinguish light from darkness. The disease commonly comes on rapidly, though sometimes its progress is slow and gradual. The opacity of the lens is found to be nearly in proportion to the degree of blindness the patient is affected with; it gradually changes from a state of transparency to a perfectly white, or light grey colour. In some very rare instances a black cataract is found. Sometimes the disease is confined to a particular spot of the lens, but generally the whole is affected. The consistence also varies, being at one time hard, at another entirely dissolved. When the eye is otherwise sound, the pupil moves according to the degree of light in which it is placed. This disease is seldom attended with pain; sometimes, however, every exposure to light creates uneasiness, owing probably to inflammation in the bottom of the eye. The real cause of cataract is not yet well understood. Numbers of authors consider it as proceeding from a preternatural contraction of the vessels of the lens, arising sometimes from external violence, though more commonly from some internal and occult cause. The disease is distinguished from the gutta serena, by the pupils in the latter being never affected with light, and from no opacity being observed in the lens. It is distinguished from hypopyon, staphyloma, or any other disease in the fore part of the eye, by the evident marks which these affections produce, as well as by the pain attending their beginning. But it is difficult to determine when the opacity is in the lens or in its capsule. The lens is generally affected; when the capsule is the seat of the disease, it is termed the membranous cataract.

215 Methods of treatment. With respect to the treatment: If the disease be in the incipient state, mercury, particularly calomel in small doses, has been attended with some advantage. When any degree of inflammation is present, blood-letting and cooling regimen will sometimes be necessary. Electricity, extract. hyoscyami, flammula Jovis, &c. have likewise been extolled; but after these or other remedies have failed, the cure must depend upon a chirurgical operation. For this purpose two methods are in general use. The first of these, and which was practised for a long time before the other, is called *couching*. It is done with a view to allow the rays of light to fall upon the retina; and it consists in removing the lens from its capsule, and lodging it in some part of the vitreous humour, where it may be entirely off the axis of the eye, and where it is supposed, in course of time, to dissolve.

The other method is termed *extraction*, where, after an incision has been made in the cornea, the lens is pushed through the pupil, and then entirely removed from the eye. Each of these methods has been much practised, and it is still a matter of doubt to which we ought to give the preference. The next circumstance deserving attention is the time at which the operation for couching or extracting can with most propriety be performed. Formerly it was thought necessary to wait till the lens had a certain degree of consistence, or was become ripe; but no certain marks of fluidity or firmness have been yet discovered; neither indeed is there any necessity for attending particularly to it, as the operation may be practised in every period of the disease, providing the retina be sound, the iris have the power of contracting, and the cornea be transparent. The proper time for the operation is when the opacity of the lens is so considerable as to prevent the patient from following his ordinary occupation. When this is not the case, or when the patient has the use of one eye, it ought not to be performed, as it is always attended with some degree of danger.

When the operation is to be performed, the following is the method of doing it: And first, *of couching the cataract*. Method of couching the cataract. To guard as much as possible against the effects of inflammation, the patient should be confined, for several days previous to the operation, to a low regimen; and two or three doses of some cooling laxative should be given at proper intervals. After this he is to be seated with his face towards the light; but sunshine ought to be avoided. Some, however, prefer a side-light both on account of the operator and patient. One assistant is to support the head, while others secure the arms. The operator is either to be seated with his elbow resting upon a table; or, which is preferred by some, he ought to stand, resting his arm upon the side of the patient. The eye being fixed by the speculum (fig. 29.), or in such a manner as to allow the whole of the cornea and a small portion of the sclerotic coat to protrude, a couching needle (fig. 31.) is to be held in the right hand, in the manner of a writing pen, if the left eye be the subject of operation; the ring and little fingers are to be supported upon the cheek or temple of the patient: The needle is to be entered in an horizontal direction through the sclerotic coat, a little below the axis of the eye, and about one fourth of a line behind the edge of the cornea, so as to get entirely behind the iris. If the needle be of the flat form, the flat side ought to be opposed to the iris, to prevent that substance from being wounded. The point of the needle is to be carried forwards till it be discovered behind the pupil. The operator is now commonly directed to push the point into the lens, and depress it at once to the bottom of the eye; but in this way the lens either bursts through the capsule at an improper place, or it carries the capsule with it, tearing it from the parts to which it is connected. Instead of this, the needle ought first to be pushed into the lens near its under edge, as Dr Taylor advises, and then carried some way down into the vitreous humour, so as to clear the way for the lens. It is then to be drawn a little back, and carried to the upper part

act. part of the capſule, when, by preſſing upon it, the lens, if ſolid, is to be puſhed down by one, or, if fluid, by ſeveral movements, to the bottom of the vitreous humour. It ſhould then be puſhed downwards and outwards, as Mr Bell directs, ſo as to leave it in the under and outer ſide of the eye; where, in caſe it ſhould riſe, the paſſage of the light would be little obſtructed. The needle is then to be withdrawn, the ſpeculum removed, and the eyelids cloſed; and a compreſs ſoaked in a ſaturnine ſolution is to be applied over them. Mr Pellier's method is to cover each eye with a linen bag half filled with fine wool, applied dry and fixed to a circular bandage of linen paſſed round the forehead: the whole is retained by a triangular napkin. The patient is then to be laid in bed, upon his back, with his head very little raiſed; and to be kept in this ſituation for about a week in a dark room. Unleſs he be of a weakly habit, he ought to be bled at the neck, or leeched at the temple, a few hours after the operation. He ſhould be kept upon low diet, and get ſmall doſes of opiates frequently repeated. His belly ſhould be kept moderately open by gentle purgatives. The dreſſings ſhould not be removed till inflammation is at leaſt ſo far gone that no danger will ariſe from uncovering the eye, which may generally be about the eighth or tenth day. Sometimes the patient perceives light immediately on the dreſſings being removed, but more frequently not till ſome time after.

7 ment ards.

Upon removing the dreſſings, if the cataract has again got back to the axis of the eye, a repetition of the operation may become neceſſary. Some time, however, after the inflammatory ſymptoms are gone, ſhould be allowed to elapſe before any other operation is again attempted; for the cataract frequently diſſolves, providing the aqueous humour get free acceſs to it. Mr Pott ſometimes, when he found the cataract to be of the mixed kind, did not attempt depreſſion, but contented himſelf with a free laceration of the capſule; in which caſes the lens hardly ever failed of diſſolving ſo entirely as not to leave the ſmalleſt veſtige of a cataract. When the operation is to be performed upon the right eye, the ſtraight needle muſt either be uſed by the left hand, or the operator muſt place himſelf behind the patient. A needle (fig. 32.) has been contrived, however, with a large curve, by which the operation may be readily performed with the right hand, while the ſurgeon is placed before the patient; only the needle is entered towards the inner, inſtead of the outer, angle of the eye.

8 od of ting ta-

The firſt hint of extracting the lens ſeems to have been ſuggeſted by Mr Petit, who propoſed to open the cornea and extract the lens when it was forced into the anterior chamber of the eye either by external violence or accidentally in couching. At firſt it was conſidered as a dangerous operation, and was ſeldom practiſed till about the year 1737, when Mr Daviel propoſed and practiſed extraction in preference to couching. The operation is now performed in the following manner: The patient and operator being placed, and the eye fixed in the ſame manner as for couching, the ſpeculum, when the operation is to be done upon the left eye, is to be held in the left hand of the operator. It is neceſſary to make as much preſſure as will ſecure without hurting the eye. Neither ought the cornea to be preſſed too near the iris, leſt the latter be wounded. The operator now takes the knife (fig. 33.), and holds it in the ſame way as he does the needle for couching; he then enters the point of it with the edge undermoſt into the cornea about the diſtance of half a line from its connection with the ſclerotic coat, and as high as the centre of the pupil; he is then to paſs it acroſs the pupil to the inner angle in an horizontal direction, keeping the edge a little outwards to prevent the iris from being cut; the point is then to be puſhed through oppoſite to where it entered; the under half of the cornea is next to be cut, and at the ſame diſtance from the ſclerotics with the parts at which the point of the knife went into and came out from the eye. Cataract.

In cutting the under half of the cornea the preſſure of the ſpeculum upon the eye ſhould be gradually leſſened; for if the eye be too much compreſſed, the aqueous humour, with the cataract and part of the vitreous humour, are apt to be forced ſuddenly out immediately after the inciſion is made. The operator then takes a flat probe, and raiſes the flap made in the cornea, while he paſſes the ſame inſtrument, or another probe (fig. 34.), rough at the extremity, cautiouſly through the pupil, to ſcratch an opening in the capſule of the lens. This being done, the eye ſhould be ſhaded till the lens be extracted, or the eyelids are to be ſhut to allow the pupil to be dilated as much as poſſible; and while in this ſituation, if a gentle preſſure be made upon the eyeball at either the upper or under edge of the orbit, the cataract will paſs through the pupil more readily than it would do when the eyelids are open.

If the lens cannot be eaſily puſhed through the opening of the cornea, no violent force ſhould be uſed, for this would tend much to increaſe the inflammation. The opening ſhould be enlarged, ſo as to allow the lens to paſs out more freely. When the cataract does not come out entire, or when it is found to adhere to the contiguous parts, the end of a ſmall flat probe, or a ſcoop (fig. 35.), is to be introduced, to remove any detached pieces or adheſions that may be preſent. The iris ſometimes either projects too much into the anterior chamber, or is puſhed out through the opening of the cornea. When this happens, it is to be returned to its natural ſituation by means of the probe already mentioned. Sometimes the opacity is not in the body of the lens, but entirely in the capſule which contains it. The extraction of the lens alone would here anſwer no uſeful purpoſe. Some practitioners attempt to extract, firſt the lens, and then the capſule by forceps; others, the lens and capſule entire. Thoſe who have had much practice in this branch of ſurgery, as Pellier, ſay they find ſuch a method practicable; but others think it better to truſt entirely to time and a cooling regimen for the cure, which, in ſome inſtances, has taken place. When the operation is to be performed on the right eye, the operator is either to uſe the left hand, to take his ſtation behind the patient, or to employ a crooked knife (fig. 36.)

After the operation is finiſhed, the eyelids are to be ſhut, and the ſame treatment obſerved as in couching. When the operation ſucceeds, the wound in the cornea is generally healed in little more than eight or ten days; but previous to this time, the eye ought not to be examined; and even then it ſhould only be done in a dull light, otherwiſe it may ſuffer conſiderably from the irritation which a ſtrong light might occaſion. When the eye is to be examined, if the eyelids be found adhering together, they ought to be waſhed with ſome gentle aſtringent. With this the eye ought alſo to be frequently waſhed afterwards, by which it will gradually recover ſtrength and ſight. About the end of the third week the dreſſing may be entirely removed, and a piece of green ſilk put over the eyes as a ſhade; and if every thing has ſucceeded, the patient may generally go out after a month from the time at which the operation was performed. 219 Treatment after the operation.

It ſometimes happens, that in extracting the lens a portion of the vitreous humour is evacuated. This does not in general prevent the ſucceſs of the operation. The eye ſoon begins to fill again, and in the courſe of two or three weeks

Fistula Lachrymalis.

weeks it is for the most part as large as it was previous to the operation. Whether this be owing to a renewal of the vitreous humour, or merely an aqueous secretion, is not yet determined; though the latter circumstance is generally supposed.

Chap. XIV. *Of Fistula Lachrymalis.*

By this disease is properly understood a sinuous ulcer of the lachrymal sac or duct with callous edges, though every obstruction of this passage is commonly called *fistula lachrymalis.*

220 Symptoms of the disease in its most simple form,

The first and most simple state of the disease is that termed a *dropsy of the lachrymal sac.* The symptoms are, a tumor between the inner cornea of the eye and side of the nose. This disappears by pressure, the tears mixed with mucus passing partly into the nose, but chiefly back upon the eye and over the cheek.

This state of the disease is what the French have called the *hernia*, or *hydrops sacculi lachrymalis.* It is frequently met with in children who have been rickety, or are subject to glandular obstructions: and in this state it sometimes remains for several years, subject to little alterations, as the health or habit shall happen to vary, the sacculus being sometimes more, sometimes less full and troublesome; the contents which are pressed out are sometimes more, sometimes less cloudy; and now and then the disease is attended with a slight ophthalmy, or an inflammation of the eyelids, but which, by common care, is easily removed. If the sacculus be not much dilated, the discharge small, and produced only by pressure, the chief inconveniences are the weeping eye, and the gumming together of the lids after sleeping: but these, by being attended to, may be kept from being very troublesome; and if the disease makes no further progress, may be so regulated as to render any more painful process totally unnecessary. If the dilatation be considerable, the swelling is more visible, and the quantity of fluid is larger; it is also in this state more frequently mixed and cloudy, and more troublesome, from the more frequent necessity of emptying the bag; but if the patient be an adult, it may, even in this more dilated state of it, be kept from being very inconvenient.

If an inflammation comes on, the tumor is thereby considerably increased, the discharge is larger, as well during sleep as upon pressure; the skin covering it loses its natural whiteness and softness, becomes hard, and acquires an inflamed redness; and with the tears a mixture of something, which in colour resembles matter, is discharged, especially if the pressure be made with any force, or continued for any time.

When the parts are in this state, the contents of the bag have so much the appearance of purulent matter, that they are now generally considered as such, though Mr Pott and several others have been of a different opinion, considering the fluid as merely mucus under a different form; allowing, however, that pus is sometimes discharged. If the puncta lachrymalia be naturally large and open, and the inflammation confined to the surface of the sac, its contents will pass off pretty freely, and the skin will remain entire.

221 In its advanced state.

But when the skin covering the lachrymal bag has been for some time inflamed, or subject to frequently returning inflammations, it most commonly happens that the puncta lachrymalia are affected by it, and the fluid, not having an opportunity of passing off through them, distends the inflamed skin; so that at last it becomes sloughy, bursts externally, and forms an opening in the most prominent part of the tumor, at which the tears and matter contained in it are discharged. When the opening thus formed is small, it commonly heals again in a few days, but it bursts as soon as a considerable quantity of this fluid is collected; and it continues thus to collect and burst alternately, till the opening becomes sufficiently large to prevent any farther collection. This state of the disorder exhibits exactly the appearances of a sinuous ulcer, with callous, and sometimes with retorted edges; and this stage forms properly the real fistula lachrymalis. Tears, mucus, and purulent matter, are now abundantly discharged from the sore. When the bone beneath is sound, this discharge is seldom either acrid or offensive to the smell, for the opening being in general in the under part of the tumor, the matter is readily evacuated; but when any of the contiguous bones are carious, they are not only found to be so by the introduction of a probe, but by the appearance, smell, and effects of the matter upon the neighbouring parts. In this case it is thin, fetid, and commonly so acrid as to fret and corrode the integuments most contiguous to the ulcer; and when the disorder is connected with scrophula or with lues venerea, which is by no means an unfrequent occurrence, the discharge and appearance of the sore will vary according as it happens to be combined with one or other of these diseases.

222 The disease divided into four stages.

From what has been said, we may divide this disease into four general heads or states, under which all its more minute distinctions may be comprehended. The first consists in a simple dilatation of the sacculus and obstruction of the nasal duct, discharging, upon pressure, a fluid either quite clear or a little cloudy; the skin covering the bag being entire and perfectly free from inflammation. In the second, the tumor is somewhat larger; the skin which covers it is in an inflamed state, but entire; and the discharge made through the puncta lachrymalia is of a pale yellow or purulent colour. In the third, the skin covering the sacculus is become sloughy, and bursts; by which means the swelling is in some measure lessened: but the matter which, while the skin was entire, used to be pressed out through the puncta lachrymalia, now discharges itself through the new aperture. The ductus ad nares, both in this and the preceding state, are not otherwise diseased than by the thickening of its lining. In the fourth, the passage from the sacculus lachrymalis into the nose is totally obliterated, the inside of the former being either ulcerated or filled up with a fungus, and attended sometimes with a caries of the bone underneath.

223 Treatment during first stage.

In the first and most simple state of the disease, viz. that of mere obstruction without inflammation, much pains have been taken to restore the parts to their natural state and use, without making any wound or division at all. The introduction of a probe, the injection of astringent fluids, and a constant compression made on the outside of the sacculus in the corner of the eye, are the principal means by which this has been attempted.

224 M. Anel's probe and syringe.

Several years ago, M. Anel made a probe (fig. 37.) of so small a size as to be capable of passing from the eyelid into the nose, being introduced at one of the puncta lachrymalia, and passing through the sacculus and duct; with which probe he proposed to break through any small obstruction which might be found in its passage. He also invented a syringe (fig. 38.), the pipe of which is small enough to enter one of the puncta, and thus furnishes an opportunity of injecting a liquor into the sacculus and duct; and with these two instruments he pretended to be able to cure the disease whenever it consisted in obstruction merely, and the discharge was not much discoloured. The first of these, viz. the passage of a small probe through the puncta, has a plausible appearance; but will, upon trial, be found very unequal to the task assigned: the very small size of it, its necessary flexibility, and the very little resistance it is capable of making, are manifest deficiencies in the instru-

22[5] Of little use.

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ment; the quick sensation in the lining of the sac and duct, and its diseased state, are great objections on the side of the parts, supposing it were capable of answering any valuable end, which it most certainly is not.

That the passing a fine probe from one of the puncta lachrymalia into the nose is very practicable, is known from experience; but the pain it gives, and the inflammation it often excites, are much greater than any benefit which does or can arise from it. It is said that the principal use of this probe is to clear the little ducts leading from the puncta into the sacculus, and the obstruction of those ducts is often mentioned as a part of this disease. Hence one would be led to suppose that it was a circumstance which frequently occurred; whereas it is seldom, if ever, met with. Nor, even if it did happen, could it ever produce the disease in question; the principal characteristic of which is a discharge into the inner corner of the eye upon pressure made in the angle.

The syringe, if used judiciously while the disease is recent, the sac very little dilated, and the mucus perfectly clear, will sometimes be found serviceable; it gives no pain; and a few trials render the use of it by no means troublesome. There is very little occasion, however, to take much trouble, or to put the patient to so much uneasiness; for if the sac be emptied by compression, if the liquor which was to have been injected be applied to the puncta, they will absorb it as readily as the fluid which naturally passes through them.

.6 Fabricius ab Aquapendente invented an instrument, which was so contrived as by means of a screw to make a pressure externally on the lachrymal bag; from the use of which, he says, his patients received much benefit. This instrument has been considerably improved by late practitioners, and is still recommended as very useful. See fig. 39.

All the good that can be obtained by compress and bandage, this screw is capable of procuring; but it is also subject to all the same inconveniences, arising from the impossibility of determining exactly the due degree of pressure: for if it be so great as to bring the sides of the upper part of the sac into contact, all communication between it and the puncta will be thereby stopped; if it be but slight, the accumulation will not be prevented; nor does it in either case contribute to the removal of the obstruction in the nasal duct, the primary and original cause of the disease. If the curative intention was to procure an union of the sides of the sacculus, as in the case of parts separated from each other by the formation of matter or sloughs, and the pressure could be made uniformly and constantly, possibly it might be so managed as to answer a valuable purpose; but as that is not the intention, the pressure, whether made by an instrument or by a common roller and compress, contributes little or nothing toward a cure.

When the disease is only beginning to form, if the lachrymal sac be frequently pressed with the finger, the contents of it will be discharged before they become acrid, and the complaint, though seldom to be cured in this manner, may be sometimes endured without any other assistance.

27 But when the disease has advanced so far as to be in a state of inflammation, considerable relief may be obtained from such remedies as are found to be useful in inflammatory affections of other parts of the body, as blood-letting, laxatives, and low diet, together with saturnine applications to the parts affected. But when these fail, and it is found that the passage of the tears to the nose is completely obstructed, as the matter, if it does not burst outwardly, may be in danger of corroding the bone underneath, a different practice is to be followed.

In this state, an opening in the upper part of the sacculus lachrymalis becomes in general absolutely necessary; and as a wound made by a knife leaves a much less disagreeable scar than that which necessarily follows the bursting of the skin, one being a mere simple division, the other a loss of substance; it will always be found best to anticipate the accident of bursting, by making the opening as soon as the integuments are in such a state as to threaten it.

For making this incision, authors have been very particular in their directions with regard to its place, manner, and form. But all that the surgeon need observe is, to take care to keep the knife at a proper distance from the juncture of the palpebræ, to begin the incision a very little above a line drawn from that juncture toward the nose, and to continue it downward so as to lay the sac completely open; and the best instrument to make it with is a scalpel of the common form, but of a small size. If the sacculus be already burst, the place of opening is determined; and the orifice may be enlarged with a knife, or dilated.

The incision being made, the contents of the tumor should be moderately pressed out; after which, some practitioners advise that the nasal duct should be searched for by means of a probe; and if found, that a piece of catgut, bougie, or lead, should be introduced, and kept there, its edge being bent a little downwards till the sides of the duct are skinned over and healed. In the mean time, the sore is to be dressed with simple pledgets of wax and oil, which are to be retained by means of adhesive plaster. As soon as the passage of the tears into the nose is sufficiently secured, the substance which has been left in it is to be withdrawn, and the wound healed.

The last state of this disorder is that in which the natural passage from the sacculus to the nose is so diseased as to be quite obliterated, or in which the bones are sometimes found to be carious. The methods hitherto described have all been calculated to preserve the natural passage, and to drive the lachrymal fluid again through it. In this attempt they are sometimes successful; but when every trial for discovering the nasal duct has been unsuccessful, recourse must be had to an artificial opening for the tears. In performing this part of the operation, the patient should be seated opposite to a window, with his head supported by an assistant. The surgeon is to place himself immediately before him, either in a sitting or standing posture. The canula of the trocar (fig. 40.) is now to be introduced to the under and back part of the lachrymal sac, and held with one hand, while the stilette is to be passed into it by the other, in a direction obliquely downwards and inwards, between the two spongy bones, till it reach the cavity of the nose, which will be known by some bloody mucus passing out at the nostril. As soon as the instrument has penetrated the nose, the opening should be made sufficiently large; then the stilette should be withdrawn, and a bit of catgut or bougie, or what is more cleanly and convenient, a leaden probe, is to be introduced, and the canula removed. One end of the probe ought to remain in the nose, and the other bent in such a way as to hang over the edge of the wound, and at the same time be in no danger of coming out. The sore is now to be covered with a pledget of lint spread with emollient ointment, and the whole retained with adhesive plaster. The probe must be removed every day or two, so as to allow it and the passage to be cleaned; and at each dressing some astringent injection should be thrown in, when the parts are to be dressed as at first. Several weeks will commonly be necessary for rendering the passage perfectly callous; but this must depend much upon the state of the parts, as well as the constitution of the patient.

After the passage is become sufficiently callous, the dressings and probe are to be withdrawn, and the parts cleared from any mucus with which they may be stuffed. The

sides

Fistula Lachrymalis.

sides of the wound, now already sufficiently contracted, are to be laid together, and covered with some adhesive plaster. If this be ineffectual, the wound is to be touched with caustic, when the cure will generally be quickly completed. To give tone to the parts, moderate pressure should frequently be made upon the sac, either by the patient's finger or by the machine already mentioned, and this should be continued for a considerable time. Sometimes the disease returns after a cure has been made, owing to diseases of the constitution, carious bone contiguous to the sore, or sometimes to too small an opening having been formed. In this case a canula of gold, silver, or lead, is sometimes introduced into the artificial passage, and the skin healed over it; by which means the passage will afterwards remain completely open, and no disease of the constitution can ever affect it. We shall describe Mr Pellier's method of performing this operation, who has made several improvements on it.

230 Mr Pellier's method of performing this operation.

The patient is to be seated, and his head properly supported by an assistant; then the sac is to be laid freely open at its inferior part; the nasal duct is to be searched for with a firm probe, or with a conductor (fig. 41.) made for the purpose; and Pellier asserts that he never fails in finding it. As soon as this is discovered, a conical tube (fig. 42.), with a projection at the top, and another in the middle for securing it in its place, must be put upon the conductor, previously furnished with a compressor (fig. 43.), and it should be of such a size that the conductor may fit it exactly. The point of the conductor is now to be passed into the lachrymal duct; and being pushed in till it reaches the nostril, which may be known either by inserting a probe into it, or by a few drops of blood falling from the nose, the conductor is to be withdrawn; leaving the compressor upon the brim of the canula, which must be firmly pressed down with the left hand, while the conductor is removed with the other. This being done, the compressor must next be taken out; and to discover whether the canula be at a proper depth, a little milk or water should be injected thro' it. If the injection pass, it will show that the canula is properly placed. If, on the contrary, any obstruction occur, there will be reason to suspect that it is already pushed too far, and that it presses against the os spongiosum inferius; in which case the canula must be withdrawn, shortened, and reintroduced as before.

The sore ought to be kept open for eight or ten days after the operation with soft lint spread with emollient ointment, and the whole covered with a compress of soft linen secured with a bandage. An injection of milk and water should be daily passed through the canula; and as soon as the sore looks clean and healthy, the dressings should be entirely removed, and a piece of court plaster laid over it. In this state it is to be left to heal; but the plaster must be renewed, if matter appear to form beneath it. By this method Mr Pellier finds, that fistula lachrymalis, not depending upon diseases of the contiguous bones or of the constitution, may commonly be completely cured in two or three weeks, which, by the usual practice, might require several months.

Chap. XV. *Of Affections of the Nose.*

Sect. I. *Of Hemorrhagies from the Nose.*

When the means mentioned for this complaint in the article Medicine have failed, recourse must be had to compression. Dossils of lint introduced into the nostrils are sometimes effectual; or the gut of some small animal, tied at one end, then introduced by a probe into the nose as far as the pharinx, and filled with cold water, or that and vinegar, and secured by a ligature, by adapting itself to all the parts, and pressing equally on them, has been attended with advantage. When these remedies likewise fail in their effect, a piece of catgut or wire may be introduced through the nose into the throat, and brought out at the mouth; a piece of sponge, or a bolster of lint of a size sufficient to fill the back-part of the nostril, is then to be fixed to it; the sponge is next to be drawn back and properly applied. Another is to be applied to the anterior part of the nostril and secured. The same may be done to the other nostril, if it be necessary; or the sponge may be of such a size as to fill the ends of both nostrils at the same time. By this contrivance the blood not finding an outlet, will soon coagulate, and prevent any farther evacuation.

Affections of the Nose.

Sect. II. *Of Ozæna.*

By this is understood an ulceration within the nose, which may be occasioned by external violence, by exposure to cold, by irritating substances, or by whatever produces inflammation in the membrane lining the nostrils. Sometimes it arises from venereal infection; and in this case the discharge becomes so acrid as to corrode, and produce caries in the bones of the nose. When the disease is local, and not depending upon any constitutional affection, astringent solutions are found to be the most useful, such as a decoction of bark or that mixed with alum. Dossils of lint dipped in these are to be introduced into the nostrils three or four times a-day, or some prefer the injection of such fluids by means of a syringe as being more effectual. If stronger astringents be necessary, a solution of styptic powder ought to be used. At bed-time an ointment prepared with zinc or with lapis calaminaris ought likewise to be applied. Upon some occasions the application of a blister to the temple has cured the disease.

Instances, however, occur, where the discharge is occasioned by a collection of matter within the antrum maxillare; and then it is apt to resist every effort till a proper outlet be given to it.

When the complaint is owing to venereal infection, the primary disease is to be attended to, and mercurial preparations are to be applied to the part; but when the bones are carious, till these are removed we need neither expect that the discharge will cease, nor the disease be otherwise completely cured.

Sect. III. *Of Imperforated Nostrils.*

Sometimes the nostrils are in part or entirely obliterated. This may be owing to burns; small-pox; different kinds of sores, especially those of a venereal nature; and sometimes it is the effect of original conformation, for it has been observed in new-born children.

When any opening appears in the obstructed nostril, it may be readily dilated by the introduction of a furrowed probe, and then cutting upon it in the course of the adhesion: but when no passage appears, the operator must endeavour, by means of a scalpel, to discover one of the nostrils; and when discovered, it must be enlarged by a director and bistoury, as in the former case. The other nostril is to be treated in the same manner. After the openings are formed, they might be preserved of a proper size by the introduction of dossils of lint, which should be frequently cleaned or renewed; but metallic tubes answer the purpose better, and allow the patient to breathe freely through them till a cure be performed. Previous to their introduction, they ought to be covered with soft leather spread with emollient ointment, and retained till the sores are completely healed.

CHAP. XVI. *Of Affections of the Mouth and Throat.*

SECT. I. *Of the Division of the Parotid Duct.*

WHEN the parotid duct is divided, the faliva which it tranfmits paffes over the cheek inftead of going into the cavity of the mouth.

When the furgeon is called to a recent divifion of the duct, he ought to lay the divided ends of it as exactly together as poffible, and to retain them in their fituation till they are united by adhefive plafters, or by the twifted future if there be confiderable retraction of the parts. But when the portion of the duct next the mouth is entirely obliterated, an artificial paffage muft be made into the mouth, and an union formed between the opening and that part of the duct which proceeds from the parotid gland. The artificial paffage ought to be as much as poffible in the direction of the natural duct. For this purpofe a perforation of a proper fize is to be made obliquely into the mouth with the trocar (fig. 44.), from the fide of the wound exactly oppofite and contiguous to the under extremity of the upper portion of the duct; and then a piece of leaden probe of the fize of the perforator fhould be introduced by means of the canula, and be kept in the cheek till the fides of the opening become callous; when the lead being withdrawn, the extremities of the artificial and natural ducts are to be brought into contact, and retained there by adhefive plafter till the cure is completed. Another method has, in a few inftances, been followed by Mr Latta (fee his *Syftem of Surgery)*, of introducing one end of a bit of catgut into the artificial opening, and bringing it out at the mouth, while the other is introduced a little way into the extremity of the natural duct, and retained by adhefive plafter till the wound is healed. Whichever way the operation is done, the patient fhould live upon fpoon-meat, and make as little motion as poffible with his lips or jaws.

SECT. II. *Of the Hare-lip.*

THE hare-lip is a fiffure in the upper lip, very feldom in the under one. It is attended with want of fubftance, and has its name from a refemblance to the lip of a hare. In general it is only a fimple fiffure, though fometimes it is double; in which cafe it renders a cure more difficult to be executed. There are many lips where the want of fubftance is fo great, that the edges of the fiffure cannot be brought together, or at leaft where they can but juft touch, and then the attempt fhould be forborne. It is likewife improper in infants, and ought not to be performed till feveral months after they have been weaned, when they will have acquired more ftrength to undergo the operation, and will be lefs liable to be attacked with bowel complaints, which frequently make them cry at an earlier period of infancy.

In proceeding to the operation, the patient, if a child, fhould be fecured upon a perfon's knee, or rather perhaps upon a table; but if an adult, he is to be feated upon a chair, in a proper light. The frænum connecting the gums to the upper lip is to be divided; if a fore-tooth project fo much as to prevent the parts from being brought properly together, it is to be extracted; or when the fiffure runs through the bones of the palate, if a fmall portion of the bone project, this muft be removed. Matters being fo far adjufted, the operator is to lay hold of one fide of the fiffure between the thumb and fore-finger, or between the forceps (fig. 45.), then with a pair of fharp and very ftrong fciffars (fig. 46.), or with a fcalpel, to cut off a thin portion of the lip, and to repeat the fame thing upon the other fide of the fiffure, fo as to render the whole edges of the fiffure completely raw; by which, if the operation be properly performed, a piece will be feparated in form like an inverted V. After the incifions have been made, the veffels fhould be allowed to bleed freely to prevent inflammation; and when the bleeding has ceafed, the fides of the wound are to be brought accurately together, and kept in that ftate by the twifted future. The firft pin ought to be as near as poffible to the under edge of the lip; another is to be inferted near the upper angle; and if the patient be an adult, a third pin will generally be neceffary, half way between the other two. In paffing them, they ought to go rather deeper than half through the lip, that the edges of the wound may be kept properly in contact. An affiftant now keeps the parts together, while the operator applies a firm waxed ligature firft to the under pin; and having made three or four turns with it in the form of an eight figure (fig. 47.), it fhould then be carried about the fecond, and in a fimilar way about the third, care being taken that the thread be drawn of a proper tightnefs. After the ligature is fecured, a piece of lint, covered with fome mucilage, fhould be laid over the wound to protect it from the air; and this is commonly all the bandage neceffary. When, however, from a great want of fubftance, the retraction has been confiderable, fome advantage is derived from the ufe of adhefive plafters applied to the cheeks and tied between the pins. During the time of the cure the patient fhould be fed upon fpoon-meat, and prevented from making any exertion with the lips, otherwife the cure might be confiderably retarded. At the end of five or fix days the pins may be taken out, when the parts will commonly be found completely united.

Affections of the Mouth and Throat.

In the cafe of a double hare-lip, the operation fhould be firft done upon one fiffure; and when a cure is completed there, it may be done fafely upon the other.

SECT. III. *Of Extirpation of Cancerous Lips.*

THE under lip is much more frequently attacked with cancer than the upper, or indeed than any other part of the body: And as little dependence is to be placed upon external applications or internal remedies, recourfe muft be had to the knife as the only certain method of cure.

When the difeafe has not attacked any confiderable part of the lip, the difeafed part is to be cut out, and the wound cured by the twifted future. The operation ought therefore to be performed early, to allow the parts to be brought properly together. The general fteps of the operation are nearly the fame as in the operation for hare-lip, and therefore need not be repeated. It is only to be obferved, that all the difeafed parts are to be removed, taking care to make the cut in fuch a way as will moft readily admit of the twifted or hare-lip future. When the parts can be brought together, the lip will have nearly the fame appearance as in the operation for hare-lip; but when the difeafe fpreads over a confiderable part of the lip, fo as to prevent the found parts from being united after the difeafed parts have been removed, all that can be done is to remove the part affected, fecure the bleeding veffels, and drefs the fore like any other recent wound.

SECT. IV. *Of Affections of the Teeth.*

232 Dentition.

IN dentition the gums inflame and fwell about the parts where the teeth are afterwards to appear; the child is continually rubbing the gums with its finger; the faliva is commonly increafed in quantity, though fometimes the contrary happens; fometimes the bowels are remarkably coftive, tho' more frequently the reverfe: there is generally quick pulfe, with heat, and other fymptoms of fever; and on fome occafions thefe fymptoms are attended with convulfions. The means found to be moft ufeful here are fuch as

are

Affections of the Teeth. are most effectual in allaying irritation; as opiates, blisters, and especially warm bathing. When these fail, cutting the gum by means of a fleme (fig. 48), over the approaching tooth, is frequently found to remove every symptom; but this ought to be done earlier than it commonly is to have the full effect. Whenever the symptoms give reason to think that a tooth is approaching, the gums should be cut freely over that part where the teeth may be first expected. When the symptoms recur, the operation should be repeated. A crucial incision is attended with still more effect; and the bleeding which afterwards takes place is of considerable service. The incision should always be carried as far as the tooth, which ought to be somewhat exposed; and when properly done, is frequently followed with immediate relief. Sometimes the same kind of symptoms attend the cutting of the second set, particularly of the dentes sapientiæ. When this is owing to the thickness of the gums, scarifying gives the greatest relief; but sometimes it is for want of room in the jaw, and then the tooth should be drawn.

233 Derangement of the teeth. Derangement of the teeth happens more frequently in the second than in the first set, and more commonly in the fore than in the back teeth. This may be owing to the first set remaining in the jaw after the second have appeared. Another cause is a waste of space in the jaw; and a third is a mal-conformation of the teeth, where they are too large in proportion to the jaw, and therefore overlope each other. The remedy is the same in each of these cases, viz. to extract the teeth which stand in the way of the rest, to allow those which are out of their place to come into the row, and put on a more uniform appearance.

The usual method of moving teeth which are out of the row is, by fixing them with a ligature to the nearest teeth; or the same thing is done by metalline plates or pieces of wire. But these methods have not been found fully to answer the purpose intended, though in some cases they may be useful. When one or more front teeth are accidentally drawn out of the jaw, they ought to be immediately replaced. When the teeth are broken over or otherwise injured, they may be supplied with others transplanted from the jaws of another person; but this can only be done when the sockets have been newly emptied, for after inflammation comes on it is impracticable. In these cases the inflammation must be allowed to subside, and then artificial teeth can be readily adapted.

234 Of loose teeth. When the teeth are loosened by external violence, by falls and blows, or by improper use of instruments in pulling diseased teeth in the neighbourhood of sound ones, they may again be made tolerably fast by pressing them as firmly as possible into their sockets and preserving them so with ligatures of catgut, Indian weed, or waxed silk, and keeping the patient upon spoon-meat till they are firm. When loose teeth are owing to tartar, nothing will fasten them till the cause be removed; and this ought to be done early, otherwise it will have no effect. Frequently the teeth become loose from a sponginess in the gums, often, but improperly, attributed to scurvy. The best remedy is scarifying the gums deeply, and allowing them to bleed freely; this should be repeated till they are fully fastened. Mild astringents, as tincture of bark, are here attended with good effects, tho' those of a strong nature will certainly do harm. The mouth should be frequently washed with cold water strongly impregnated with these, and the patient should not use the teeth which have been loose till they become firm again. The loosening of the teeth in old age cannot be remedied, as it is owing to a wasting of their sockets, from which the teeth lose their support.

The teeth sometimes become yellow or black without any adventitious matter being observed in them; at other times they become foul, and give a taint to the breath, in consequence of the natural mucus of the mouth, or part of the food remaining too long about them. The most frequent cause of foul teeth is the substance called *tartar*, which seems to be a deposition from the saliva, and with which the teeth are often almost entirely incrusted. When this substance is allowed to remain, it insinuates itself between the gums and the teeth, and then gets down upon the jaw in such a manner as frequently to loosen the teeth. This indeed is by far the most common cause of loose teeth, and when they have been long covered with this or with any other matter, it is seldom they can be cleaned without the assistance of instruments. But when once they are cleaned, they may generally be kept so by rubbing them with a thin piece of soft wood made into a kind of brush, and dipped into white-wine vinegar; after which the mouth is to be washed with common water.

When the teeth are to be cleaned by instruments, the operator ought, with a linen cloth or with a glove, to press against the points of the teeth, so as to keep them firm in their sockets, with the fingers of the one hand, while he cleans them with the necessary instruments, fig. 51. n° 1, 2, 3, 4, 5, held in the other; taking care not to scrape them so hard as to loosen them, or to rub off the enamel. This being done, the teeth should be rubbed over with a small brush, or a piece of sponge dipped in a mixture of cream of tartar and Peruvian bark. The same application may be made to the teeth for a few days, after which they may be kept clean as already directed.

The teeth are sometimes covered over with a thin dark coloured scurf, which has by some been mistaken for a wasting of the enamel, but which is only an extraneous matter covering it. By perseverance this may be cleaned off as completely as where the teeth are covered with tartar; but it is apt, after some time, to appear again. When this is observed, the same operation must be repeated.

For the purpose of applying powders or washes to the teeth, a brush or a sponge is commonly employed; the latter is certainly preferable, as being less in danger of wearing down the enamel, or of separating the teeth.

The causes producing toothach may be, exposure of the nerve of a tooth, by breaking or wasting of the enamel, inflammation in or about the tooth, or from sympathy when distant parts are affected, as the eye, the ear, the stomach, or the uterus, as in time of gestation. After toothach has once been produced and removed, it is apt to return by exposure to cold, by taking hot liquids, by hard bodies pressed against the nerve in the time of chewing, by the use of a pick-tooth, &c.

With respect to the cure of this disease, no rule can be laid down which will answer with certainty upon all occasions. No remedy has yet been discovered which will at all times even moderate the pain; relief, however, is frequently obtained from acrid substances applied to the tooth, so as to destroy the irritability of the nerves, such as opium, spirit of wine, camphire, and essential aromatic oils. When these fail, blisters behind the ear, or destroying the nerve by the cautious use of strong acids, or by a red hot wire frequently applied to the part, have been attended with advantage.

When a black or mortified spot appears on a tooth, if it be quite superficial, it may be removed; but if it go through the thickness of the enamel, it will be more adviseable to let it remain.

When a small hole breaks out in a tooth, particular attention should be paid to prevent the admission of air. Tin, lead, or gold-leaf, commonly employed for this purpose, sometimes give relief for many months, or even years; but at

at other times are of little advantage, and in some instances create great pain. Gum-mastich or bees-wax are frequently employed, and can be made to fill the cavity of the tooth still better than metalline substances. When stuffing is to be employed, it ought to be done in the intervals of the fits of toothach, otherwise it will give great uneasiness. When it is to be used, the whole cavity of the tooth should be filled; and this is to be done with the instruments, fig. 52. n° 1, 2, 3.

When the remedies made use of for the removal of toothach have failed in their effect, and it is found that the complaint still continues, it will be necessary to extract the tooth. In doing this, it may be observed, that all the teeth may be pulled to either side, excepting the dentes sapientiæ of the lower jaw, which ought to be pulled outwards, otherwise the jaw may be splintered. As soon as the socket is cleared of blood, if the tooth be not much spoiled, it may be immediately replaced, when it will become as useful as before. It is difficult, however, to replace the large grinders, on account of their diverging roots. The more perpendicularly the teeth are pulled, the less contusion and injury will be done to the jaws and alveoli. But as no instrument has been yet invented capable of effecting this properly, surgeons are obliged to be contented with an instrument which acts in a lateral direction. One of the best is that (fig. 53.) in form of a key, with a claw and fulcrum. Previous to the operation, this should be covered with a linen rag, to prevent the gum from suffering. After dividing the gum, or separating it from the tooth, the claw is to be fixed as deep between the teeth and gum as possible. Then the fulcrum is to be applied on the opposite side. The surgeon may now, with one turn of the handle of the instument, pull the tooth out at once. But the turn should not be effected by a sudden jerk, but in the most cautious and slow manner. When it happens to be one of the great molares, whose roots diverge very much, and when they are firmly fixed, after only loosing it with the first pull, the claw of the instrument is to be applied to the other side of the tooth, and the turn given in a contrary direction to the first. After it has been sufficiently loosened in this manner, it is to be laid hold of by a common teeth forceps (fig. 54.), and extracted in the easiest manner. Upon extraction of the tooth, any detached splinters occurring are to be immediately removed. Should any considerable hemorrhagy take place, the patient may take some cold water, vinegar, or spirit of wine into his mouth, and dossils of lint may be introduced into the socket. After all these fail, recourse must be had to the actual cautery.

When stumps occur from caries, or when the teeth have broken in time of the extracting, the common key will sometimes remove them; if that fail, the punch (fig. 55.) is to be used. The operator, having this instrument in one hand, is to place the fore finger of the other, with a piece of cloth wrapped round it, upon the inside of the jaw opposite to the stump, to protect the neighbouring parts.

Teeth can never be transplanted with propriety in childhood or in old age. The constitution must be free from those diseases which affect the gums. The tooth to be transplanted must be taken from a person of a sound constitution, otherwise it will convey infection. To guard as much as possible against infection, it should be immersed for a few minutes in lukewarm water, and then well dried and cleaned. It ought to fit the socket exactly; if it be too large, it may be filed down, avoiding the enamel as much as possible. The surface of it should be at first on a level with the rest, or rather a little more depressed, that it may be as secure as possible in its place. If the tooth fit the socket properly, there will be no occasion for using a ligature to fix it; but if a ligature be found necessary, it may be made of threads of fine silk properly waxed. After the operation is finished, the patient ought to avoid whatever may be in danger of shaking the tooth, and this is to be attended to till the tooth is perfectly firm. He should also guard against cold and moist air, and live upon spoon-meat.

Boils and Excrescences of the Gums.

Sect. V. *Of Boils and Excrescences of the Gums.*

240 Of gum boils.

Gum boils may arise from cold or from external violence, &c. but most frequently they are the consequence of toothach. The complaint begins with pain attending a tumor on the parts affected; by degrees the side of the face swells considerably; the tumor of the gum now begins to point; and if it be not opened, it bursts and gives the patient immediate relief. When the boil is owing merely to inflammation, after the matter is evacuated, the complaint goes off; but when it proceeds from a caries of a tooth, it will continue as long as the cause remains; the tooth therefore ought to be extracted. After the abscess has burst, if the matter continue to be discharged, it may sometimes be dried up by injecting some astringent liquor; but the most effectual method is to lay the abscess fully open, and to heal it from the bottom by dossils of lint. Sometimes abscesses occur of a more obstinate nature, owing to a carious state of the jaw. In that case suppuration ought to be promoted, and the part laid open as soon as matter is formed; keeping the passage open for the discharge, being the only means for effecting a cure.

241 Excrescences of the gums.

Excrescences of various degrees of firmness sometimes grow upon the gums. Some are soft and fungous, while others are of a warty nature. In general they are not attended with pain. They frequently originate from caries of the teeth, or of their sockets; in which case the removal of the spoiled teeth, and the subsequent exfoliation of the carious part of the jaw, will often accomplish a cure. But when this does not happen, the tumor should be removed as soon as it becomes troublesome, otherwise there may be danger of its ending in cancer. The removal may be effected by a ligature or knife, according as the tumor may have a narrow or broad basis. It is sometimes necessary to use a speculum oris to keep the mouth open. After the tumor is extirpated, the wound should be allowed to bleed freely, to prevent subsequent inflammation. When the hemorrhagy proceeds too far, it should be restrained by the application of spirit of wine, or tincture of myrrh, or solution of alum, &c. and should these prove unsuccessful, the lunar caustic will seldom fail of having the desired effect. No dressings can be applied; but for some days after the operation, the mouth should be frequently washed with a warm emollient decoction; and the cure will be afterwards promoted by the application of some gently astringent liquor, as port wine, tincture of roses, &c.

Sect. VI. *Of Abscesses, &c. in the Antrum Maxillare.*

This disease is known by a pain and uneasiness beginning in the cheek, and extending upwards to the eyes, nose, and ears, together with a swelling, which in the latter stages of the disease tends to a point, most frequently in the cheek. Sometimes a discharge ensues between the roots of the back-teeth, when they happen to penetrate the antrum. Sometimes a discharge of matter from the nostrils takes place, particularly when the patient lies on the side opposite to the tumor. The disease may arise from cold, or whatever produces inflammation in general; but the most common causes are violent fits of the toothach, occasioning excessive pain and inflammation of the membranes of the nose and antrum.

The cure is performed by giving a free discharge to the con-

Ranula.

Plate 488.

contents of the tumor: and this is done in two ways; either by extracting one of the two anterior great molares, which are situated under the antrum, and making a perforation with a round trocar (fig. 49.) through the bottom of the socket; if this has not been already perforated by the fangs of the tooth or eroded, in which case the matter will pass out immediately after the extraction: or the perforation may be made by the instrument represented in fig. 50. thro' that part of the antrum which projects outwardly over the molares. As most people wish to avoid the pulling of a tooth, when it does not appear to be absolutely necessary, the perforation is commonly made in the way last mentioned. Some authors, however, object to this, as not giving a sufficiently depending opening to the matter. As soon as the matter is discharged, a plug may be introduced into the perforation, which may be removed frequently to allow the matter to pass out, and to admit astringent solutions of bark, &c. to be occasionally thrown into the cavity of the antrum. In this way a cure is obtained, if the bones be sound; but if they are carious, it is impossible to expect a cure till the diseased portions of the bone exfoliate and be removed. When cloated blood is formed in the antrum, it is to be removed in the same manner. Sometimes the tumor of the cheek is owing to a swelling of the bones, and no matter is found in the antrum: In that case the operation does harm. No external application has yet been discovered for removing such a swelling, though a long continued course of mercury has been found to be of some service.

Sect. VII. *Of Ranula.*

This is a tumor under the tongue, most frequently owing to an obstruction in one of the salivary ducts. Sometimes it contains matter like the synovia of the joints, sometimes a fatty matter, now and then stony concretions, but most commonly a fluid like saliva. It often acquires such a size as to prevent sucking in infants, or mastication and speech in adults. When the person attempts to speak, he only makes a croaking noise: hence the name of the disease.

The best mode of treatment is to lay the tumor fully open by means of a scalpel or large lancet, to evacuate its contents completely, and then to wash the cavity with any mild fluid, as milk and water. If the sore be difficult to heal, tincture of bark or other astringents may be used. When the tumor is observed to be filled with a fatty or any other firm substance, it ought to be removed entirely. The only application necessary in the time of the cure, is the frequent injection of milk and water, or any other mild fluid, by means of a syringe.

Sect. VIII. *Ulcers within the Mouth.*

When ulcers of the mouth arise from a general affection of the system, this must be removed before a cure can be expected. When they originate from sharp points in the teeth, these are to be filed off, and some astringent solution taken occasionally into the mouth. Notwithstanding these and other remedies, the sores sometimes becomes worse, discharging a thin fetid sanies, attended with much pain, and putting on every appearance of cancer. In this situation, extirpation is the only thing that can effect a cure. If the sore be only superficial, it may pretty readily be extirpated; but when deep seated it may sometimes be necessary to cut through the whole substance of the cheek, and heal the sore by the hare-lip suture. When the tongue is the subject of operation, the operator ought to be ready to take up the bleeding vessels by the tenaculum or the needle. Along with ligature, it may be necessary to use astringent gargles, or a mixture of vitriolic acid in water. If these fail, the potential or even actual cautery must be used.

Sect. IX. *Division of Frænum Linguæ.*

Division of Frænum Linguæ.

Sometimes the frænum linguæ extends to the point of the tongue, and tying it down; whereas, in the natural state, it ends about one-fourth of an inch farther back. When this is the case, it is to be divided, guarding against wounding the neighbouring vessels, or the ends of the salivary ducts. The division may be made with a common scalpel, but still better with a pair of very sharp sciffars with blunt points.

The child being laid across the nurse's knee, the surgeon should open the mouth, and raise the tongue with the two first fingers of the one hand, while with the other he introduces the sciffars, and divides the frænum in the middle, and as far back as is necessary.

Sect. X. *Of Enlargement of the Tonsils and Uvula.*

Enlargement of the tonsils.

The tonsils sometimes grow so large and hard as to become incurable, and even to threaten suffocation. The tumors here have been commonly considered as to be of a scirrhous nature; but they are neither attended with shooting pain, nor are they apt to degenerate into cancer; neither do swellings return after the tonsils have been extirpated: hence they ought not to be removed till by their size they impede deglutition or respiration; but whenever they do this, they may be removed with safety. The only proper method of removing them is that by ligatures, which are not only void of danger, but seldom fail to perform a cure. If the base of the tonsil be smaller than the top, the ligature is to be used as for polypi in the throat; but however broad the base of it may be, much difficulty will seldom occur in fixing it, for the swelling is always very prominent. In diseases of this kind both tonsils are generally affected; but if the removal of one of them forms a sufficient passage for the food, the other may be allowed to remain. When, however, it is necessary to extirpate them both, the inflammatory symptoms produced by the extirpation of the first should be allowed to subside before any attempt be made to remove the other.

When the form of the tonsils happens to be conical, so that the ligature would be apt to slip over their extremities, Mr Chefelden has recommended a needle (fig. 56.), with an eye near the point: a double ligature being put into the eye, the instrument is to be pushed through the centre of the base of the tumor, and the ligature being laid hold of by a hook and pulled forwards, the instrument is to be withdrawn; then it is to be divided, and so tied that each part may surround one half of the tumor. This method however is scarcely ever found to be necessary.

And of the uvula.

Enlargements of the uvula, from inflammation or from other causes, may generally be removed by the frequent use of astringent gargles, as of strong infusions of red rose-leaves or of Peruvian bark. But when these fail, and the enlargement is so considerable as to give great uneasiness by impeding deglutition, irritating the throat, and so causing cough, retching, and vomiting, extirpation is the only thing upon which any dependence can be placed. Excision is the readiest method when the uvula is only elongated; but when the size is considerable, dangerous hemorrhagies sometimes attend this method; on which account a ligature is preferable. The operation may be readily performed by those of the common kind; some prefer the curved probe-pointed bistoury.

Extirpation of the uvula.

In performing the operation, the speculum oris (fig. 57.) is necessary to keep the mouth sufficiently open, and the uvula should be laid hold of by a pair of forceps or a small hook, so as to keep it firm, and prevent it from falling into the throat. After the operation, if the bleeding be considerable, it may be checked by astringent gargles, or by touch-

touching the part with lunar cauftic; but this will feldom be neceffary.

When a ligature is to be employed, it may be readily done according to the method recommended in the extirpation of polypi. A double canula with a ligature may be paffed through the nofe, or the ligature may be applied according to Chefelden's method in extirpation of the tonfils.

Sect. XI. *Of fcarifying and fomenting the Throat.*

In inflammatory affections of the throat, the means commonly employed are gargles, fomentations, fcarification, or top-bleeding. Gargles are ufeful for cleaning the fauces from thick mucus or other fordes; they may likewife be ufeful in cafes of ulceration. In relaxation of the parts, they are employed to advantage when made of aftringent materials. Fomentations may be of fome ufe when externally applied; but the fteam of water, &c. drawn into the throat, by means of Mudge's inhaler (fig. 58.), is preferable. Sometimes it is neceffary to draw blood from the part affected. Here recourfe may be had to fcarifying with a common lancet, the tongue being depreffed with a fpatula. It may be ftill more readily done by the fcarificator (fig. 59). After a fufficient number of punctures have been made, the flow of blood may be promoted by the patient's frequently applying warm water to the punctures. When abfcefs forms, notwithftanding the ufe of thefe remedies, the matter may be difcharged with the fcarificator already mentioned.

Chap. XVII. *Of Difeafes of the Ear, and Operations performed upon it.*

Sometimes a thin membrane is fpread over the mouth of the external paffage, while at other times a confiderable part of the paffage is filled up with a flefhy looking fubftance, occafioning deafnefs. When the firft circumftance occurs, the fkin is eafily divided by a fimple incifion, and the accretion of its fides may be prevented by a doffil of lint or a bit of bougie inferted between the edges of the wound, and daily cleaned and returned till the part be rendered callous.

When the other caufe is prefent, the incifion muft be continued confiderably deeper, till the refiftance be removed, or till the inftrument reach near to the membrane of the tympanum, when the operator fhould defift, left the membrane fhould be wounded; then the fame kind of treatment may be followed as in the former cafe. The proper time for performing the operation is when children ufually begin to fpeak; for previous to this the patient may be too weakly to bear it, and after this fpeech would be impeded.

Sometimes the meatus externus is entirely wanting in the temporal bone. For this an opening through the maftoid procefs has been propofed; but the operation has not been performed, at leaft in this country.

Children fometimes pufh hard bodies into their ear, or different kinds of infects occafionally creep into it, fo as to caufe confiderable uneafinefs. Subftances lying near the outer end of the paffage may generally be extracted by the fmall forceps reprefented in (fig. 60.); but round, hard bodies fituated deeper in the paffage are more readily removed by a crooked probe. When infects are deep feated in the ear, they ought firft to be killed, by filling the paffage with oil, or any other fluid which proves noxious to them, without hurting the tympanum. They may then be wafhed out by injecting warm water frequently by means of a fyringe.

Wax is one of the moft frequent caufes of deafnefs, and it may be readily detected by looking into the ear in a clear funfhine.

Difeafes of the Ear.

247 Of fuperabundance of wax in the ear.

Various methods have been propofed for removing wax from the ear; but one, not inferior to any, is to throw in frequently, by means of a fyringe (fig. 61.), warm milk and water, or water in which a little foap has been diffolved. Affiftance may likewife be given here, by ufing along with the injection a blunt probe or fine hair pencil, by which the bottom of the paffage may be cleared out. After the wax is removed, the patient ought to guard againft the effects of cold by introducing a little wool for fome time into the meatus.

248 Deficiency of wax.

When deafnefs is owing to a deficiency of wax in the ear, a little oil of almonds, or even oils of a hotter nature, or foap, or galbanum &c. have been of fervice.

249 A difcharge of matter from the ear.

Purulent matter is now and then formed in the ears of adults, but oftener in thofe of children. Sometimes it is produced by ulcers fituated in the lining of the meatus, or upon the membrane of the tympanum. It feems to be merely a local affection, and does not, as many have fuppofed, originate from morbid humours of the fyftem. The remedies beft calculated for removing it are fuch as are of a moderately aftringent nature, as a weak folution of faccharum faturni. A little of this may be dropped in two or three times a-day, but it is ftill better to ufe a fyringe. If the difcharge has continued long, it may be proper, in addition to the other applications, to keep open a fmall blifter for fome time in the neck, arm, or wherever it may be thought moft convenient.

It fometimes happens, particularly in old people, that, from expofure to a ftream of cold air, the tympanum becomes affected, and a noife is heard by the patient like the rufhing of water. In other cafes the patient is incapable of accurately diftinguifhing the words of fome perfons fpeaking in a loud tone of voice; or, in mixed companies, he hears only a confufion of founds. Complaints of this kind frequently originate from a relaxation of the foft parts of the tympanum; and though a complete cure is not very frequently performed, yet confiderable advantage is fometimes derived from the ufe of hot ftimulating oils, and from keeping the part warm at the fame time with a little wool. When deafnefs arifes from affections of this nature, fome affiftance may be derived from collecting the found, fo as to make a ftronger impreffion upon the internal ear. A variety of inftruments have been invented for this purpofe. Some ufe a convoluted tube as is reprefented in fig. 62, (fee Trumpet); others a fort of cup, fig. 63. which is concealed under the hair, and fixed to the head with ftraps.

In fcrophulous habits, fuppurations fometimes occur in the neighbourhood of the ear, and penetrate into the external paffage, or into the tympanum itfelf; after which it is not unufual for the fmall bones of the ear to lofe their connecting membrane, and to be difcharged along with the matter, and for caries to enfue in the tympanum; in confequence of which a high degree of deafnefs is produced, which can never be removed. In fuch a fituation little elfe can be attempted than to preferve the parts clean and free from fmell, which is readily done by injecting a little warm milk and water morning and evening by means of a fyringe. If this be neglected, the matter from the carious bones is apt to become offenfive; and it commonly continues till the difeafed parts are either diffolved and difcharged, or probably during the life of the patient.

250 Affections of the Euftachian tube.

Befides the affections which may arife in the meatus externus, and may be the caufe of deafnefs, others may occur in or about the meatus internus or euftachian tube, which may have in part the fame effect, though by no means in the fame degree. Inflammation and its confequences may originate

The Wry Neck. originate in the cavity of the tube, or swellings or ulcers in the throat may affect it so as to cause some degree of deafness. When this is the case, it is practicable to introduce a pipe, fig. 64. crooked at the extremity, through the mouth or nose, and then to inject into the mouth of the eustachian tube any mild fluid which may be thought fittest for the purpose, though no great dependence is to be placed upon the attempt.

251 Of perforating the lobes of the ears. Formerly piercing the lobes of the ears was sometimes recommended in complaints of the head, and was considered as a chirurgical operation; but it is now never practised, unless for the sake of ornament. As the substances suspended at the ears are sometimes so heavy as to tear down the parts, the perforation should be made as high on the lobes as can be done with propriety, and care should be taken that the perforations be made exactly in the corresponding parts of the ears. Previous to the perforation the lobes may be marked with ink; then the patient being seated, the lobe of the ear should be stretched upon a piece of cork placed beneath it, and perforated with an instrument, fig. 65. The cork is then to be withdrawn with the point of the instrument sticking in it: A small piece of lead, or silver, or gold wire, is now to be inserted into that part of the instrument which remains in the ear, and on being drawn into the perforation, the wire is to be left in it. By rubbing it with oil, and moving it daily, the passage will soon become callous, and fit for receiving the ornament intended for it.

CHAP. XVIII. *Of the Wry Neck.*

252 Causes of wry neck. Wry neck may be owing to different causes; as contraction of the skin in consequence of burns, or other kinds of sores; relaxation of the muscles of one side of the neck, particularly the mastoid, while those of the other side continue to act with vigour; preternatural contraction of the muscles of one side of the neck, the others having their usual power; or, a bend in the vertebræ of the neck.

When the disease is owing to a contraction of the skin, this is to be divided through the whole of the contracted part, guarding against cutting the external jugular vein.

253 Treatment. When the contraction of the mastoid muscle is the cause of the disease, the muscle should be divided by gentle strokes, so as to run no risk of wounding the great vessels situated under it. When an incision is made either with a view to divide the muscle or the skin, the head is afterwards, by means of a machine (fig. 66.), to be kept in a proper posture during the cure, till new granulations form and fill up the empty space. When the disease is merely owing to a curve of the bones of the neck, the same kind of machinery may be useful with that recommended for cure in the other parts of the spine. But sometimes the disease arises from an affection of the bones of a more serious nature. Here the disease in the vertebræ commonly begins with a slight pain, which gradually becomes worse, and the head is turned over to the sound side. As the disease becomes worse, a fulness can be observed very painful to the touch; and moving the head becomes so difficult as to be almost impracticable. The only method which has been found to be effectual in this case, is the insertion of a pea-issue on each side of the tumor, and retaining it till the pain and fulness are entirely removed.

CHAP. XIX. *Of Bronchotomy and Oesophagotomy.*

254 Bronchotomy. The operation of bronchotomy is an incision made in the trachea, to make way for air into the lungs, when respiration is obstructed to such a degree that life is in danger. If the patient's breathing be already stopped, the operation ought to be done with the greatest expedition; using any instrument which will most readily make an opening in the trachea, as the delay of a few moments will often put a period to the person's existence. Experience has shown, indeed, that in by much the greater number of cases, by a total stoppage of respiration for only five or six minutes, life is irrecoverably destroyed.

In performing the operation, where, from the nature of the case, sufficient time is allowed, the patient is to be laid on his back upon a table, and properly secured by assistants. A longitudinal incision is to be made, about an inch and an half long, through the skin and cellular substance; beginning at the under edge of the thyroid cartilage; the sterno hyoid and thyroid muscles are then to be separated; the thyroid gland is to be avoided as much as possible, on account of its vascularity. As soon as the trachea is laid bare, the bleeding-vessels, to prevent coughing, are to be secured; then, with a common lancet, a puncture is to be made as high as may seem practicable between two rings of the trachea, of such a size as to admit the introduction of a double canula (fig. 67.), large enough to allow the patient to breathe freely, and of such a length as neither to be in danger of slipping out, nor of irritating the back part of the trachea. Such a canula has long been recommended by Doctor Monro in his course of surgery. Previous to the introduction the canula may be put through several plies of linen compress; or these may be first slit half way down, and applied so that any of them may be removed and replaced at pleasure. This double canula is to be fixed by a strap round the neck; and when mucus obstructs the passage of the instrument, the inner tube can be withdrawn, cleared, and readily replaced; while the patient is, during this time, breathing through the outer one; and by means of a screw the tubes can be regulated according to the motions of the trachea. After the canula is fixed, it ought to be covered with a piece of muslin or crape, to prevent the admission of dust, insects, &c. As soon as the causes inducing suffocation are removed, the canula is to be withdrawn, and the skin immediately brought over the orifice, and retained there by a slip of adhesive plaster.

Œsophagotomy. By œsophagotomy is understood the cutting open the œsophagus, to allow substances sticking in it, and which cannot be extracted otherwise, to be removed. It is only to be done, however, in cases of the most extreme danger, as it is attended with much hazard; and there are only two instances yet on record of its having been performed with success, though there are several instances of wounds in the œsophagus being healed. The operation may be rendered necessary, where obstructions of the œsophagus become so complete as to prevent the passage of nourishment into the stomach, or of air into the lungs. But it is evident, that when the obstructing cause is in the under end of the œsophagus, any incision becomes useless.

In performing the operation, the patient is to be secured in the same manner as for bronchotomy, and an incision made through the skin and cellular substance as directly opposite as possible to the part obstructed. If it be done with a view to remove an obstruction, the muscles over the trachea are to be pulled to one side, and the trachea to the other, by means of a blunt hook; by which the œsophagus will be brought into view. If the obstructed part now come in sight, the incision is to be made directly upon the obstructing body, which is to be extracted by a pair of small forceps; but if the obstruction happen to be farther down than we can with safety have access to the œsophagus, the incision is to be enlarged as much as possible, that the forceps may be able to reach and extract it. When the operation is performed, the wound will be difficult to heal,

heal, as the ſides of it will be frequently ſeparated by the action of deglutition. On this account as great a degree of abſtinence as poſſible is to be adviſed; and nothing but nouriſhing liquids, in ſmall quantities, are to be allowed. The patient ſhould be prevented from moving his neck; and the wound is to be healed as ſoon as poſſible by the ſame methods which are uſed with wounds in other parts of the body. On the other hand, if the operation has been done for the purpoſe of conveying nouriſhment into the ſtomach, when the patient was diſtreſſed by a tumor either in the œſophagus itſelf or in ſome of the neighbouring parts, it will be neceſſary to keep the wound open during the continuance of the tumor, or the life of the patient.

Chap. XX. *Of Sore Nipples.*

Women are more generally affected with ſore nipples in ſuckling their firſt child than at any period afterwards. This may, in ſome meaſure, be owing to the ſmallneſs of the nipples; but very often it ariſes from their being unaccuſtomed to the irritation of ſucking. In ſome caſes, the nipples are ſo flat, and ſo much ſunk in the breaſt, as to render it difficult for the child to lay hold of them. Here aſſiſtance can ſometimes be given, by the mother preſſing back the prominent part of the breaſt, ſo as to make the nipple project between two of her fingers. Should this be inſufficient, the nipple may be made to project by applying to it a ſtout child ſeveral months old: but when this cannot be done, breaſt-glaſſes, ſuch as fig. 68. may anſwer the ſame purpoſe. By applying theſe to the nipple, and ſucking out the air, the child will commonly be enabled to lay hold of it.

The nipples at this time are liable to excoriations, cracks, or chops; which, though not attended with a formidable appearance, are frequently more diſtreſſing than large ulcers. Mild, aſtringent, and drying applications are moſt to be depended upon in ſuch complaints; as port wine, brandy properly diluted, or lime-water; all of which ought to be applied warm. After bathing the parts with any of theſe, the nipple ſhould be covered with unguentum nutritum, or Goulard's cerate; the firſt of which is conſidered as beſt. Even a little ſoft pomatum frequently rubbed upon the part, and covered with a ſoft linen rag, is ſometimes found to give conſiderable relief. But the nipple ſhould be perfectly cleared of theſe applications before the child is laid to the breaſt; and this may be done with a little port wine, or equal parts of brandy and vinegar. If proper attention be paid to theſe remedies, they will commonly be found to have the deſired effect; but if the contrary ſhould happen, another remains to be mentioned, which, in different inſtances, has given great relief: it conſiſts in the application of a thin ſkin to the nipple, as the neck and part of the body of a ſwine's bladder with an aperture in it; which, being properly moiſtened and fixed to the breaſt, will completely protect it in the time of ſucking. As long as the nipples remain any way affected, ſmall cups of glaſs or tin are uſeful for retaining the dreſſings, defending the nipples from the friction of the clothes, and receiving any milk which may fall from the breaſt.

Chap. XXI. *Of Paracenteſis of the Thorax.*

When either the action of the heart or of the lungs is impeded by fluids collected in the cavity of the pleura, a diſcharge of theſe fluids by a perforation is the only chance the patient has for relief. The fluids which collect in the pleura are, ſerum, blood, air, or pus. A collection of water or ſerum is frequently found in the thorax, combined with dropſy in other parts of the body; but the affection is often local, and it is then chiefly that advantage is to be derived from an operation. Beſides, in the two great cavities of the thorax, collections of water are frequently met with in the pericardium, and are ſaid to be ſometimes diſcovered between the layers of the anterior mediaſtinum. The diſeaſe is marked by the following ſymptoms: There is a ſenſe of weight or oppreſſion in the thorax, and difficulty of breathing; the patient has frequently a more uneaſy ſenſation in one ſide than in the other; has ſudden ſtartings during ſleep, with a ſenſe of ſuffocation; is troubled with a frequent dry cough; the pulſe is ſmall and irregular; the ſkin dry, and the urine ſcanty.

Paracenteſis of the Thorax.

257 Symptoms of water being collected.

With theſe ſymptoms there are commonly other marks of dropſy; and the patient ſometimes, upon any ſudden motion, is ſenſible of an undulation within the cheſt; and when the quantity of water is conſiderable, the undulation will even be heard by the byſtanders, if the body be ſmartly agitated. For this purpoſe, the patient's body ſhould be uncovered while under examination; and the ſurgeon ſhould place his hand upon the breaſt near the ſternum; then an aſſiſtant ought to raiſe the patient ſuddenly from an horizontal to an erect poſture, or to ſtand behind the patient and make ſudden jerks; when, if water be preſent, the undulation will be felt; but it is neceſſary to guard againſt being deceived by the noiſe ſometimes made by the contents of the ſtomach.

When the water is collected in one ſide only, if the diſeaſe be of long ſtanding, for the moſt part that ſide is more prominent than the other. If the water be in the pericardium, the ſymptoms are nearly the ſame as thoſe above enumerated, with this difference, that the pain is generally felt behind, and to the left ſide of the ſternum; and the ſtroke of the heart is as if buried in water, while an undulatory motion has been ſaid to be felt oppoſite to the anterior extremities of the third, fourth, and fifth ribs.

258 Internal remedies of little advantage.

In the treatment of this diſeaſe, little advantage can be derived from internal remedies. Squills, cream of tartar, mercury, and digitalis, are upon ſome occaſions attended with advantage; but the only method from which we can expect any degree of ſucceſs is the removing of the water by an operation, which ſhould be performed as ſoon as there is reaſon to expect that danger may ariſe from delaying it longer. The operation is done in the ſame way as ſhall be afterwards deſcribed in the caſe of empyema.

259 Blood collected in the thorax.

Blood collected in the thorax is always extravaſated thro' ſome wound or rupture of the veſſels of the lungs or thorax. The breathing becomes oppreſſed, the motion of the heart and arteries feeble and irregular, and all theſe ſymptoms are more diſtreſſing than collections of other fluids. As it frequently happens, in caſes of this kind, that ſome of the veſſels of the lungs are injured, part of the blood is thrown up by coughing; which, when conſiderable, gives a temporary relief to the lungs and heart; and while this is the caſe, no operation is neceſſary; but whenever the action of theſe parts becomes much impeded by a great accumulation of blood, a perforation ought to be made to diſcharge it. When the extravaſated blood is too firmly coagulated to paſs off by a perforation, the wound ought to be made conſiderably larger; and if this be inſufficient, injections of warm water ought to be thrown in, and allowed to remain for ſome time, to promote the diſſolution of the maſs, which is afterwards to be evacuated. If the extravaſation has been occaſioned by a wound in the lower part of the thorax, a new perforation will be unneceſſary; an enlargement of the wound will be quite ſufficient. But if it be ſituated in the upper part of the cavity, a perforation in the

Paracentesis of the Thorax. middle and lateral part of the thorax ought to be made, that the blood may be freely discharged. In case of a rib being fractured, or a vessel ruptured, the incision ought to be made as near as possible to the part affected, to allow the blood to escape, and loose pieces of bones to be removed.

260 Air collected in the thorax. The discharge of air into the cavity of the thorax produces symptoms little less alarming than those proceeding from the effusion of blood. In general they are, oppression in breathing: a tightness of the breast, attended with pain; inability to breathe in the recumbent posture; a flushing and swelling of the face; a feeble, and at last an irregular pulse: The extremities become cold, and cold sweats break out on the forehead. With these symptoms there is frequently a swelling over the external parts of the body, by air getting from the ruptured lungs into the common cellular substance; and all these complaints increasing, the patient, if not quickly relieved, soon dies; sometimes in a few hours, with marks of suffocation.

Air may be produced in the cavity of the thorax by wounds in the lungs, by mortification generating air in any of the thoracic viscera, by erosion of ulcers, by laceration in consequence of fracture in any of the bones of the thorax.

We distinguish this from other collections by the sudden oppression in breathing, by the flushing of the face, by no blood being thrown up, and by the emphysematous swelling of the chest and other parts, which has a crackling noise upon being pressed.

The treatment of this complaint consists in making small punctures in the affected part of the skin, so as to allow the air to escape from the cellular substance; and if the air shall have spread to distant parts of the body, it will escape most readily by such openings. But if this give no relief to the oppressed breathing, paracentesis ought to be performed. In former times, patients labouring under such symptoms were almost constantly left to their fate. Within these few years, however, some cases have occurred where the patients have been completely relieved by an operation being performed. This is done in the same way as in the evacuation of other fluids.

261 Empyema or pus collected in the thorax. Purulent matter is more frequently collected in the thorax than any other fluid: it is much more frequently formed, however, than confined there. As the matter is usually spit up as fast as it is generated, in the dissections of those who have died of this species of consumption, much extravasated pus is rarely found in the cavity of the thorax, though a great portion of the lungs be destroyed. Cases not unfrequently occur, however, which require the operation; and these may be distinguished by the following symptoms: The patient at first generally complains of a fixed pain in some part of the thorax, attended with heat, quick pulse, and other symptoms of inflammation; respiration becomes oppressed; he is unable to lie on the sound side; or, if both sides be affected, can only lie on his back; has a constant tickling cough, clammy sweats, frequent rigors or shiverings. If these symptoms be attended with an enlargement of the affected side, or with a soft œdematous fulness there, and, along with these, if there be a sensible undulation of a fluid, it may be concluded that a collection of matter is formed. The matter is commonly first formed in the substance of the lungs, and is afterwards discharged into the cavity of the pleura, though in many instances large quantities of purulent matter have been found to originate from an inflamed state of the pleura.

The operation ought to be performed as soon as there is evidence of the collection being the cause of the oppressed breathing, and that there are no signs of this being relieved by expectoration. The operation ought to be done upon the part where the collection is supposed to be situated; and this may be known by the seat of the previous pain, and perhaps by the matter being distinguished between two of the ribs. If no matter flow, it is probably seated in the substance of the lungs; but even in this case, such an opening may be useful, by taking off the support, and giving the abscess an opportunity of bursting. If the undulation of the fluid be general, the operation is to be performed in the following manner: The patient is to be laid in an horizontal posture, with the affected side inclining a little over a table. An incision is then to be made with a scalpel through the skin and cellular substance, between the sixth and seventh ribs, and half way between the spine and sternum, from one to two inches in length, and in the direction of the ribs. The muscles are then to be cut through, keeping as near as possible to the upper edge of the inferior rib to avoid wounding the intercostal vessels and nerves. As there is no occasion for the bottom of the wound being of the same length with the external incision, it may be gradually contracted, so as at last to be only about the half. The pleura being now exposed, is to be divided by slight scratches, taking the assistance of a furrowed probe to prevent the lungs from being injured, in case they shall be found adhering to the ribs. If the contrary takes place, the fluid will rush out immediately upon a small opening being made into the cavity of the thorax; but if an adhesion appear, and if it be slight, which may be known by the introduction of a blunt probe, as much of it may probably be separated as to allow the fluid to escape. In case it be considerable, the incision is either to be continued a little nearer to the sternum, or an attempt made in some other part. After the fluid is observed to flow, it will be proper to introduce a silver canula, fig. 69. at the opening; by which means it will run more readily off, or can be more easily stopped in case the patient become faint. If the quantity of fluid be not considerable, it may generally be drawn off at once; but if it be great, partial evacuations ought to be made at different intervals, as circumstances may direct.

The canula therefore should be so formed, that by means of a strap put round the body of the patient, it can be readily secured. Its mouth is to be shut by means of a cork. A pledget of emollient ointment is to be laid over the wound; and the whole being fixed by a napkin and scapulary bandage, the patient should be laid to rest. The remainder may be drawn off, probably in a day or two, or as soon as it is supposed the patient can bear it. After the fluid is carried off, the canula is to be withdrawn and the wound healed; or in case the operator be afraid of bad effects being produced upon the lungs by irritation from the canula, though of this there will be little danger, as the lungs will generally be out of its reach, the skin may be so drawn back before the first incision is made as afterwards to serve the purpose of a valve. And for some days after the operation, the incision in the integuments may be brought opposite to that in the pleura, to allow the matter to run off, or to produce a radical cure by exciting a certain degree of inflammation over the lungs and inside of the thorax.

After the matter is evacuated, the wound ought to be kept open a considerable time for the purpose of discharging the matter as fast as it is collected. If the wound be apt to heal up too soon, which will be known by the symptoms of oppression being renewed, it will be proper to keep the passage open by tents, or to introduce a bougie or silver canula a few hours occasionally, till the source of the matter be dried up; which, however, seldom happens for a considerable time, and frequently never. By attending to this circumstance, the patient may enjoy good health; whereas,

as, by the neglect of it, a repetition of the first operation would soon be necessary.

Chap. XXII. *Of Paracentesis of the Abdomen, or Tapping.*

This operation is an opening made into the abdomen, in order to empty any quantity of extravasated water collected in that species of dropsy called the *ascites*.

263 Symptoms of fluid in the abdomen. A fluid in the cavity of the abdomen is discovered by the swelling which it produces; by a sense of tightness in the part affected; by laborious and difficult breathing, especially when in the horizontal posture; but particularly by a sense of fluctuation being communicated to the fingers placed on one side of the abdomen, while the swelling is forcibly struck on the opposite side. There is besides much thirst, a dry skin, scantiness of urine, &c. Whatever may be the influence of diuretics and other evacuations in the cure of general dropsical affections, they are rarely serviceable in local diseases of this kind, and even the operation of tapping seldom cures the distemper; but it commonly gives the patient ease for the present time, and is attended with very little pain.

264 Manner of performing the operation of paracentesis. Upon the supposition that nothing forbids the extraction of the water, the manner of operating is this: Having placed the patient in an horizontal situation, as best suited to prevent fainting, and to allow the water to run freely off, the part to be perforated ought to be marked with ink; and the most approved part for the operation seems to be at a point lying at nearly an equal distance between the umbilicus and the centre of the spine of the os ilium, this being most out of the way of any of the viscera, and sufficiently depending to allow the water to escape; and as the spleen is less frequently enlarged than the liver, the left side is generally preferred. Various means have been used for applying an equal pressure in this operation. Some apply pressure by the hands of assistants; others use a broad piece of flannel, or other kinds of cloth, slit a certain way from each end; then the ends are drawn by assistants till sufficient pressure is made. Broad belts are used by some practitioners; but one of the best contrivances for this purpose is the bandage invented by the late Dr Monro, (fig. 70.) Plate CCCXC. Till very lately, a puncture was first made with a lancet, then a trocar of a round form (fig. 71.), and with a triangular point, was constantly used: but the entrance of this instrument being always attended with difficulty and pain, a flat trocar is now very frequently employed; and that invented by Mr Andree (fig. 72.) seems the best which has yet appeared. The bandage being now applied and drawn a little tight, the part to be punctured is to project a little over the edge of the bed. The operator fixes the head of the trocar in the palm, while the fore finger directs the point of the instrument. He is then to push it forwards till he is satisfied, by the want of resistance, that the end of the canula has reached the cavity of the abdomen. The perforator is now to be withdrawn, and the water allowed to flow as long as any of it can be taken off, the bandage being from time to time pulled to favour the discharge. But if the patient become faint, a stop for a few minutes should be put to the discharge every now and then, by placing the point of the finger upon the mouth of the canula. If any of the viscera happen to stop the flow of the water before the swelling is much diminished, a blunt probe is to be introduced, but bent at the end, lest it slip into the cavity of the abdomen. When the serum is thick and gelatinous, it may sometimes be necessary to introduce a larger trocar than the one first employed. When the water does not flow, because it is collected into cists, the canula is to be withdrawn, and the wound covered with a pledget of simple ointment. The operation may then be renewed immediately, or on the following day, upon the opposite side of the abdomen, or in the most depending part of the tumor, in whatever part of the abdomen it may be placed. Paracentesis of the Abdomen, &c.

During the operation it is necessary to keep up a pressure on the abdomen, otherwise the patient will be apt to fall into faintings from the weight on the great vessels of the abdomen being taken off, and the sinking of the diaphragm succeeding, in consequence of which more blood flows into the inferior vessels than usual, the superior ones are left too empty, and thus the regular progress of the circulation is interrupted. To obviate this, the pressure must not only be made during the operation, but be afterwards continued. As to the dressing, it has been already mentioned, that the wound may be covered with a pledget of simple ointment; but between the skin and the roller some recommend a piece of flannel dipped in brandy or spirit of wine to be applied. The bandaging in this manner may even have some effect in preventing a return of the disorder. When the water again collects, the operation should be repeated whenever the swelling has acquired a considerable size: and though this operation does not always effect an absolute cure, yet it sometimes preserves life a great many years, and even a comfortable one, especially if the waters have been long collected.

After the operation, practitioners advise the abdomen to be frequently rubbed with astringent spirituous applications. This cannot be done for the first two days after the operation, as it would then be improper to remove the bandages; but after that time, they may be removed daily, for about a quarter of an hour; and camphorated spirit of wine, or other applications which may have a similar effect, may be applied with strong friction over the abdomen, the body being kept, during this period, in the horizontal situation, and the bandage applied immediately after the friction is finished.

Sometimes, instead of water, we find air contained in the abdomen; and the inflation is of two kinds: First, that in which the air is contained in the intestines; in which case the patient has frequent explosions of wind, with a swelling of the belly frequently unequal. Secondly, where the air is collected in the cavity of the abdomen; and here the swelling is more equal, without any considerable emission of air. In both varieties of the disease the swelling is more tense than where water is contained, and the belly sounds when struck, and affords to the touch and pressure nearly the same sensation as is received from a bladder filled with air. Of these two disorders the former is by much the most common. Many extensive practitioners have never met with an instance of true abdominal tympanites. A few well authenticated cases, however, have occurred, where the air was collected between the containing and contained parts of the abdomen. In some of them the air was found to have escaped by a small hole in the intestines, from which it has been supposed that the other cases were of the same nature. When the symptoms become urgent, there is as much necessity for discharging the air as for drawing off the water in cases of dropsy. The pressure and perforation are to be made in the same manner as directed for ascites, with this difference only, that a trocar of the very smallest size ought to be used; for by it the air can be as easily discharged, and the wound will heal more readily than when a large opening is made. After the air has been extracted, the treatment ought to be nearly the same as that recommended in cases of ascites. 265 Of Tympanites.

Chap.

Herniæ in general.

Chap. XXIII. *Of Herniæ.*

Sect. I. *Of Herniæ in general.*

266 Definition of a hernia.

The name of *hernia* might with propriety be applied to every swelling occasioned by the dislodgement of parts from those boundaries within which, in a state of health, they are contained; but the general acceptation of the term implies a tumor produced by the protrusion of some part or parts from the cavity of the abdomen.

267 Situation and contents of herniæ.

The parts in which herniæ usually appear are the groin, scrotum, labia pudendi, the upper and fore part of the thigh, the umbilicus, and different points between the interstices of the abdominal muscles. If the situation of such tumors be various, the viscera which produce them are still more so; instances having occurred of the stomach, uterus, liver, spleen, and bladder, being found to form their contents. But a part of the intestinal canal, or a portion of the omentum, are from experience known to be the most frequent cause of their formation.

268 Their different names.

From these circumstances of situation and contents, all the different appellations are derived by which herniæ are distinguished. Thus they are termed *inguinal, scrotal, femoral, umbilical*, and *ventral*; from their appearing in the groin, scrotum, thigh, navel, or belly. When the tumor is confined to the groin, the hernia is said to be incomplete, and is termed *bubonocele*; but when the swelling reaches down to the bottom of the scrotum, the rupture is then supposed to be complete, and the disease obtains the name of *scrotal rupture*, or *oscheocele*.

Of these disorders the inguinal hernia is by much the most frequent; next to that is the femoral. The umbilical is seldom observed in men, or even in women who have not born children.

The causes which tend to the production of hernia in its more usual form are these:

269 Causes which produce them.

I. The containing parts of the abdomen we know to be elastic and compressible; whatever, therefore, tends to produce a diminution of capacity in the cavity of the abdomen, must occasion a proportional degree of risk of some of the contained parts being pushed from their natural situations. Violent coughing, crying, laughter, or great bodily exertion, are attended with more or less contraction of the abdominal muscles, and particularly of the diaphragm; and as the contraction of these muscles must always diminish the abdominal cavity, these causes therefore are frequently found to be productive of hernia.

II. Falls, in consequence of the derangement they produce in the abdominal viscera, from the sudden and violent shock with which they are often attended, are not unfrequently the immediate causes of hernia.

III. Persons of a preternatural laxity of frame are very liable to herniæ. The containing parts of the abdomen, from the want of a sufficient tone and firmness, are unable in such people to resist on all occasions the weight of the different viscera; and they are therefore more particularly exposed to disorders of this kind on the slightest application of any of the causes already mentioned.

IV. Sprains are apt to induce a laxity of the part injured; and have therefore a similar influence in inducing herniæ with general laxity.

V. It has been observed that the people of those countries where oil is much used as an article of diet, are particularly liable to herniæ.

In whatever parts the parietes of the abdomen happen to be weakest, these various causes will most readily operate in producing herniæ; and accordingly we find, that descents of the bowels usually occur only in such parts.

In whatever situation a protrusion of any portion of the intestines occurs, except in the case of the hernia congenita, as all the viscera are contained within the peritonæum, a portion of that membrane, it is evident, must be carried down together with the parts protruded; and in every such instance, it is this portion of the peritonæum which goes down along with the gut that is termed the *hernial sac*. The size of this sac is various in different subjects, and in different stages of the same disorder. On the first appearance of the disease, it is commonly of no very considerable size, as such swellings seldom acquire any great bulk at once: but by repeated descents of the bowels, it comes to be pushed lower and lower, till in some instances its bulk becomes very considerable indeed; and when in this advanced period of the disorder the sac happens to be laid open, it is found to contain either large quantities of omentum or intestine, and frequently large portions of each. As the peritonæum has this property in common with many other parts of the body, of thickening according to the degree of any gradual extension applied to it, so in many instances the thickness and firmness of the hernial sac are often really astonishing.

270 Of the hernial sac.

271 Cause of the bad symptoms which appear in herniæ.

All the bad symptoms which are found to occur in herniæ, proceed, as may be readily supposed, either from obstruction to the passage of the fæces when the intestinal canal forms the tumor, or from a stoppage of circulation occasioned by stricture on the prolapsed parts: so that the attending symptoms, it is evident, will be always more or less hazardous according to the nature of the parts so protruded.

Thus, when omentum alone forms the substance of hernial swellings, as that organ does not appear to be so immediately necessary for life as many of the other viscera, such tumors accordingly are not so frequently productive of bad consequences, at least they are seldom in any degree so hazardous as when a part of the alimentary canal is either protruded by itself or along with omentum.

Although this, however, is in general the case, yet it does sometimes happen, that even an omental rupture is productive of no small degree of danger. When a stricture so complete upon it occurs as to occasion a stoppage of circulation in the protruded part, mortification with all its bad consequences must be the certain event: And besides, the connection between the omentum, stomach, and other viscera, is such, that a sudden descent of any considerable portion of the former sometimes brings on vomiting, hickup, and other troublesome symptoms: And lastly, although a rupture containing omentum only might not of itself produce any thing bad; yet as the passage through which the omentum has slipped must of necessity continue open so long as that viscus remains protruded, and as that circumstance alone must, so long as it continues, render it more easy for a portion of gut likewise to get down, this of itself is a sufficient reason for intitling even this species of hernia to the serious attention of practitioners.

But whatever the contents of such swellings may be, as their remaining in some instances for a considerable length of time without being productive of any bad symptoms, must proceed entirely from the circulation continuing to go freely on, notwithstanding the derangement of parts; so, whenever a stricture occurs up the protruded viscera, sufficient to produce either a stoppage of the circulation, or of the fæcal contents of the alimentary canal, when a portion of gut forms the disease, the following in general are the symptoms which accrue.

272 Enumeration of the symptoms.

An elastic colourless swelling is observed at the part affected; a slight pain is felt not only in the swelling itself, but, if part of the alimentary canal is down, an universal uneasiness

eaſineſs is perceived over the whole abdomen; and this pain is always rendered worſe by coughing, ſneezing, or any violent exertion. The patient complains of nauſea; frequent retching; can get no diſcharge by ſtool; becomes hot and reſtleſs; and the pulſe is commonly found quick and hard. When the ſwelling is formed entirely by a portion of gut, if no fæces be contained in it, it has a ſmooth, equal ſurface; and is eaſily compreſſible, but inſtantly returns to its former ſize on the preſſure being removed: but, in gut-ruptures of long ſtanding, where hard fæces have collected in the protruded bowels, conſiderable inequalities are detected. When again the tumor is compoſed both of gut and omentum, its appearance is always unequal, it feels ſoft and ſomewhat like dough, and of courſe is not ſo elaſtic as when part of the inteſtinal tube only is down; for although, like the other, it is compreſſible, it does not ſo readily regain its former dimenſions on the preſſure being taken off.

It will be readily ſuppoſed, that the ſymptoms we have deſcribed never can happen from the preſence of omentum *only*: For although ſtricture produced on a portion of omentum, even when no part of the inteſtinal tube is down, does now and then occaſion a good deal of diſtreſs, ſuch as pain in the part, ſickneſs, vomiting, and twitching pains through the whole belly; yet no obſtruction of the gut ever occurs from this, and of courſe none of the ſymptoms ever prove ſo alarming as when any part of gut is affected. If theſe ſymptoms we have deſcribed as being produced by a ſtrangulated gut, are not now obviated by a removal of the ſtricture which produced them, the nauſea and retching terminate in frequent vomitings, firſt of a bilious, and afterwards of a more fetid matter; the belly becomes tenſe; the pain turns more violent; a diſtreſſing convulſive hickup comes on; the fever, which before was not apparently of much conſequence, now becomes very formidable; and a total want of reſt, with a very diſagreeable ſtate of anxiety, continues through the whole courſe of the complaint. Theſe ſymptoms having gone on with violence for ſome time, the patient is at laſt commonly relieved in a ſudden from all manner of pain; and then he flatters himſelf that all danger is over. But inſtead of that, the pulſe, from having been hard and frequent, becomes languid and interrupted; cold ſweat breaks out over the whole body, but eſpecially on the extremities; the eyes acquire a kind of languor; the tenſeneſs of the abdomen ſubſides, and the ſwelling of the part affected diſappears; the teguments covering the parts, which before were either of a natural appearance, or had ſomewhat of a reddiſh inflamed caſt, now acquire a livid hue, and a windy crepitous feel is diſtinguiſhable all over the courſe of the ſwelling. If the protruded parts have not of themſelves gone entirely up, their return is now in general eaſily effected by a ſmall degree of preſſure, and the patient then diſcharges freely by ſtool; but the cold ſweats increaſing, the hickup turns more violent, and death itſelf is at laſt uſhered in by its uſual forerunners, ſubultus tendinum, and other convulſive twitchings.

Theſe are the ordinary ſymptoms of what is termed a *ſtrangulated* or *incarcerated gut hernia*: that is, when the parts protruded become ſo affected by ſtricture as to produce pain; and do not either return to their natural ſituations on the patient's getting into a horizontal poſture, or cannot even be immediately replaced by the hands of a practitioner.

In whatever ſituation a ſtrangulated hernia occurs, the only rational method of cure, it is evident, muſt conſiſt in the removal of that ſtricture which prevents the return of the protruded parts. It is that ſtricture which ought to be conſidered as the cauſe of all the miſchief; and unleſs it be removed, nothing effectual can be done for the relief of the patient. Hernia in general.

Various methods have been attempted by practitioners for the removal of ſtricture in theſe diſorders; all of which may be comprehended under two general heads.

I. Such as effect a reduction of the protruded parts, without the interpoſition of inciſion or any chirurgical operation properly ſo called; and,

II. A diviſion of the parts producing the ſtricture, ſo as to admit of a replacement of the deranged viſcera, conſtituting what is termed the *operation for the hernia*.

The remedies to be employed for accompliſhing the firſt of theſe are, a proper poſture of the patient, with the manual aſſiſtance of a practitioner; blood-letting, ſtimulating clyſters, opiates, the warm bath, and proper applications to the tumor itſelf.—If theſe fail, there is then no other means of cure left but the operation of dividing the integuments, and replacing the viſcera.

As ſoon as the aſſiſtance of a practitioner is deſired for the removal of ſymptoms in caſes of hernia, the firſt circumſtance requiring his attention is the placing of his patient in ſuch a poſture as will moſt probably favour the return of the protruded parts. Placing the patient's feet over the ſhoulders of another perſon, while his body is allowed to hang downwards, and cauſing him to be a good deal jolted about, has on ſome occaſions anſwered when other means have failed. 216 Method of reducing the inteſtine.

The ſurgeon ſhould at the ſame time endeavour to aſſiſt the return of the bowels, by means of gentle preſſure with his hands and fingers. In the inguinal or ſcrotal hernia, this preſſure ſhould be made obliquely upwards and outwards to correſpond with the opening in the external oblique muſcle; in the femoral hernia it ought to be made directly upwards; in the umbilical and ventral hernia directly backwards.—The ſwelling ſhould be graſped with one hand at the bottom, while with the fingers of the other hand an attempt is made to puſh gently the contents of the tumor into their place, always obſerving that the parts laſt protruded be firſt reduced. This operation is by authors termed the *taxis*.

When the means now mentioned have failed, no remedy affords more relief than blood-letting. The quantity to be drawn ought chiefly to be determined by the ſtrength of the patient. There is ſcarcely any diſeaſe, however, where ſuch large quantities of blood can with propriety be taken from weak people. Blooding till the patient is in a ſtate of deliquium animi, is frequently known to produce a more effectual relaxation of the muſcles than can be done by any other means. On that account it is ſometimes adviſed in caſes of hernia, and the practice is now and then attended with advantage.

As an obſtinate coſtiveneſs is commonly one of the moſt alarming ſymptoms of hernia, it has been a common practice to exhibit a variety of ſtimulating purgatives both by the mouth and anus; but they are very ſeldom of much ſervice, and in that caſe almoſt univerſally do injury, by increaſing not only the ſickneſs at ſtomach, but the tenſion and pain of the tumor. When they are to be employed, they ought to be thrown up by the anus. For this purpoſe aloes and other ſtimulating ſubſtances, but particularly tobacco-ſmoke, are employed; and although this laſt remedy, which is to be thrown in by double bellows, &c. does not always act as a purgative, it may be uſefully employed as an anodyne. Where an evacuation by ſtool is wanted, it may in general be readily procured by the injection of warm water, in which a little Caſtile ſoap is diſſolved, in the proportion of a drachm or a drachm and a half of the latter to a pound of the former. Warm bathing is another remedy greatly extolled, either by general immerſion or local application, by

Herniæ in general.

by means of warm water put into ox-bladders covered with flannel, and laid acroſs the abdomen.

To diminiſh the ſize of the tumor, remedies of an oppoſite quality from theſe have been uſed; and though by ſome this practice has been conſidered as hazardous, yet by others, particularly by the late Dr Monro and Mr Benjamin Bell, more advantage has been found from cooling applications than from thoſe of a different nature. Snow, ice, or cloths dipped in a recent ſolution of ſal ammoniac in water and vinegar, or cold ſaturnine applications, or cold water and vinegar, have been employed with advantage. If, notwithſtanding theſe remedies, the diſeaſe becomes worſe, and no probability remains of ſucceſs, the diviſion of the parts producing the ſtricture can alone ſave the life of the patient.

277 When the operation for reducing the inteſtine ſhould be performed.

To determine the exact time at which to proceed to an operation, has been conſidered as one of the niceſt points in ſurgery. In general, when every attempt has failed, and no repetition of the former remedies is likely to ſucceed, the ſurgeon ought certainly to proceed to the operation. A few hours, even when aſſiſtance has been early applied, is perhaps all the time which ought ever to be conſumed in trials of this nature. But however neceſſary this operation may be when a patient's life is in danger, as it is always attended with ſome degree of hazard, it ought never to be practiſed where ſymptoms of ſtrangulation do not exiſt.

In that kind of hernia called *chronic*, the circulation of the part forming the hernia, as well as the periſtaltic motion of ſuch parts of the alimentary canal as have been protruded, go freely and regularly on. There are many inſtances of large herniæ falling down even to the bottom of the ſcrotum, and continuing there for many years, without producing any interruption to the uſual diſcharge by ſtool. All that can be done here is, to prevent any accumulation of fæces in the inteſtine, by preſcribing a proper diet, and the occaſional uſe of gentle laxatives; and obviating any inconvenience which might ariſe from the weight of the tumor, by the application of a proper truſs or ſuſpenſary bandage; to warn them of the riſk to which they are conſtantly liable, and to caution them againſt violent exerciſe, particularly leaping, and every ſudden exertion. The truſs ought to be fitted exactly to the part for which it is intended, for without the utmoſt nicety in this reſpect, it muſt always do more harm than good: for the ſole purpoſe of a bandage, in caſes of hernia, is to prevent effectually the falling down of ſuch parts as have been newly replaced. If therefore the pad or bolſter of the bandage does not bear properly againſt the opening upon which it is placed, a portion of gut may ſlip out, and be materially injured by the preſſure of the pad. Fig. 74. repreſents a truſs for an inguinal or femoral hernia of one ſide, fig. 75. a truſs for the ſame diſeaſe in both ſides, and fig. 76. a truſs for an umbilical hernia.

278 Method of performing it.

We ſhall now proceed to deſcribe the circumſtances to be attended to in performing the operation for hernia in general. A table of convenient ſize and height being placed in a proper light, the patient muſt be ſo laid on it as to relax the diſeaſed parts as much as poſſible, and then ſecured by proper aſſiſtance. To leſſen the contents of the abdomen as much as poſſible, the bladder ought to be emptied previous to the operation. An inciſion is to be made with a common round-edged ſcalpel through the ſkin and part of the cellular ſubſtance, long enough to allow the ſtricture to be fully expoſed. The reſt of the cellular ſubſtance is then to be divided with the greateſt attention. That part of the muſcle forming the ſtricture or ring muſt next be laid diſtinctly in view. A ſmall portion of the protruding ſac muſt alſo be expoſed; after which the directory (fig. 73.) is to be paſſed between the ring and the ſac. A ſtraight probe-pointed ſcalpel is now to be introduced into the groove of the directory, and by it the ring is to be dilated till the point of the finger can be introduced. The finger is here conſidered as the ſafeſt director; for it being inſinuated into the aperture in the tendon immediately above the protruded parts, the point of the knife is eaſily introduced upon it; and by keeping the end of the finger always a little before the knife, the opening may be enlarged to any neceſſary extent without riſk of wounding any of the contiguous parts.

Herniæ in general.

By the eaſe with which the finger is introduced, the operator will be enabled to judge when the ring is ſufficiently dilated; and if the ſtrangulation was entirely in the ring, it will now be evident that every obſtacle to the reduction muſt be removed, and of conſequence that the prolapſed parts may be returned with little difficulty. If the patient be young, or if the diſeaſe has continued a conſiderable time, ſuch a degree of inflammation frequently enſues in the neck of the ſac as to produce thickening and ſtraitneſs; ſo that, after the ſac and its contents have been entirely freed from the ſtricture of the ring, the inteſtines cannot be reduced. We judge this to be the caſe when, after the ſtricture of the ring has been removed, the parts prolapſed do not expand into their natural ſize, and farther, when they make reſiſtance when we attempt to return them. In this caſe, the neck of the ſac muſt be opened with the utmoſt caution, to avoid wounding the parts within it.

If the herniary ſac, under the ſtraitened place of its neck, be thin and tranſparent, and there is little or no reaſon to ſuſpect an adheſion of the bowels to the ſac, the beſt method, as Dr Monro, in his publication on the Burſæ Mucoſæ, obſerves, will be to make a ſmall hole in the ſac below the ſtricture, and then to introduce a ſmall furrowed probe, and to cut cautiouſly upon it. But if the ſac be thick and dark coloured, and there is likewiſe a ſuſpicion that the bowels may adhere to it, the eaſieſt and ſafeſt manner will be to make the hole in the peritoneum above the ſtricture; then to introduce a common probe, bent near its point into a ſemicircle, with its point directed downwards through the ſtricture into the ſac; and upon the point of it to make, with great caution, another ſmall hole; after which we may either cut upon the probe, or introduce a furrowed probe, and divide the neck of the ſac.

After this, the bowels are to be returned by preſſure upon the ſac, without opening it farther; and the ſides of the wound in the ſkin are to be brought together, and kept ſo by means of ſlips of adheſive plaſter, though ſtitches made at the diſtance of a finger-breadth from each other will exclude the air, and prevent the return of the bowels more effectually. Over theſe are to be laid ſeveral folds of charpee, and the whole is to be ſecured by a bandage adapted to the nature of the part.

279 Treatment afterwards.

The patient, upon being carried to bed, ſhould be ſo placed as to have the part upon which the operation was performed higher than the reſt of his body, or at leaſt as high as the ſituation of the part operated upon will allow, in order to prevent a return of the diſeaſe. After the operation, opiates are particularly uſeful, and ought to be repeated as circumſtances may require. It is likewiſe neceſſary that the patient be kept cool. In plethoric habits, blood-letting is proper, together with a rigid attention to low diet. A frequent uſe of clyſters and gentle laxatives, to keep the belly moderately open, ought not to be neglected. When the conſtitution has been previouſly much reduced, inſtead of blood-letting and a low diet, a nouriſhing regimen is neceſſary. The dreſſings ought not to be removed till the third or fourth day after the operation, when the ſides

sides of the wound will be found almost adhering together; and if attention be paid to the subsequent treatment, the sore will be generally healed in two or three weeks. As soon as the wound is firmly cicatrized, a truss ought to be properly fitted to the part, and should never, on any future period of life, be laid aside.

When the hernia is of long standing, and when there is reason to think adhesions have taken place between the sac and bowels, or that mortification has already begun, or that some filaments run across the sac and prevent the reduction, or that there is water in the sac, or that the gut is in danger of being entangled from a part of the omentum being down, a different method of operating becomes necessary.

The patient is to be placed as already directed. The operator is to grasp the tumor with the one hand, so as to make the skin tense on the fore part of it, while with the scalpel in the other he divides the skin from one end of the tumor to the other. The cellular substance is by gentle strokes to be divided, till not only the ring, but the whole length of the sac, is laid bare. An opening is now, in the most cautious manner, to be made into the sac by slight scratches, to avoid hurting any of its contents.

In making this perforation, which is considered as the nicest part of the operation, considerable assistance is obtained from the use of the small directory, upon the point of which the fibres of the sac are to be successively raised and divided till an opening is made. The opening is to be enlarged till it admit the fore-finger of the left hand, which serves as a directory for conducting the straight probe-pointed scalpel with which the sac is to be divided through its whole length.

The sac being laid fully open, the parts contained in it ought to be examined with the nicest attention, to discover whether they are all sound or not; and if, upon an attentive inspection, it is found that they are not evidently in a gangrenous state, even although they seem considerably inflamed, they should be immediately returned into the abdomen. When adhesions take place between different parts of the protruded gut, the greatest caution is necessary in separating them. When one part of a gut adheres so firmly to another as not to be separated but with difficulty, it is much better to return the whole, even in that state, into the abdomen, than to run the risk of hurting the intestine materially by using much force. When adhesions occur between the hernial sac and the gut, or between the gut and omentum, if the filaments producing the connection cannot be otherwise removed, as there is no great hazard in wounding the omentum, and still less in hurting the sac, a very small portion of these may be dissected, and returned with the gut into the abdomen. When the bowels cannot be reduced with ease, the ring is to be dilated by the blunt pointed scalpel in the manner already directed. After returning the contents of the sac into the cavity of the abdomen, it has been proposed by some authors to pass a ligature round the neck of the sac, with a view of procuring a reunion of its sides, so as to prevent a future descent of the bowels; and various other methods, even actual and potential cauteries, have been proposed: but as none of them yet attempted have been found sufficiently to answer the purpose, the only thing that can be recommended is a well made truss.

When the bowels are actually in a state of gangrene, as the returning of such mortified parts might be attended with the very worst consequences, a great degree of caution is necessary. When the omentum is found in a mortified state, as the excision of a portion of this substance is not attended with much risk, it is the common practice to cut away the diseased parts, and to obviate any inconvenience which might ensue from the hemorrhagy. We are advised to make a ligature on the sound parts previous to the removal of those which are mortified; whilst the ends of the ligature being left hanging out of the wound, the surgeon has it in his power to remove them when circumstances appear to render it proper. These ligatures on the omentum, however, are frequently productive of bad consequences. No hemorrhagy of any importance ever occurs from a division of this membrane, even in a sound unmortified state; such parts as have become gangrenous may therefore be freely cut off, and the remaining sound parts be afterwards, without the intervention of ligatures, safely introduced into the abdomen. If a vessel of any size in the omentum has been divided, a ligature may be passed above the vessel itself, and the ends left hanging out of the wound; the threads may be afterwards pulled away at pleasure. When a rupture has been of long duration, it sometimes happens, that from the pressure made by the truss, and other circumstances, portions of the omentum are collected together into hard lumps. If these be small, they may be returned into the abdomen without producing any inconvenience: but if from their bulk and hardness they are likely to do mischief, they ought to be cut off. When part of the omentum is to be removed, it ought to be previously expanded and divided with scissars, which will be more convenient than any other instrument. When again a small portion of gut is found mortified, we are to endeavour, by means of a needle-ligature, to connect the sound part of the gut immediately above the mortified spot to the wound in the abdomen already made. By this means, when the mortified part separates, or perhaps what is better, when it has been immediately cut out, the fæces are discharged by the wound; and there are different instances where, after such a discharge has continued for some time, the wound has entirely healed.

But when the mortified portion of gut is of considerable extent, and includes the whole circumference of the intestine, all that can be done is to remove it, and to draw, by means of a ligature, the upper end of the gut towards the under, and afterwards connect them to the inner edges of the wound. This at least affords a chance of the ends of the gut being brought to reunite; and if unfortunately that event should not take place, a passage of the fæces will still be secured. All such mortified parts as are to be removed ought to be cut off, and the remaining sound intestine retained, before the opening in the ring can be dilated with safety, lest the gangrenous portion slip in together with the sound. The parts forming a hernia being all completely replaced, when the sac in which they were contained is found thick, hard, and much enlarged, as in such a state no good suppuration can take place, and as its preservation cannot be in any degree useful, such parts of it as can be cut away with propriety ought to be removed. All the lateral and fore parts of the sac may be cut off with safety; but as it is commonly firmly connected with the spermatic vessels behind, this part of it ought not to be touched.

Hernia in general.

Sect. II. *Of Bubonocele, or Inguinal and Scrotal Hernia.*

252 Symptoms of bubonocele.

This species of hernia is formed by a protrusion of some of the abdominal bowels through the rings of the external oblique muscles. It is known by the general symptoms of hernia already enumerated, and by a soft and somewhat elastic swelling, beginning in the groin, and descending by degrees into the scrotum in men, and into the labia pudendi in women. When the hernia contains omentum only, the swelling is both more soft, compressible, and more unequal than when the gut alone is down; the scrotum becomes more oblong than in the intestinal hernia; and when the quantity of omentum is large, it is also much more weighty than a gut rupture of the same size; but frequently the tu-

Bubonocele or Inguinal and Scrotal Hernia.

mor is composed of both gut and omentum, and then the distinguishing symptoms of each can never be so clearly marked.

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How distinguished from other diseases.

Bubonocele may be confounded with certain other diseases; but may be distinguished by the following marks which are present in these disorders, while the symptoms of hernia are absent: From venereal bubo, by the presence of that incompressible hardness with which all such swellings are at first attended, and by the fluidity of matter which in the suppurative state is always observable: From hernia humeralis, or swelling of the testes, by the absence of the hardened and enlarged state of the testis and epididymus, and likewise of the pain, the tumor of the testicle being remarkably heavy in proportion to the bulk, the spermatic process being commonly free from the swelling. In the hernia humeralis also the intestines are unobstructed, and the general symptoms of hernia are wanting. From the hydrocele of the tunica vaginalis testis, by the tumor generally feeling more smooth to the touch than in hernia, by the swelling here beginning in the under part of the scrotum and ascending, by the spermatic cord being always free and distinct, and by a fluctuation being evident. From hydrocele of the spermatic cord, sometimes with much difficulty, and therefore it requires here particular attention. In every case of tumor in the testes, where the most perfect certainty is not obtained, and when it is necessary to have recourse to an operation, the surgeon ought to proceed as in a case of real hernia.

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Treatment.

The treatment of bubonocele is the same with that already advised in the treatment of hernia in general, only making allowance for the situation of the disease. In attempting the reduction by means of the hand, the pressure should be obliquely upwards and outwards, corresponding with the ring of the abdominal muscle. In performing the operation, the patient should be laid on a table, with his head and body almost horizontal, whilst at the same time his buttocks are somewhat elevated by pillows placed beneath them. The legs hanging over the edge of the table ought to be separated, so as to admit the operator between them; and should in that situation be firmly secured by an assistant on each side, who should take care to keep the thighs so far raised as to relax all the abdominal muscles. The parts being previously shaved, an incision must be made with a common round-edged scalpel through the skin and part of the cellular substance, beginning at least an inch above the superior end of the tumor, and continuing it down to between two and three inches below the ring.

Although in by much the greatest proportion of hernial swellings the spermatic vessels lie behind the protruded parts, yet on some occasions they have been found on the anterior part of the tumor; so that in order to avoid the risk of wounding them, as soon as the skin is divided, the remainder of the operation ought to be done in the most cautious manner, care being taken to avoid every large blood-vessel which makes its appearance. The ring must now be laid distinctly in view; a small portion of the protruding sac must also be exposed; after which the directory is to be introduced between the ring and the sac, placing the point of the instrument obliquely upwards and outwards. A blunt pointed bistoury is now to be introduced into the groove of the directory, and by it the ring is to be dilated till the point of the finger can be introduced. The directory is now to be laid aside, and the finger used in place of it through the rest of the operation. After the operation is finished, the dressings are to be applied, and the whole secured by a T bandage, or suspensory bag, properly stuffed with soft lint.

The patient, on being carried to bed, should have a pillow under the buttocks, to elevate them a little above the rest of the body, and should be treated in the manner which has been already directed. As soon as the wound is firmly cicatrized, a truss ought to be properly fitted and used through the rest of the person's life. Females are liable to this species of rupture as well as men; and as the opening in the external oblique muscles is exceedingly similar in both sexes, the treatment of this species of hernia in females is very similar to what is found to answer in men. When clysters, blood letting, and the other remedies formerly enumerated, fail, the same operation of enlarging the opening in the tendon of the oblique muscle is here equally proper as in the other sex.

As modest women are apt to conceal disorders of this kind, they may frequently happen when the surgeon receives no information about them. Whenever, therefore, such symptoms of colic occur as give reason to suspect the existence of hernia, a particular examination ought always to be made, in order, if possible, to detect the cause of the mischief, from the removal of which alone a cure can be expected.

Sect. III. *Of Hernia Congenita.*

Hernia Congenita.

The testes in the fœtus are, till near the time of delivery, lodged in the cavity of the abdomen. When they descend into the scrotum, they push before them a portion of the peritonæum, which afterwards forms the vaginal coat. The passages by which they descend are soon shut up; but sometimes the contrary happens, and then a portion of some of the abdominal viscera passing down, forms that species of hernia to which new-born infants are liable, termed by Haller the *hernia congenita*. The testicle and protruded intestine being here in contact with one another, the tunica vaginalis testis forms the hernial sac.

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How hernia congenita is distinguished from bubonocele.

It has been affirmed by some of the latest writers, that hernia congenita cannot be distinguished from that contained in the common herniary sac; and that though there was a distinction, it could be of no material use in practice. But Dr Monro observes, that a hernia congenita may be distinguished in an adult by an evident external mark; which is, that the bowels push down between the sac and the forepart and sides of the testicle, so as often in a great measure to conceal it; whereas, in the common hernia, every part of the testicle can be felt distinctly: And that it is of material use to make the distinction; because in whatever manner we operate in hernia congenita, unless we take the utmost care to exclude the air, there will be a more violent inflammation and greater distress than in common cases, because the testicle will partake of the inflammation.

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Treatment.

In the treatment of ruptures of the congenital kind, little difference occurs from the management of the common scrotal hernia; only a truss ought never to be applied to infants, unless the testicle can be felt in the scrotum, after the contents of the hernia have been reduced; as it would entirely prevent the descent of the testicle, which yet remains in the abdomen. If any operation has been performed, the testicle should, immediately after the bowels are reduced, be covered with the vaginal coat, and at each dressing care should be taken that the air be excluded. In every other respect the treatment of congenita hernia is the same with that of hernia in general.

Sect. IV. *Of Femoral or Crural Hernia.*

28[illegible]
Situation of the protruded bowels in femoral hernia.

The seat of this species of hernia is upon the upper and fore part of the thigh; the protruded bowels passing out at the same opening through which the large blood-vessels of the thigh are transmitted from the abdomen, and of consequence under that part of the tendon at the under end of the abdomen known by the name of *Poupart's* or *Fallopius's ligament*. Sometimes the bowels which protrude are situated imme-

al immediately over the femoral veſſels, ſometimes on the outſide of theſe, but more frequently they lie upon their inner ſide. The diſeaſe is more frequent in women than in men, on account of the width of the female pelvis, and of conſequence the length and laxity of the ligament. The femoral hernia is more in danger of being confounded with inguinal hernia than with any other; the tumor, however, is deeper, and the ring of the abdominal muſcles, which lies entirely above the tumor in femoral hernia, completely ſurrounds the parts in that of the inguinal kind.

ent. In the treatment of femoral hernia, when ſymptoms of ſtrangulation occur, we muſt uſe all the remedies commonly practiſed for hernia in general; only that here, in attempting to reduce the parts by the hand, the preſſure ſhould be made directly upwards. An inciſion of ſufficient length is to be made through the integuments, ſo as to allow that part of the tendon which forms the ſtricture to be laid fairly in view; and after dividing the integuments, we are cautiouſly to cut the faſcia lata of the thigh, and ſeparate any glands which may come in the way till the ſtricture and part of the ſac diſtinctly appear. The ſtricture is then to be divided, by cutting fibre after fibre ſucceſſively. The ſpermatic veſſels in the male, or round ligament in the uterus in the female, may be avoided by cutting in a direction towards the umbilicus, carefully dividing the tendon tranſverſely. Some authors, from a ſenſe of the danger attending this part of the operation, have recommended merely to dilate the paſſage, inſtead of dividing the tendon; but in ſuch a ſituation, to attempt a farther dilatation without the aſſiſtance of the knife, would probably be ſeldom attended with any advantage. After the parts are reduced, the wound is to be dreſſed as directed in the treatment of hernia in general: a piece of thin leather ſpread with ſome adheſive plaſter retains the dreſſings better, and with much more eaſe, than any other bandage.

Sect. V. *Of other Species of Hernia.*

9 ipha- um- l her- In umbilical hernia the parts protruded paſs out at the umbilicus, and are commonly the inteſtines, or omentum, or both; ſometimes part of the ſtomach, the liver, and even the ſpleen, have been found in the ſac. Here, as in other ruptures, the peritonæum forms the ſac, and in recent caſes it is generally very evident; but by the ſize of its contents, or a long continuance of the diſorder, it ſometimes becomes ſo connected with the ſurrounding parts, that by many its exiſtence has been doubted, and ſometimes the ſwelling has increaſed to ſuch a degree as to burſt even the ſkin itſelf. The diſeaſe occurs moſt frequently in infancy, ſoon after birth. In the adult ſtate corpulent people are more ſubject to it than thoſe of a contrary habit; and pregnant women are particularly ſubject to it, on account of the ſize of the uterus. The diagnoſis in this diſeaſe is readily made, as the diſorder can ſcarcely be confounded with any other. If the diſeaſe be attended to in due time, a bandage properly fitted will generally effect a cure; and in ſuch ſwellings as occur in pregnancy, delivery will commonly remove the diſorder; but even in caſes of pregnant women, a bandage early applied and properly uſed will give conſiderable relief, till a cure can be obtained by delivery. In this diſeaſe the omentum is more frequently puſhed out than any other viſcus; hence umbilical herniæ in general are not productive of ſuch bad ſymptoms as uſually occur in the other kinds of rupture. When, however, the inteſtines protrude, the uſual ſymptoms of a ſtrangulated hernia are apt to be induced; and when the means uſually employed for returning the gut into the abdomen do not ſucceed, a cure it is evident muſt depend entirely on a thorough removal of the ſtricture. In performing this operation, an inciſion through the integuments is the firſt ſtep to be taken, ſo as to expoſe the ſtricture of the tendon and the neck of the ſac. The ſtricture is to be removed in the manner already deſcribed; and as the tendon completely ſurrounds the neck of the ſac, the ſtricture may be cut wherever it can be moſt readily dilated. A radical cure ſimilar to that for the other ſpecies has been propoſed, but with as little probability of ſucceſs. Other ſpecies of Hernia.

Ventral rupture is a protruſion of ſome of the bowels through the interſtices of the abdominal muſcles, and is moſt frequently obſerved in ſome of the parts moſt contiguous to the linea alba. The treatment of this ſpecies of diſeaſe is exactly the ſame with that of exomphalos. 290 Ventral hernia.

Hernia of the bladder of urine, though leſs frequent than that of the omentum or inteſtines, is not very uncommon. The ſituation in which it occurs is in the groin, through the abdominal ring, in the fore part of the thigh, under Poupart's ligament, ſo as to form inguinal or crural hernia. Inſtances have likewiſe occurred of the bladder being puſhed into the perinæum. Sometimes it occurs by itſelf, without any complication; at other times it is accompanied with inteſtines and omentum, both in inguinal and femoral herniæ: when complicated with bubonocele, the protruded part of the bladder is ſituated between the inteſtine and ſpermatic cord. 291 Cyſtic hernia, or rupture of the urinary bladder.

The uſual ſymptoms are a tumor, attended with fluctuation either in the groin, in the fore part of the thigh, or perinæum, which generally ſubſides when the patient voids urine. When the ſwelling is large, before water can be made with freedom, it is commonly neceſſary to have recourſe to preſſure, at the ſame time that the tumor, when in the groin or thigh, is as much elevated as poſſible; but when the ſwelling is ſmall, and eſpecially when no ſtricture is as yet produced, the patient generally makes water with great eaſe, and without any aſſiſtance from external preſſure. When the diſeaſe occurs without any complication, it is commonly owing to a ſuppreſſion of urine. In the diagnoſis care ought to be taken not to miſtake it for a hydrocele. In recent caſes, the part protruding may in general be eaſily reduced, eſpecially if we attend to the ſuppreſſion of urine, which probably gave riſe to the diſeaſe. A proper truſs ought afterwards to be worn for a conſiderable time. When the diſeaſe has been of long ſtanding, adheſion takes place between the bladder and cellular ſubſtance of the ſcrotum. In this caſe, therefore, as long as no ſymptoms occur to render the operation neceſſary, a ſuſpenſory bandage, ſo fitted as effectually to ſupport the prolapſed parts, is the only probable means of relief. 292 Symptoms.

Sometimes the bladder, owing to a ſuppreſſion of urine, at other times part of the inteſtines, have been found to protrude through the vagina. In the former caſe a fluctuation of water is perceptible to the touch. 293 Hernia vaginalis.

The reduction is made by laying the patient on her back with her loins ſomewhat raiſed, and preſſing with the forefinger from the vagina. Deſcents may in future be generally prevented, by evacuating the urine often, and by the uſe of a peſſary introduced into the vagina. Nearly the ſame means are employed in reducing the inteſtine when it is found to protrude.

Chap. XXIV. *Of Hydrocele.*

Every tumor formed by a collection of water might with propriety be named *hydrocele*, but the chirurgical acceptation of the term implies a watery ſwelling ſituated in the ſcrotum or ſpermatic cord. Hydrocele is either anaſarcous or encyſted. In the former, the ſerum is chiefly diffuſed in the cellular ſubſtance: In the latter, the water is collected in a diſtinct bag. The ſcrotum with its contents are liable

 to

Anaſarcous Hydrocele of the Scrotum. to both varieties of the diſeaſe; ſo is the ſpermatic cord with its coverings.

Sect. I. *Anaſarcous Hydrocele of the Scrotum.*

294 Symptoms of this diſeaſe. As ſoon as water has collected in any conſiderable quantity in the ſcrotum, a ſoft, inelaſtic, colourleſs tumor is obſerved over the whole of it; impreſſions are eaſily received and retained for ſome time; the ſkin at firſt preſerves its natural appearance, and the rugæ of the ſcrotum are not much altered; but as the ſwelling advances, they gradually diſappear, and are at laſt totally obliterated. The ſwelling, from being at firſt ſoft, and of a conſiſtence ſimilar to dough, by degrees turns more firm, and the ſkin at laſt acquires an unnatural white ſhining appearance. The tumor at length becomes large; and though originally confined to the ſcrotum, it at laſt ſpreads up the groin. The penis likewiſe becomes affected, and often ſo ſwelled and diſtorted as to excite much inconvenience and diſtreſs; and although the ſcrotum is compoſed of parts which readily admit of dilatation, the tumor ſometimes becomes ſo enormous that it burſts from one end to the other.

295 Treatment. In the ſurgical treatment of this diſeaſe punctures made with the point of a lancet are moſt adviſable, as large ſcarifications, in anaſarcous habits, are ſometimes apt to produce inflammation and mortification; while ſimple punctures readily heal, and can be renewed with very little pain as frequently as may be neceſſary: and beſides, punctures are equally uſeful with the inciſions; for as the cells of the ſcrotum communicate freely, if the punctures be made fairly through the ſkin, the water drains off very readily, though not ſo ſoon as by ſcarification. Previous to the operation beſmearing the part with ſome tough ointment of an innocent nature, and afterwards keeping it as dry as poſſible by a frequent renewal of dry ſoft linen cloths, in order to imbibe the moiſture, is here a neceſſary piece of attention. The want of this ſeems to be the cauſe of much of the miſchief which frequently enſues from operations of this kind. When ſcarifications or punctures go wrong by beginning to inflame and turn painful, &c. a cold ſolution of ſaccharum ſaturni, applied upon ſoft linen, proves moſt effectual in putting a ſtop to the farther progreſs of the inflammation, and affords moſt immediate relief to the patient in the preſent diſtreſs. Lime water, employed in the ſame manner, proves alſo a very uſeful application. When, however, the diſorder proceeds to gain ground by a real mortification coming on, we ſhould immediately have recourſe to bark and other medicines uſually employed in ſuch affections.

296 Sometimes owing to a local cauſe. Although the anaſarcous hydrocele, for the moſt part, depends upon a general dropſical tendency, ſome inſtances occur of a local cauſe producing a mere local dropſy of the ſcrotum. Thus, it has been known to happen from ſwellings in the groin and in the abdomen obſtructing the paſſage of the lymphatics. When this is the caſe, if tumors producing ſuch obſtructions can be extirpated, no other means will afford ſuch effectual relief; but when they are ſo deeply ſeated as to render any attempt for removing them improper, the practice we have already pointed out of making punctures in the moſt depending part of the tumor muſt be employed with a view to palliate ſuch ſymptoms as occur. It ſometimes happens in ſuppreſſion of urine, whether ariſing from ſtrictures in the urethra or from ſtones impacted in it, that the urethra burſts, and the urine in this manner getting acceſs to the cellular texture of the ſcrotum, an anaſarcous ſwelling riſes immediately over the whole of it; nor does it commonly diminiſh till the cauſe by which it is produced is removed.

In order to prevent the formation of ſinuſes, which in ſuch circumſtances will otherwiſe be apt to occur, an inciſion ſhould be made into the tumor, and carried to ſuch a depth as is ſufficient for reaching the wound in the urethra. In this manner a free vent will not only be given to the urine already diffuſed, but the farther collection of it may probably be prevented. If a ſtone impacted in the urethra be found to be the cauſe of effuſion, it ſhould be cut out; and if the obſtruction be produced by ſtrictures in the urethra, they muſt be removed by a proper uſe of bougies. The cauſe being thus removed, if the habit of body of the patient is good, and untainted with any venereal or other general affection, by dreſſing the ſore properly with ſoft eaſy applications, the opening into the urethra will probably heal, and a complete cure will in this manner be obtained. But when theſe ailments are complicated with any general affection, particularly with old venereal complaints, it frequently happens that neither mercury nor any other medicine has much influence in removing them. Hydrocele of the Tunica Vaginalis Teſtis.

Sect. II. *Hydrocele of the Tunica Vaginalis Teſtis.*

In the healthy ſtate of the body, a ſmall quantity of aqueous fluid is exhaled for lubricating the ſurface of the teſticle, the ſuperfluous part of which is abſorbed by veſſels appointed for that purpoſe. When the ſecretion of this fluid is either morbidly increaſed, or its abſorption diminiſhed, a preternatural collection of water is formed in the cavity of the vaginal coat, and hydrocele of the vaginal coat produced.

The ſymptoms are, a fulneſs at firſt obſerved about the inferior parts of the teſticle, and moſt remarkable when the patient is erect, becoming gradually more tenſe as the diſeaſe advances; the tumor by degrees changing from the globular to the pyramidical form; no degree of preſſure making the ſwelling diſappear at any period of the diſeaſe. In the early part of the diſeaſe therefore, if it be not combined with hernia, or with a hydrocele of the cord, the ſpermatic proceſs may be diſtinctly felt, becauſe the ſwelling does not extend beyond the ſcrotum. In its more advanced ſtate, it cannot be diſtinguiſhed: the weight of the tumor now drags the ſkin of the neighbouring parts ſo much as to cauſe the penis almoſt to diſappear; and in this ſtate of the diſeaſe the teſticle cannot be felt without much difficulty. On a minute examination, a hardneſs is always to be felt along that part of the ſcrotum where the teſticle is ſituated; and at this point preſſure excites ſome uneaſineſs. Fluctuation of a fluid may in general be diſtinguiſhed through the whole courſe of the diſeaſe. In late ſtages, however, the appearance of a fluid is not very evident. 297 Symptoms of this diſeaſe.

The tranſparency of the tumor has been generally ſuppoſed to be the principal criterion of this ſpecies of the diſorder; but this muſt depend upon the nature of the contents, or thickneſs of the ſac; ſo that, though the tranſparency of the tumor is a certain ſign of the exiſtence of water, its opacity cannot upon any account be conſidered as an indication of its abſence. Through the whole courſe of the diſeaſe the tumor is not attended with pain, but ſome uneaſineſs is commonly felt in the back by the weight of the ſwelling of the ſpermatic cord. This is more particularly the caſe when a ſuſpenſory bandage is not uſed.

In the radical cure of hydrocele, in whatever way it is attempted, ſome degree of fever and inflammation will take place. Under the circumſtances mentioned in the prognoſis, the operation, if properly performed, is generally attended with the moſt complete ſucceſs. But if the patient be very old, infirm, and diſeaſed, an operation may be attended with ſuch a degree of inflammation, and conſequent ſuppuration, 298 Cure.

puration, as to be in danger of destroying a constitution already greatly impaired, and therefore ought not to be performed.

Various methods have been proposed for the cure of hydrocele, all of which may be reduced to two general heads: Such as have in view only a temporary relief, and which is therefore termed the palliative cure; and such as are meant to effect a radical cure. When the tumor has become so large as to be inconvenient from its size, an evacuation of the water by surgical means becomes necessary. In this case, if the patient either refuses to submit to the operation for a radical cure, or if his state of health render that operation improper, the palliative treatment, or a mere evacuation of the water by puncture, is the only means which can be employed.

A lancet pointed trocar was many years ago recommended for drawing off the water in this manner by the present Dr Monro; and since that time it has in an improved state (fig. 77.), been recommended by Mr Andree; another (fig. 78.) has been proposed by Mr Bell. With any of these an opening may be made into the tunica vaginalis with safety.

The operator with one hand should grasp the tumor behind, to press the contained fluid to the anterior and under part of it. If a round trocar is to be used, a puncture with a lancet should be made where the trocar is to enter; but where a flat trocar is to be employed, the assistance of the lancet is unnecessary.

As soon as the instrument has pierced the vaginal coat, the stilette should be withdrawn, and the canula left in the cist. The water will now run off; and if the tumor be not uncommonly large, it may be all drawn off at once; but as the sudden discharge of it, by taking off the support, might be in danger of rupturing some of the vessels, it should be discharged by slow degrees. When the whole is evacuated, a piece of adhesive plaster should be immediately applied to the orifice; and a compress of soft linen being laid over the scrotum, the whole should be firmly supported with a suspensory bag (fig. 79.) or a T bandage. The patient in this state being laid in bed, all kind of uneasiness is in a few minutes commonly gone, and he is able to follow his ordinary business without interruption.

The intention of every means now in use for the radical cure of this species of the disease, is to induce such a degree of inflammation on the parts in which it is seated as may obliterate entirely the cavity of the tunica vaginalis, by making it adhere to the surface of the testicle. The means at present generally employed for effecting a cure are, excision of the tunica vaginalis; the application of caustic; the use of a seton; a simple incision of the sac; and the injecting of acrid liquors into the tunica vaginalis, after drawing off the fluid which it contained. The method of cure, by the removal of the vaginal coat, is, first to lay open the vaginal coat, and then to cut it away by different snips of a pair of scissars. The sac being removed, the parts are to be dressed and treated in the same manner as in the operation where simple incision is used.

The cure by caustic is attempted in the following manner: The scrotum being shaved, a piece of common paste caustic, properly secured with adhesive plaster, is applied, of about a finger's breadth, the whole length of the tumor; and if, on removing the caustic, it has not penetrated into the vaginal coat, an opening is made in it with a scalpel, so as to evacuate the contents, lay bare the testicle, and admit of proper dressings. But Mr Else, one of the latest writers in favour of the method of cure by caustic, says, that there is no necessity for such an extensive application of caustic as many have recommended; that an eschar of the size of a shilling is sufficient; that this may be always fully obtained by the application of caustic paste of the size of a sixpence, which is to be laid on the anterior and under part of the scrotum, and to be properly secured by plaster, in order to prevent it from spreading. The caustic commonly produces all its effects in five or six hours, and may then be removed. At this time digestives, or an emollient poultice, must be applied over the scrotum, and the whole suspended with a bandage. Inflammation, Mr Else observes, is soon induced over the whole tunica vaginalis; and the febrile symptoms which succeed, he advises to be kept moderate by blood-letting, injections, emollient poultices, and a low regimen. In a few days the eschar of the scrotum separates, and comes away; and in a gradual manner, in the course of four, five, or six weeks, the whole tunica vaginalis comes off, when the wound for the most part soon heals, and a complete cure is obtained.

Hydrocele of the Tunica Vaginalis Testis.

303 By a seton.

Where it is intended to treat hydrocele by means of a seton, it may be done in the following manner: An opening is made with a scalpel, or the sharp-pointed bistoury, in the superior part of the tumor, large enough to admit with ease a thick cord of common white sewing silk. A director, with an eye at one end, in which the cord is inserted, is introduced at this opening; and its farther extremity being carried down to the most depending part of the tumor, an opening is there made, of about half an inch in length, by cutting upon the director with the bistoury; the director being now drawn till a sufficient quantity of silk is left hanging out below, the operation is in this manner finished.

Another very simple method of introducing a seton is by means of a silver canula and perforator.

304 By incision.

In the operation for a radical cure by incision, the patient being laid upon a table of convenient height, and properly secured by assistants, with the scrotum lying nearly on the edge of the table, the operator with one hand should grasp the tumor behind, so as to keep it firm and make it somewhat tense anteriorly: With a common round edged scalpel in the other hand, he should now divide the external integuments by one continued incision from the upper to the under end of the tumor. An opening is next to be made in the vaginal coat with a large lancet, or a sharp pointed bistoury (fig. 80.), at the upper end of the first incision. This opening should be of such a size as freely to receive the finger of the operator, which is to conduct a blunt pointed bistoury, so as to divide the sac down to its bottom, which is considered as being of advantage, by preventing partial adhesions and the risk of a return of the disease.

The incision being completed, the testicle is now brought fully into view; and if the tunica vaginalis be found, the dressing may be finished immediately. But if the sac be diseased, it is to be removed, which may be readily accomplished by a scalpel or bistoury.

When the hydrocele, as sometimes happens, affects both sides at the same time, if, when the operation is done on one side, an opening be made into the vaginal coat of the opposite side, at the upper part, through the septum scroti, and the incision carried down to the bottom of the tumor, the cist can be equally well laid open, the water as completely evacuated, and a return of the disease as much prevented, as when the operation is done in the usual manner, and at different times.

In whichever way the incision is made, if the testicle be found, the wound ought to be quickly dressed; for it is found, that on this much of the success of the operation depends. For if the vaginal coat be merely applied to the testicle, or united by sutures, as some have advised, partial adhesions are apt to take place, before a degree of inflammation is produced over the whole sufficient for making a

Hydrocele of the Tunica Vaginalis Testis.

complete cure. In this manner cavities are left, which either fill with pus during the cure, and require to be laid open, or they afterwards give rise to collections of water, and thereby occasion a return of the disease. The practice of stuffing the cavity of the sore with dressings is also a frequent cause of mischief, by exciting too great a degree of inflammation in the part. But when the dressings are properly managed, symptoms of violence almost never occur. The latest authors advise, that in dressing the parts after the operation, two pieces of lint or soft old linen are to be dipped in oil, or in a liniment of wax and oil, and then, by the help of a probe, are to be inserted into the bottom of the sac on each side of the testicle, leaving a sufficient quantity of the pledgets hanging out of the wound, so as to admit of being easily withdrawn at the first or second dressing. The edges of the wound are next to be dressed with pledgets of cerate, and the ends of the oiled pledgets turned over on each side. Several pieces of soft lint are then to be laid over the wound, and these should be more or less numerous in proportion to the heat of the season. A compress of linen is now to be laid over the whole, and the dressings supported by a T bandage or suspensory bag properly fitted. The patient is then to be carried to bed; an anodyne should be given, especially if there be much pain; and he ought to be advised to lie as much as possible upon his back for a few days after the operation.

In the third or fourth day after the operation, all the dressings, except those between the testicle and tunica vaginalis, are to be removed; and if this cannot be done readily, as the parts are otherwise apt to become uneasy, a sponge dipped in warm water should be applied. On some occasions, at the first dressing, and always at the second or third, the pledgets inserted between the tunica vaginalis come away; and whenever this happens, they should be renewed. It is also proper to renew them daily for the first fourteen or fifteen days after the operation; not however of the same depth as the first, for during the latter part of the cure they need only to be inserted as far as to prevent the divided edges of the tunica vaginalis from adhering to the testicle, before the adhesive process has taken place in the parts more deeply seated. Particular attention however is necessary to this part of the treatment; for when the disease returns, it has been found to be chiefly owing to the edges of the vaginal coat being allowed to adhere to the testicle, before adhesion had taken place between the deeper parts.

A complete adhesion of the two coats of the testicle, the tunica vaginalis, and tunica albuginea, takes place most frequently about the third week after the operation. Previous to this time, inflammation continuing gradually to increase, the tumor becomes larger till it acquire somewhat of the size of a swelled testicle from gonorrhœa; but after this period it gradually subsides, and the sore produced by the incision, and now reduced to a line, heals in some time between the fourth and eight week, according to the habit of body, age of the patient, and other circumstances.

305 Comparative advantages of each of these methods.

Having thus given an account of the methods usually employed in the cure of hydrocele, we shall now make a few observations on the comparative advantages of the three last. From the testimony of many authors of credit, it is evident, that any of these methods, in most instances, prove effectual; but every practitioner being apt to be prejudiced in favour of a particular method, he generally continues to follow that mode and no other; and finding it commonly succeed, he by degrees persuades himself, that other methods of cure, with which he has not had such opportunities of becoming acquainted, are liable to objections, which those who have practised them do not find to be the case. The result of Mr B. Bell's observations upon this subject is, that although all the three modes of operating, by caustic, the seton, and simple incision, are perhaps equally capable of producing a radical cure; yet, that of the three, the latter, viz. the mode by the simple incision, is liable to fewest objections, and effects a cure, both with least trouble to the operator and least risk to the patient: and of the other two, the treatment by caustic appears to be the best. He has seen all the three produce troublesome symptoms, such as, pain and tension of the abdomen, inflammation, and fever; but hesitates not to say, that the seton is more frequently productive of these effects than any of the other methods.

3[illegible] Radical cure by injection.

Besides the methods already mentioned, another has been lately revived, viz. the injecting of irritating liquors into the vaginal coat of the testicle. This method is particularly described by a Monsieur Lambert of the last century, and may be of much older date for any thing which is known to the contrary. From some cause or other it seems to have been entirely laid aside till about the middle of the present century, when it was practised by Mr Monro (afterwards a physician-general in the West Indies), under the sanction of the late Dr Monro, and favourably received and followed by some of the first surgeons of this place. But in general, though the cure appeared complete, the disease returned.

The preference is usually given to wine, and commonly that is somewhat diluted; but where no pain is excited by the injection, the liquor should be discharged, and a stronger one used. For where no pain takes place, a cure is not to be expected.

The following is the most approved method of performing the operation: The operator should be provided with a flat trocar and canula, and with a bag of resina elastica, fitted with a stop-cock and pipe, which ought exactly to suit the canula. See fig. 81.

The patient being laid in an horizontal posture, either upon a bed or a table, the water should be drawn entirely off from the tumor by a flat trocar passed into the under and fore part of it. The operator securing the canula with the one hand, is with the other to pass the tube of the injection-bag fairly through it, and with gentle pressure to force in as much of the liquid as may reach the whole surface of the vaginal coat, as well as the whole surface of the testicle. The bag should now be removed, leaving the tube within the canula of the trocar, so that by turning the stop-cock the injection may be retained in the cavity of the tumor. The canula of the trocar ought still to be kept fixed, otherwise it might recede, by which the liquid would insinuate into the cellular substance of the scrotum. The liquor should likewise be brought into contact with every part of the cavity; and after remaining about four, or at the most five, minutes in the sac, it should be entirely discharged through the canula of the trocar, after withdrawing the tube of the elastic bag.

Sometimes intense pain is felt immediately after the liquor is thrown in. When this is the case, it should be discharged as soon as it has passed over the different parts of the tunica vaginalis. Some recommend a repetition of the same kind of injection immediately after the first has been discharged, and to be retained for the same period, though this is not commonly practised.

The whole of the injection should be completely discharged, after which the scrotum should be covered with a pledget of cerate, a compress being applied over it, and retained with a suspensory bag. The patient ought to be in bed for several days, and support the scrotum in the bandage by means of a small pillow.

Though it is difficult to ascertain the proportion of those

ple who are cured by the method of injections, and though it is to be regretted that hitherto the disease is found to return in a great proportion of those upon whom this operation has been performed; yet, on account of the facility with which it can be done, the comparatively small pain with which it is attended, the quickness of the cure, and chiefly because it does not, in case of a return of the disease, preclude the future operation of incision, it appears a method which, in all probability, will be more and more adopted into practice.

Sect. III. *Of Hydrocele of the Spermatic Cord.*

Anasarcous hydrocele of the spermatic cord sometimes accompanies ascites, and at other times it is found to be confined to the cellular substance in or about the spermatic cord. The causes of this disease may be, obstructions in the lymphatics leading from the part in consequence of scirrhous affections of the abdominal viscera, or the pressure of a truss applied for the cure of hernia.

When the affection is connected with anasarca in other parts, it is then so evident as to require no description. When it is local, it is attended with a colourless tumor in the course of the spermatic cord, soft and inelastic to the touch, and unaccompanied with fluctuation. In an erect position of the body it is of an oblong figure; but when the body is recumbent, it is flatter and somewhat round. Generally it is no longer than that part of the cord which lies in the groin, though sometimes it extends as far as the testicle, and even stretches the scrotum to an uncommon size; an instance of which is related by Mr Pott, who from a swelling of this kind discharged 11 English pints at once. By pressure a great part of the swelling can always be made to recede into the abdomen. It instantly, however, returns to its former situation on the pressure being withdrawn.

When the tumor is connected with general anasarca of the system, it can only be cured along with the rest of the disease; but when the swelling is local, the remedy is also to be locally applied. An incision is to be made of such a size as may be sufficient for discharging the whole of the water; in the performance of which, attention is necessary to guard against hurting the spermatic vessels. The contents of the tumor being discharged, the sore is to be treated like any other simple wound.

Encysted hydrocele of the spermatic cord sometimes begins in the upper, but generally at the lower part of the spermatic cord. On its first appearance it is so small as to give little or no trouble; hence it is seldom particularly attended to till it has acquired a considerable size. By degrees it extends as far as the abdominal muscles, and sometimes reaches to the bottom of the scrotum; and to a person unacquainted with the appearance of the disorder may be mistaken for a hydrocele of the tunica vaginalis. But here the tumor is always above the testicle, which is distinctly felt below; and even in the advanced state of the disease the testicle is found in the back part of it perfectly unconnected with the swelling; whereas, in the advanced stages of hydrocele in the vaginal coat, although some hardness is discovered where the tunica vaginalis adheres to the testicle, yet when the swelling is great the testicle cannot be distinctly felt. In the encysted hydrocele of the cord, the figure and size of the penis is little altered; whereas, in cases of common hydrocele, the penis frequently disappears almost entirely. In other respects the two diseases are nearly similar. It sometimes happens that the water is contained in two distinct cells. In that case the tumor is somewhat puckered up, or diminished in its diameter. A similar appearance also occurs, when this variety of the disease is connected with hydrocele of the tunica vaginalis, which sometimes takes place. Hæmatocele Scroti.

The only other tumors with which this one may be confounded are, the anasarcous hydrocele of the spermatic cord, and a real hernia. But in neither of these is the fluctuation of a fluid perceptible, and to the touch they are both soft and inelastic; whereas, in this variety of hydrocele, the tumor has a springy feel, and a fluctuation is sensible to the touch; and in both the one and the other the swelling recedes somewhat upon pressure, which it never does here.

From hernia it is chiefly distinguished by the tumor beginning some way down the cord. In hernia the tumor turns less when the patient is in an horizontal posture, and is considerably affected by coughing and sneezing; but this kind of hydrocele is not altered in size by any such circumstances, nor has it the common symptoms which attend a hernia.

Infants are frequently subject to this disease, as well as to an anasarcous swelling of the cord, and an œdematous tumor of the scrotum. But here the complaint is seldom permanent; for in most instances it readily yields to gentle friction, with any stimulating or astringent application, as a strong solution of sal ammoniac in vinegar, &c. But in adults, the cist, in every variety of encysted hydrocele, becomes so firm as not to be affected by external applications; so that when the tumor becomes large, it is necessary to use means for producing either a palliative or radical cure, in the same manner as is done for a hydrocele in the vaginal coat.

Sect. IV. *Of Hæmatocele Scroti.*

We shall mention in this place the disease called *hæmatocele scroti*, which is occasioned by blood extravasated in the inner substance of the scrotum, in the tunica vaginalis, or in the spermatic cord; but the usual situation is in the tunica vaginalis testis.

Tumors of this kind may be produced by any thing which ruptures the blood vessels of the part, but they are commonly the consequence of external violence. In the tunica vaginalis this disorder may be produced by the point of a trocar or of a lancet in tapping for hydrocele. In such a case, we are commonly informed of the accident by blood being discharged along with the water; though sometimes it does not appear till the whole of the water is evacuated, and then a tumor of a considerable size suddenly takes place. Sometimes it happens where the quantity of water has been so uncommonly great that the sudden discharge of it, by taking away the support which the vessels have been accustomed to receive, has been the cause of their rupture; and it seems certain, that whenever a tumor is produced either in the scrotum or cord suddenly after the water of a hydrocele has been evacuated by tapping, that it is entirely owing to an extravasation of blood.

In the spermatic cord injuries of the same kind will be attended with a similar effect upon the vessels of the sac containing the water. The distinction between blood and water in the substance of the scrotum is readily made by the colour; for where the disease is produced by blood, it forms a real eschymosis. The tumor feels heavier in the tunica vaginalis when filled with blood than where it is filled merely with water; the treatment is nearly the same with that in hydrocele. In the commencement of the anasarcous or diffused hæmatocele, when produced from slight external violence, the application of stimulating or astringent fluids will sometimes discuss it; but if this prove ineffectual, the tumor is to be laid open, and treated exactly as was directed for hydrocele: only if a ruptured vessel be discovered, it must be secured by ligature. In like manner, all collections

of

Varicocele, Circocele, Spermatocele, and Pneumatocele.

of blood either in the vaginal coat or ſpermatic cord are to be laid open, and treated as in hydrocele. If bleeding veſſels appear, they are to be ſecured. Sometimes, however, theſe cannot be detected; an oozing takes place which it is difficult to reſtrain, even by the uſe of bark, vitriolic acid, and other means generally employed in ſuch caſes. It has been uniformly found, that local remedies prove chiefly uſeful here, particularly the application of ardent ſpirits, æther, or tincture of myrrh, to the ſurface of the ſore. Pledgets of ſoft lint, ſoaked in one or other of theſe, not only ſerve to check the diſcharge of blood, but in general tend to promote the formation of good matter.

Chap. XXV. *Of Varicocele, Circocele, Spermatocele, and Pneumatocele.*

311 Varicocele. Varicocele is a preternatural diſtenſion of the veins of the ſcrotum, which in this ſtate form a tumor of hard, knotty inequalities, ſeldom painful, and generally attended with no inconvenience excepting what ariſes from its bulk.

312 Circocele. Circocele is ſimilar in its nature to the former, but ſituated in the ſpermatic cord, extending from the abdominal ring to the ſuperior part of the ſcrotum, and produced by a varicoſe ſtate of the ſpermatic vein. Both of theſe diſorders are occaſionally produced by obſtruction in the veins; but are moſt frequently owing to a relaxed ſtate of theſe veſſels; to which we may add, that on account of the ſmallneſs of the correſponding artery, they are not ſufficiently affected by its influence. The tumor produced by theſe diſorders is ſometimes ſo large as to appear like a hernia or hydrocele; but we diſtinguiſh it from theſe by the touch, for varicoſe veins are like worms filled with elaſtic matter. We have another mark upon which we can ſtill more depend: The tumor in the erect poſture of the body is much increaſed, while in the horizontal ſituation it almoſt entirely diſappears.

313 Of collections of blood within the tunica albuginea. Another diſorder is obſerved by late authors, where a collection of blood is ſometimes found within the tunica albuginea teſtis, and is ſuppoſed to be a kind of hæmatocele, or more probably varicocele. Sometimes the collection is ſo conſiderable, that a fluctuation reſembling that of an hydrocele of the vaginal coat of the teſticle is obſervable. When this is miſtaken for hydrocele, and an opening is made into it with a trocar, a diſcharge is produced of a duſky-coloured blood, ſomewhat reſembling thin chocolate: But though the tumor may be diminiſhed by the evacuation thus obtained, yet the alteration is inconſiderable; nor is the patient ever relieved, but on the contrary made worſe by ſuch an operation. Caſtration, after this, becomes neceſſary; but even this has been found ineffectual: ſo that the patient had better be adviſed to truſt to nature, aſſiſted by a proper ſuſpenſory bandage, than to ſuffer the attempt of a radical cure; for it has been obſerved, that in ſome inſtances they have remained ſtationary for many years, whereas they never fail to become much worſe by any attempt to evacuate the fluid.

When tumors, or the preſſure of a truſs, has been the cauſe of ſuch complaints, a proper attention to theſe ought to be the firſt attempt towards a cure. But when a relaxed ſtate of the veins is ſuſpected, we ought to recommend a ſuſpenſory bandage, an horizontal poſture, the cold bath, and the application of a ſolution of alum and other aſtringents. By a proper exhibition of theſe, the diſeaſe may at leaſt be prevented from increaſing, ſo as to render any operation unneceſſary.

314 Spermatocele. By ſpermatocele is underſtood a morbid diſtenſion of the vas deferens and epidydimis. The diſeaſe may ariſe from tumors, ſtricture, or inflammation about the vas deferens, or its termination in the penis; but more probably from inflammation there. When an inflammatory diſpoſition is diſcovered, general and topical blood-letting, gentle laxatives, a low cooling diet, and reſt of body, will commonly be found the beſt remedies. When tumors are found to preſs upon the vas deferens, they ought either to be brought to a ſtate of ſuppuration, or entirely extirpated, if that can be properly effected. If the diſeaſe proceed from a venereal cauſe, nothing can be ſo uſeful as a courſe of mercury properly directed.

By pneumatocele is underſtood a diſtenſion of the ſcrotum from a collection of air. Pneumatocele.

The principal cauſe of this diſeaſe, which rarely happens, is wounds in the lungs, by which air paſſes through the common cellular ſubſtance into the ſcrotum; but from whatever cauſe the tumor is produced, the diſeaſe is to be treated by making ſmall punctures with the point of a lancet, as in the caſe of anaſarcous ſwellings formed by water.

Chap. XXVI. *Of Sarcocele, or Scirrhous Teſticle.*

Sarcocele implies a fleſhy, enlarged ſtate of the teſticle, much firmer and harder to the touch than is obſerved in hernia humeralis or inflamed teſticle.

The ſymptoms vary exceedingly in different patients; but the following are the moſt general: The firſt ſymptom is commonly a ſmall enlargement, without much pain, and no diſcoloration of the part. The tumor becomes gradually larger, and the hardneſs increaſes; but for a conſiderable time the ſurface remains ſmooth; and when the conſtitution is otherwiſe good, the diſorder will ſometimes remain in this ſituation for a conſiderable number of years; and in a few rare inſtances, by a moderate diet, keeping the belly open, ſuſpending the tumor properly, and avoiding violent exerciſe, or any thing which may conſiderably increaſe the impetus of the blood, the diſorder has not only been prevented from increaſing, but has in a gradual manner diſappeared entirely. More commonly, however, the tumor increaſes in ſize, and becomes ragged and unequal on its ſurface. Smart and ſevere ſhooting pains are frequently felt through its ſubſtance. Sometimes ſerum is extravaſated in the vaginal coat, or matter is collected in different parts of the tumor. The ſcrotum, now much diſtended, burſts, and thin, fetid, bloody matter diſcharging, the diſeaſe terminates in an ulcerated cancer of the worſt kind.

The ſpermatic cord is commonly unaffected till the tumor has acquired a conſiderable ſize, and generally not till collections of matter have been formed. After this, from being at firſt only ſlightly ſwelled, it gradually increaſes in hardneſs and bulk; after which it becomes very painful, knotty, or unequal through its whole extent. The diſcharge from the ſcrotum ſtill continues; but although the matter increaſes in quantity, the ſize of the tumor is not thereby diminiſhed, but, on the contrary, continually increaſes; the edges of the ſore become hard, livid, and retorted, and fungous excreſcences puſh out from every part of it; the health of the patient becomes entirely deſtroyed, and he is at laſt carried off in great miſery.

Hernia humeralis produced by venereal infection has been conſidered, by ſome authors, as a frequent cauſe of the worſt kind of ſcirrhous teſticle; but the fact is very much otherwiſe; and ſuch an idea has this bad tendency, that it prevents the perſeverance in the uſe of ſuch remedies as might have removed the diſeaſe without the neceſſity of extirpation.

Another cauſe mentioned by authors as producing ſcirrhus

scirrhus of the testicle, is the hydrocele of the vaginal coat; but though sarcocele is frequently combined with this disease, there is every reason to think that the primary disorder was in the testicle itself, and that the water is only a consequence of the other complaint. When the hydrocele happens to be the original disease, the testicle is also found frequently altered in its appearance. It is here paler than in its natural state. It is sometimes diminished, but more frequently enlarged. The enlargement however is soft, harmless, and free from pain; and in such a situation should never be extirpated. To this point particular attention ought to be paid, otherwise we run the risk of committing a mistake, into which practitioners have been too frequently led—the extirpation of a testicle which ought to have been saved. To keep free of this error, we ought to attend to the following circumstances.

When the disease begins in the testicle itself, especially in the body or glandular part, or when it becomes hard and enlarged previous to any collection of water in the vaginal coat, it is to be considered as of a different nature from that in which an enlargement of the part succeeds to a collection of water; or if, upon evacuating the water, the testicle be found hardened, enlarged, and attended with pain and other marks of scirrhus, especially if the surface be unequal or ulcerated, extirpation ought certainly to be performed. The symptoms above mentioned sometimes, though rarely, begin in the epidydimis. In such cases, however, extirpation will seldom be advisable, as there is here always a suspicion of a venereal affection; and then we ought by all means to try the remedies commonly used in such diseases. In the prognosis, we attend to the age and habit of the body, as well as to the state of the disease and length of time it has continued.

When the patient is young and the constitution unbroken, we may always hope for a cure, although the symptoms should be very considerable; whereas, in old infirm people, and in habits attended with an emaciated look, with indigestion, and other symptoms of obstructed viscera, whatever state the disease may be in, there will be but a small chance of success.

If the disease has subsisted for a long time without considerably increasing in size, we may reasonably think it is of a milder nature than where it has made a rapid progress. As long as the testicle is only hard and free from the formation of matter, we may expect a favourable event; but where collections of matter have already formed, either in the substance or upon the surface of the testicle, there is no other chance of saving the patient than by means of extirpation. Previous to this, however, we are to attend to the state of the spermatic cord; for were any of it left in a diseased state, little advantage could be derived from extirpation; nor ought the operation ever to be performed but where we can reach the whole of the diseased parts. We are not to be prevented from performing it though the cord should be considerably enlarged, providing it do not evidently partake of the disease of the testicle; for the cord is generally somewhat enlarged in the diseased state of the testicle; but this enlargement is for the most part merely either a varicose state of the veins, or a watery disposition of the cellular substance.

But supposing no obstacle to the operation, the method of doing it may be this. The parts being previously shaved, the patient is to be laid upon a square table of about three feet four inches high, letting his legs hang down; which, as well as the rest of his body, must be held firm by assistants; or, he may be laid across a bed in the same manner. Then with a knife the incision is to be begun above the rings of the abdominal muscles, that there may be room afterwards to secure the vessels; then carrying it through the membrana adiposa, it must be continued downward to the bottom of the scrotum. A firm, waxed, flat ligature, composed of small threads, is next, by means of a curved needle, to be passed round the spermatic cord, at least an inch above the diseased part, or as near the abdominal ring as possible; after which the vessels are to be secured by a running knot, and divided about a quarter or half an inch below the ligature. The cord and testicle are then to be removed from the surrounding parts by dissecting from above downwards, and no instrument is better for this purpose than the common scalpel. After the diseased parts are removed, the knot upon the cord must be slackened to discover the spermatic arteries and veins; both of which, by means of the tenaculum or a common forceps, are to be taken up. The ligature upon the spermatic cord is now to be left loose, so as to act as a tourniquet if a hemorrhagy should ensue; nor is there more occasion for leaving the ligature tied than for leaving a tourniquet firmly applied to one of the extremities after amputation; besides, where patients have suffered such pain as is sometimes mentioned by authors, it has been found to be owing to the tightness of the ligature rather than to any other cause. In dividing the ligatures of the blood-vessels at the extremities of the cord, they must be left of such a length without the wound as to be readily removed, however much the cord may retract in the time of the cure.

In separating the testicle, a considerable hemorrhagy sometimes ensues from the division of the scrotal arteries. In such a case, they ought always to be fixed with ligatures before proceeding in the operation. The parts being removed, and the blood-vessels secured, the wound is to be cured, if possible, by the first intention; and for this purpose the sides of the scrotum are to be brought together in the most accurate manner, beginning at the under end, and securing the parts by adhesive plaster as we proceed upwards, and in such a way that the sides of the sore may be kept properly together. About two inches of the ligatures of the cord are to be left out, and this part of the wound treated in the same manner as the rest; the whole to be secured by a compress of linen and a T bandage.

The patient should now be laid to rest, and an opiate administered; and if, upon the second or third day, any inflammatory symptoms ensue, they are to be removed by methods commonly employed upon these occasions; as, topical blood-letting, gentle laxatives, and keeping the part constantly moist with a solution of sugar of lead. The dressings ought not to be allowed to shift, else the cure will be greatly retarded. They are to be examined about four or five days after the operation; and if nothing material has happened, they may be allowed to remain two or three days longer, by which time generally the ligature can be readily removed; and the wound will be healed by the first intention, excepting some small opening in the skin, more especially where the ligatures were placed. These are to be drawn together by adhesive straps, and dressed in the same manner as formerly. In this way, if the patient be otherwise healthy, a cure may be expected in little more than a fortnight. 318 Treatment after the operation.

The method of dressing most frequently practised is to apply a quantity of soft lint to the sore, and then a compress of linen over it, and to secure the whole with a T bandage or a suspensory bag. The patient is then laid to rest, and an opiate given. The sore is not to be touched till a free suppuration takes place, which will commonly be about

Stone in the Bladder. about the fifth or sixth day, and then the dressings are to be removed, and renewed from time to time; once every two days, or oftener, as the quantity of matter may render it necessary. Sometimes after the operation the patient complains of pain in the sore, and of tension and uneasiness in the belly. In such a case, warm fomentations should be applied to the abdomen, and the sore covered with an emollient poultice, and this repeated as often as may be necessary.

Chap. XXVII. *Of the Stone.*

Sect. I. *Of Stone in the Bladder.*

319 Causes of the formation of calculi. A variety of causes have been assigned as tending to the formation of calculi in the bladder of urine; as, a decomposition of a superabundant quantity of earthy matter from the blood, on account of a sedentary life; certain articles of diet or drink, containing a greater quantity of earthy matter than others; a continued use of solid food without a sufficient quantity of drink; the peculiar action of absorbent vessels; the particular structure of the kidney; the nature of the different excretory vessels; the time the urine may remain in the kidney; the habit of retaining the water in the bladder; particles of blood getting into the kidney or bladder, and attracting the stony matter so as to form a nucleus. A certain change of the vessels of the kidney forming the urine has by some been considered as a more probable cause than any of the former. The formation of calculus sometimes begins in the kidneys, at other times in the bladder.

After a calculus has begun to be formed, it sometimes acquires a great size in a few months from the first obvious symptoms; but sometimes it remains in the bladder for many years without arriving at any considerable size.

320 Symptoms of calculus. The symptoms commonly come on gradually, and bear some kind of proportion to the size and inequalities of the stone. One of the first commonly taken notice of is an uneasy sensation at the point of the urethra, which for some time is perceptible only upon making water, or upon using violent or jolting exercise. This sensation gradually increases; and there is along with it a frequent desire to make water, which is commonly voided in small quantities, and sometimes only in drops. When running in a full stream, it often suddenly stops, though the patient is conscious that a considerable quantity still remains, and feels a strong inclination to void it. If the stone be large, the patient has a constant dull pain about the neck of the bladder, and frequent desire of going to stool. The urine is generally of a limpid colour; but it is frequently thick, depositing a mucous sediment, and when the disease is violent it is often tinged with blood. All these complaints are greatly increased by exercise, especially by riding on horseback; and from a long continuance of pain, the patient's health by degrees becomes much impaired, and unless effectual means are employed for removing the cause of the disorder, death alone puts an end to his misery.

We are rendered certain of the existence of calculus when small pieces of stone are frequently passed along with the urine. When this does not occur, we cannot be certain that the symptoms do not arise from an ulcer or tumor in the body or neck of the bladder, or from the pressure of tumors in the neighbouring parts. In doubtful cases, however, we have one mark by which we can judge with certainty, which is by means of sounding.

321 Method of sounding. This is performed by introducing an instrument called a *sound* (or staff), formed of steel finely polished, and having the natural curvature of the urethra. The patient is to be laid upon a table or across a bed, with his shoulders raised upon a pillow, to bring the stone to the neck of the bladder, and his thighs a little elevated and separated from each other. A sound adapted to the size of the urethra is to be chosen; and previous to the introduction it is to be laid in warm water till it be of the heat of the body, and then wiped and rubbed over with bland oil, butter, or axunge. The surgeon lays hold of the penis with his left hand, while with his right he introduces the sound with its concave side towards the abdomen. He is now with his left hand to draw the penis gently forward upon the instrument, which is to be gradually pushed into the bladder. If any difficulty occur about the neck of the bladder, this may be obviated by introducing the finger into the anus, and raising the point of the instrument; or the same purpose is more readily answered by depressing the handle of the sound. If still it does not pass with ease, much force ought by no means to be used, lest the instrument perforate the membranous part of the urethra.

As soon as the instrument enters the bladder, if it happen at once to touch the stone, a tremulous motion will be communicated to the fingers of the operator, and the business of sounding is then accomplished, the nature of the disease being now ascertained. Great care, however, is here always necessary, as a few particles of sand, or a hardened state of the bladder, have sometimes communicated the same sensation. If the stone be not soon discovered, the instrument is to be moved in all directions; and should the operator be still unsuccessful, one of the fingers of the left hand is to be introduced into the rectum, so as to raise that part of the bladder in which a stone may probably be concealed. If even this attempt prove ineffectual, the body of the patient is to be put into different positions, and perhaps one of the best is depressing the shoulders and raising the pelvis. By this mean a stone may generally be felt, providing it is not contained in a cyst, which very rarely happens. If after all these different attempts the surgeon should fail in discovering the stone, the instrument is to be withdrawn; and if symptoms of stone be strongly marked, and it appear that neither scirrhus nor inflammation, which might give rise to these symptoms, do exist, a second or even a third trial is to be made on the following days.

Various lithontriptics have been recommended for dissolving the stone in the bladder; such as lime-water, caustic alkali, soap, &c. but none of them can be conveyed in such a state into the bladder as to be much depended upon, as they undergo the greatest change in the course of the circulation. To obviate these changes, it has been recommended to inject certain fluids of this class through the urethra into the bladder; but this has not been attended with any material advantages, and has generally been found to do injury to the bladder. The only effectual method of removing stones from the bladder is by means of a chirurgical operation; the success of which depends much upon the dexterity of the surgeon, as well as on the constitution of the patient. 322 Of lithontriptics.

When the constitution has been so much impaired that the patient complains greatly of sickness and oppression at stomach, with nausea and an inclination to vomit, especially upon taking food; when he has likewise a constant thirst, and the pulse is as high as a hundred strokes in the minute—an operation is improper till these symptoms are removed. The operation is improper also when the patient labours under a severe fit of the stone; for then inflammation of the bladder is apt to ensue to such a degree as to produce suppuration. By frequent attacks and continuance of these fits, the coats of the bladder are apt to be thickened and greatly contracted. This last circumstance may be known by the introduction of the sound; for then it will stop after 323 Symptoms forbidding lithotomy.

ter getting past the ſphincter of the bladder, and cannot be puſhed farther without conſiderable force, and at the ſame time giving the patient the moſt exquiſite pain. Nor ought the operation to be performed when the bladder is ulcerated, eſpecially where the patient is old and much debilitated, and where the diſcharge of matter is great.

Children more readily recover from the operation of lithotomy than adults; and old people from the age of 55 to that of 70, whoſe conſtitutions have not been broken, are in leſs danger than thoſe in the full vigour of life, probably owing to inflammatory ſymptoms being more apt to proceed to a dangerous length in the extremes of age than at the middle period of life. When the conſtitution, however, is not much impaired by the continuance of the diſeaſe, the operation may be undertaken with a probable degree of ſucceſs almoſt at any period of the patient's life.

Several methods have been recommended for performing this operation; but there are only two which can be practiſed with any propriety. One is, where the operation is to be performed immediately above the pubes, in that part of the bladder which is not covered with peritonæum: the other, where it is done in the perinæum, by laying open the neck and lateral part of the bladder, ſo as to allow of the extraction of the ſtone.

Franco, a French ſurgeon, finding a ſtone in a child of two years of age too large to be extracted through an opening in perinæo (the place where the operation was then performed), was induced to make an inciſion into the bladder above the pubes; but though the ſtone was extracted and the child recovered, Franco, who publiſhed the caſe in 1561, never attempted the operation again, and even diſſuades others from doing it. It does not appear indeed to have been much practiſed anywhere till ſome time after the commencement of the preſent century, about the year 1720, when it was adopted and frequently performed in Britain and other parts of Europe for the ſpace of about 12 or 15 years. The lateral operation came then to be more generally known, and ſince this period the high operation has been ſeldom practiſed.

In performing the high operation, the bladder muſt be in a diſtended ſtate, ſo as to make it riſe above the oſſa pubis, to allow an inciſion to be made into that part of it which is uncovered by the peritonæum, and thereby to prevent the abdomen from being opened or its contents expoſed. Some days, or even weeks, previous to the operation, the patient ought to be deſired to retain his urine as long as he can, ſo as to diſtend the bladder till it can hold at leaſt a pound and a half, when the perſon is an adult and of an ordinary ſize; or the penis may be tied up to allow the urine to collect. As theſe methods may be attended with great diſtreſs, ſome prefer diſtending the bladder by injecting warm water by ſlow degrees till the bladder is ſufficiently full, which may be eaſily known by relaxing the abdominal muſcles and feeling above the pubes.

When the operation is to be performed, the patient is to be laid upon a table of convenient height, with the pelvis higher than the ſhoulders, that the parts may be fully on the ſtretch, and to prevent the bowels from preſſing upon the bladder. The legs and arms are to be properly held by aſſiſtants. An inciſion is to be made through the ſkin, in the very middle of the under and fore part of the abdomen, from ſome way under the umbilicus to the ſymphyſis pubes. The cellular ſubſtance, the tendon of the oblique muſcles, the muſculi recti and pyramidales, are now to be ſeparated; and it is better to make this ſeparation from the pubes upwards, ſo as to be in no danger of cutting into the abdomen. The ſurface of the bladder will now appear uncovered by the peritonæum. Then the operator, with a common ſcalpel, or an abſceſs lancet, or, what is better, with a concave ſharp-pointed knife, makes a perforation into the moſt prominent part of the bladder, till the fore finger of the left hand can be introduced. The ligature is now to be removed from the penis; then with a probe-pointed biſtoury, making the finger ſerve as a conductor, the wound is to be made ſufficiently large for the extraction of the calculus, taking particular care, however, not to carry the inciſion ſo far as to cut the peritonæum. This part of the operation being finiſhed, the ſtone is to be extracted with the finger; or if that be impracticable, the forceps are to be employed. Should it unfortunately happen that the ſtone is broken in the extraction, the pieces are to be removed entirely by the fingers rather than by ſcoops, which were ſometimes uſed. The edges of the wound in the integuments are now to be drawn together by means of the twiſted ſuture, leaving about an inch and a half immediately above the pubes for the diſcharge of any urine which may be there evacuated. The patient is to be laid in bed, with the pelvis ſtill kept higher than the ſhoulders. Gentle laxatives are to be occaſionally given, and the antiphlogiſtic plan ſtrictly adhered to.

The advantages of this method are, that larger ſtones can be extracted by this than by the lateral operation, and that fiſtulous ſores are leſs apt to enſue. The diſadvantages are, the danger of opening or wounding the peritonæum, and thereby expoſing the abdominal bowels; the frequent occurrence of inflammation about the beginning of the urethra, ſo as to occaſion the urine to be diffuſed in the cellular ſubſtance on the outſide of the bladder, and thereby producing ſinuſes difficult to cure; the extreme difficulty of healing the wound, eſpecially in bad conſtitutions; and, laſtly, the ſmall number of patients, after the age of thirty, who have been found to recover from this operation. 326 Advantages and diſadvantages of the high operation.

Frere Jacques, a French prieſt, was the inventor of the lateral operation. He firſt appeared at Paris in 1697, and afterwards operated in a great number of caſes. 327 Lateral operation.

He introduced a ſound through the urethra into the bladder with a ſtraight biſtoury, cut upon the ſtaff, and carried his inciſion along the ſtaff into the bladder. He then introduced the fore finger of the left hand into the bladder, ſearched for the ſtone, which, having withdrawn the ſound, he extracted by means of forceps. The patient was now carried to bed, and the after treatment left to the attendants. 328 Frere Jacques's method of performing lithotomy,

Profeſſor Rau of Holland improved upon this method, by making a groove in the ſtaff, which enabled him, with greater certainty, to continue his inciſion into the bladder: but inſtead of dividing the urethra and proſtate gland, the latter of which he was afraid of wounding, he diſſected by the ſide of the gland, till the convex part of the ſtaff was felt in the bladder, where he made his inciſion, and extracted the ſtone; but this method was too difficult to perform, and attended with too many inconveniences and dangers ever to be generally received. It ſuggeſted, however, to the celebrated Cheſelden the lateral method of cutting, as it is now with a few alterations very generally practiſed. We ſhall attempt to deſcribe the different ſteps of this operation in its preſent improved ſtate. 329 Improved by Profeſſor Rau. 330 Suggeſted the lateral operation.

The manner of preparing the patient depends upon a variety of circumſtances. If he be plethoric, a few ounces of blood ſhould be taken away, and at proper intervals the bowels ought to be emptied by any gentle laxative which will not gripe. The diet ſhould conſiſt of light food for ſome time previous to the operation. If the pain be violent, opium is neceſſary. Sometimes it is relieved by keeping the patient in bed with the pelvis raiſed, ſo as to remove the ſtone from the neck of the bladder. He ought not to 331 Manner of preparing the patient.

Stone in the Bladder.

sit up, or take any exercise, in the time of preparation. The warm bath ought to be used two or three times, and the patient should remain in it half an hour at each time. A laxative ought to be given on the day preceding the operation, and an injection a few hours before it is performed. The patient ought to drink plentifully of some diluent liquor, and to retain the urine several hours previous to the operation. If this cannot be readily affected, a slight compression, by means of a ligature, may be made upon the penis, so as to have the bladder sufficiently distended, that there may be no danger of the posterior surface being hurt by the end of the gorget. The perinæum and parts about the anus should be well shaved.

332 Manner of performing the operation.

A table somewhat more than three feet in height, and of sufficient strength, is now to be firmly placed, and properly covered with blankets, pillows, &c. Upon this the patient is to be laid and properly secured; and for this purpose there ought to be two pieces of broad firm tape, each about five feet in length, which are to be doubled, and a noose formed upon them. A noose is then to be put upon each wrist, and the patient desired to lay hold of the middle of his foot upon the outside. One end of the ligature is to go round the hand and foot, and the other round the ankle and hand, and cross again, so as to repeat the turns in the reverse way. A running knot is then to be tied, by which the hand and foot will be properly secured. The buttocks are then to be made to project an inch or two over the table, and to be raised considerably higher than the shoulders by a couple or more pillows, and one ought to be put under his head.

The operator is now to introduce a grooved staff (fig. 83.) of proportionable size, and open to the very end, through the urethra into the bladder; and having again fully satisfied himself of the existence of a stone, he inclines the staff, if the surgeon be right handed, obliquely over the right groin, so that the convex part of the staff may be felt in the perinæum on the left side of the raphe. He then fixes it, and delivers it to his assistant, who is to hold it with his right hand, desiring him to press it gently, in order to make the sulcus of the staff project in the direction in which he received it. With his left hand the same assistant is to raise and support the scrotum.

The thighs of the patient being sufficiently separated by the assistants, and the surgeon being seated upon a chair of a proper height, and in a convenient light, he makes an incision with a common convex edged scalpel through the skin and cellular substance, immediately below the symphysis of the ossa pubis, which is a little below the scrotum, and where the crus penis and bulb of the urethra meet, and on the left side of the raphe, and continues it in a slanting direction downwards and outwards to the space between the anus and tuberosity of the ischium, ending somewhat lower than the basis of that process, by which a cut will be made of three or four inches in length. This incision ought not to be shorter than is here directed, otherwise there will not be room for the rest of the operation. As soon as the integuments are thus divided, he ought to introduce two of the fingers of the left hand. With one he keeps back the lip of the wound next the raphe, and with the other he presses down the rectum. He ought likewise particularly to guard against cutting the crures of the penis, which he can readily feel, and separate at their under part with one of the fingers. He next makes a second incision almost in the same direction with the first, but rather nearer to the raphe and anus, by which he preserves the trunk of the arteria pudica. By this incision he divides the transversalis penis, and as much of the levator ani and cellular substance within these as will make the prostate gland perceptible to the finger. If any considerable vessel be cut, it is immediately to be secured, though this is seldom necessary. After this he will have a view of the membranous part of the urethra, which is distinguished from that covered by the bulb by being very thin. He is now to search for the groove of the staff with the fore finger of his left hand, the point of which he presses along from the bulb of the urethra to the prostate gland, which surrounds the neck of the bladder. He keeps it there; and turning the edge of the knife upwards, he cuts upon the groove of the staff, and freely divides the membranous part of the urethra, from the prostate gland to the bulb of the urethra, till the staff can be felt perfectly bare, and that there is room to admit the point of the finger; and as the finger assists in keeping the parts stretched, and effectually prevents the rectum from being hurt, the incision into the urethra may be made with perfect ease and safety.

The next part of the operation, viz. dividing the prostate gland and neck of the bladder, might, by a dexterous operator, be safely performed with a common scalpel, with the edge turned the opposite way. But to guard against accidents, a more convenient instrument, called the *cutting gorget* (fig. 84.), is now in general use. It was originally invented by Mr Hawkins of London, and since his time has undergone various alterations. Fig. 85 is a double gorget invented by Dr Monro. The inner plate, which is blunt, is made to slip forwards to protect the back part of the bladder. The membranous part of the urethra being now divided, and the fore-finger still retained in its place, the point of the gorget, previously fitted to the groove, is to be directed along the nail of the finger, which will serve to conduct it into the groove of the staff; and as this is one of the nicest parts of the operation, the most particular attention is here required that the point of the gorget be distinctly heard to rub in the bare groove, and that nothing is interposed.

In the introduction of the gorget into the bladder, if the assistant could be depended upon, the staff might be allowed to remain in his hand: the operator, however, generally chooses to manage it himself. He now rises from his seat, takes the staff from the assistant, raises it to near a right angle, and presses the concave part against the symphysis of the ossa pubes; satisfies himself again that the point or beak is in the groove, and then pushes on the gorget, following the direction of the groove till the beak slip from the point of the staff into the bladder. The gorget is not to be pushed farther than this, otherwise it may wound the opposite side of the bladder, &c.

The gorget having now entered the bladder, which is readily known by the discharge of urine from the wound, the staff is to be withdrawn, and the finger introduced along the gorget to search for the stone, which, when felt, will point out the direction to be given to the forceps; at any rate, the introduction of the finger serves to dilate the wound in the bladder; and this being done, a pair of forceps (fig. 86.) of a proper size, and with their blades as nearly together as their form will allow, are to be introduced, and the gorget withdrawn slowly, and in the same direction in which it entered, so as to prevent it from injuring the parts in its return. After the forceps are introduced, and passed till they meet with a gentle resistance, but no farther, the handles ought to be depressed till they are somewhat in an horizontal direction, as this will most correspond with the fundus of the bladder. One blade of the forceps is to be turned towards the symphysis of the pubes to defend the soft parts there, the other of consequence will guard the return. After they have distinctly touched the stone, by moving them a little in various directions, they are then to be opened, and the stone laid hold of, which may generally

rally be done with confiderable eafe. It frequently happens, however, that when the ftone is fmall, it is not readily felt with the forceps; and inftances may happen where the under and back part of the bladder may be fo depreffed as to conceal the ftone. In fuch a fituation, nothing will more readily bring it in the way of the forceps than to introduce the finger into the rectum, and elevate this part of the bladder. Straight forceps are generally ufed; crooked ones, in fome very rare cafes, however, may be neceffary, and therefore the furgeon ought to be provided with them.

After the forceps has laid hold of the ftone, if it be fmall and properly placed, it may readily be extracted; but if, on the contrary, the handles of the forceps are now obferved to be greatly expanded, it is certain the ftone is improperly fixed, or that it is remarkably large: in either cafe it fhould not be held faft, but allowed to move into the moft favourable fituation; or the finger is then to be introduced fo as to place it properly for extraction. If this cannot be done with the finger, it ought to be allowed to flip out of the forceps, in order to get it more properly fixed; and as the moft common form of the ftone is flat and oval or fomewhat like a flattened egg, the forceps fhould have hold of the fmalleft diameter, while an end prefents to the neck of the inftrument. The ftone fhould be grafped with no greater firmnefs than is merely fufficient to bring it fairly out. It fhould be extracted in a flow and gradual manner.

When a ftone is broken in the bladder, all the larger pieces are to be extracted by the forceps, which are to be introduced by means of the finger ferving as a director. The fmaller parts are to be removed by means of a fcoop (fig. 87.), or probably the finger may be more convenient; and as the leaft particle allowed to remain, or which is not wafhed off by the urine, may ferve as the nucleus of another ftone, a large quantity of water, properly warmed, is to be injected by a bag and pipe, or by a fyringe; and for this purpofe the body of the patient fhould approach at leaft to an upright pofture; and to give the particles of ftone an opportunity of collecting near the incifion of the bladder, the wound may be ftopped for a little after the injection is thrown in.

When a ftone is extracted of a regular, firm, and rough furface, it feldom happens that any others remain in the bladder. On the contrary, when it is of an irregular fhape, and fmooth and polifhed, particularly in certain places, with impreffions formed upon it, there is the greateft probability of others remaining. There are exceptions, however, to thefe rules; and therefore the operator, inftead of trufting to them, fhould introduce his finger, which will anfwer the purpofe without any other fearcher.

If, after the operation, any confiderable artery bleeds much, it is to be taken up with a ligature; but if this be impracticable, the hemorrhagy ought to be ftopped by means of preffure, and for this purpofe a firm roller introduced at the wound anfwers fufficiently: and to prevent any ftoppage to the difcharge of urine, a filver canula, covered with caddis, and dufted over with ftyptic powder, may be introduced into the wound with advantage.

Sometimes it happens that a confiderable quantity of blood, inftead of iffuing off by the wound, is collected in the cavity of the bladder, and may produce very dangerous fymptoms. To prevent this as much as poffible, immediately upon the operation being finifhed, the patient's pelvis fhould be made confiderably lower than the reft of his body; by which means the wound will be kept in a depending pofture, and the blood will efcape more readily by the wound. But if it be found that blood is ftill lodged in the cavity of the bladder, it muft be immediately extracted.

As foon as the blooding is ftopped, the patient is to be untied, a piece of dry foft charpee put between the lips of the wound, and often renewed, and the thighs brought together. He is then to be laid in a bed, in fuch a way that the pelvis may be confiderably lower than the reft of the body, to give a favourable direction to any blood which may afterwards flow from the wound. A confiderable dofe of laudanum is now to be given. From 30 to 50 drops for an adult will commonly be neceffary. From this period, unlefs the ftone has been large and difficult to extract, the patient commonly falls afleep, or at leaft lies quiet for a few hours; but afterwards generally begins to complain of pain in the under part of the abdomen. Anodynes are now to be given both by the mouth and anus, and warm fomentations, by means of flannels or bladders filled with warm water, are to be applied to the region of the bladder, as the affection feems to be of the fpafmodic kind. Stone in the bladder.

If by a continuance of thefe remedies the pain abates, no anxiety needs be entertained concerning it; but if it increafe, and efpecially if the abdomen become hard and fwelled, and the pulfe full and quick, and thefe fymptoms become gradually worfe, great danger is to be apprehended, as they moft commonly take place in confequence of inflammation. In this fituation, as much blood ought to be taken as the patient can bear. A large injection of warm water and oil, or linfeed tea, fhould be given every fix or feven hours, and the fomentations continued at the abdomen. If the fymptoms continue to grow worfe, the patient fhould be immediately put into the femicupium or half bath.

By a proper continuance of thefe means, with a low diet and plenty of diluent drink, the above fymptoms may frequently be removed. The reverfe, however, is fometimes the cafe. The wound becomes floughy and ill conditioned; all the fymptoms, in fpite of every effort, continue to increafe, and foon terminate in death.

But where matters end favourably, the wound by degrees puts on a better appearance; the urine paffes almoft from the beginning by the urethra (moft frequently, however, it is difcharged by the wound for the firft two or three weeks); the pain in the abdomen gradually abates, the feverifh fymptoms are foon removed, a complete cicatrix is formed, and the wound is fometimes cured in a month; though upon other occafions three will be neceffary. But it muft depend greatly on the nature of the conftitution.

Excoriation of the buttocks may be prevented by placing a fheet under them feveral times doubled, the breadth to be 18 or 20 inches, and to be all rolled up, except the part which is to be laid under the patient, the reft of the roll to be by his fide, which is to be unrolled as the nurfe draws the wet part from under him. If, after the ufe of this, excoriations fhould ftill happen, the part may be wafhed with cold water; or the parts round the wound, after being well dried, may be rubbed with any tough fimple ointment.

In patients of a debilitated conftitution incontinence of urine frequently occurs after this operation. In general, this is removed as the patient acquires ftrength. Nourifhing diet, cold bath, the bark, and other tonics, are of much fervice here; but where thefe are afterwards found ineffectual, inftruments for compreffing the penis, or others for receiving the urine, have been found ufeful, and are now made in fuch a convenient way as to allow them to be conftantly ufed as long as they may be found neceffary.

An operation for ftone in the bladder is much feldomer required in women than in men, on account of the fhortnefs of the urethra in the former allowing a readier paffage for the fmall calculi which get into, or are formed in, the bladder. It is likewife in women more fimple, and of courfe more readily performed. It might be done in the fame 334 Lithotomy in females.

manner

Stones in the Kidneys. manner as in the male; but there would be the greateſt probability of wounding the vagina. In a few caſes the operation has been performed from the vagina itſelf; but it is by no means adviſable, as ſtones would not only be extracted with greater difficulty, but, on account of the thinneſs of the parts, the urine would moſt probably form a fiſtulous opening, and a communication be maintained between the bladder and vagina; or cicatrices here might be attended with great inconvenience in child labour.

In the method commonly practiſed, the patient being placed and ſecured in the ſame manner as in the operation upon the male, the operator introduces a ſhort grooved ſtaff, ſlightly curved (fig. 88.), into the bladder; then by means of the common gorget already mentioned, with its point paſſed along the groove of the ſtaff he lays open the whole of the urethra and the neck of the bladder. The ſtaff is now to be removed, the finger introduced upon the gorget, and to feel for the ſtone, which is to be removed as already directed for the operation on the male ſubject. Where incontinence of urine occurs after the wound is healed, a peſſary is to be uſed within the vagina, or a ſponge applied, or a tin machine to receive the urine.

Sect. II. *Of Stones in the Kidneys.*

The ſymptoms of ſtone in the kidneys are, pain in the region of the kidneys, ſickneſs, and vomiting, the urine ſometimes mixed with blood, at other times with mucus or even purulent matter; but the ſame ſymptoms are often induced by other cauſes, eſpecially from inflammation and ſuppuration of the kidney. Nephritic complaints have frequently ſubſiſted for a long time, where ſtones have been blamed as being the cauſe of them; and yet upon diſſection purulent matter alone has been detected. From this circumſtance, as well as from the great depth of the parts and the large ſize of the blood-veſſels of the kidney, the operation of nephrotomy could not be performed, but with the greateſt uncertainty and moſt imminent danger, and is therefore never attempted. A few caſes indeed have appeared where inflammation induced by a ſtone in the kidney terminated in abſceſs, and the ſtones were taken out; but it was not till they had worked their way out of the kidneys into the cellular ſubſtance, ſo that it only remained to open the abſceſs and extract them; but otherwiſe the operation is never to be thought of.

Sect. III. *Of Stones in the Urethra.*

Those who are troubled with calculous complaints frequently paſs ſmall ſtones along with their urine; and when there are angular or of conſiderable ſize, they ſometimes
325. Symptoms of ſtones in the urethra. ſtick, and give much uneaſineſs. The ſymptoms are at firſt pain, then inflammation and ſwelling, attended with a partial, or total ſuppreſſion of urine, which, if long neglected, is apt to terminate in a rupture of the urethra, when the urine will be diſcharged into the neighbouring parts. The greateſt attention is therefore neceſſary to get the ſtone extracted as ſoon as poſſible.

326 Method of extracting them. When a ſtone is in the urethra, unleſs it be of a large ſize, or has been long impacted, and the inflammation great, attempts ought to be made with the fingers to puſh it out; but previous to this, the penis ſhould be relaxed as much as poſſible, ſo as to remove a certain degree of ſpaſm which the preſence of ſtone here probably creates. Blood ought to be drawn by general or local means, according as the patient may be of a plethoric or emaciated habit. He ſhould be immerſed in a warm bath, and get a full doſe of laudanum, and warm oil ought alſo to be thrown into the urethra. After theſe remedies have relaxed the parts as much as may be, the extraction is to be attempted.

For this purpoſe certain inſtruments have been contrived, Sto particularly a tube containing a pair of elaſtic forceps (fig. the u 89.), to be introduced into the urethra ſo as to lay hold of th the ſtone. In ſome caſes they certainly might anſwer the purpoſe, but they have not been found very uſeful; and as they may increaſe the irritation already preſent in the urethra, they are ſeldom, if ever, employed. Inſtead of them, the ſurgeon uſes gentle preſſure on the penis to puſh the ſtone outwards; and as calculi larger than a field bean have ſometimes been paſſed by the urethra, an operation ought not to be performed till gentler means have been perſiſted in for ſome time. When theſe means have failed, an inciſion ought to be made immediately upon the ſtone, which is then to be removed by a probe, or with a pair of ſmall forceps. When a ſtone is lodged near the neck of the bladder, after the patient has been placed and ſecured in the ſame manner as for the lateral operation, while an aſſiſtant ſupports the ſcrotum and penis, the operator introduces a finger oiled into the anus, to ſupport the ſtone in its place, and prevent it from ſlipping into the bladder. An inciſion is then to be made, and the ſtone turned out. The after treatment will be nearly the ſame as that after the operation of lithotomy.

When, again, a ſtone has advanced further in the urethra, the beſt method is to draw the ſkin ſtrongly forwards or backwards, and then to cut upon it and turn it out, when the ſkin will ſlide back ſo as to cover the wound, and prevent the urine from paſſing through it; and by this means it will generally heal by the firſt intention. If part of the urine paſs through the wound, and inſinuate into the cellular ſubſtance, an attempt is to be made with the hand to preſs it back. If that prove inſufficient, a cut is to be made through the ſkin oppoſite to the inciſion of the urethra; but this will ſeldom be found neceſſary. If a ſtone is fixed near the point of the urethra, it may be removed with a pair of forceps; or, if this fail, the urethra is to be dilated with a ſcalpel; and if this alſo be inſufficient, an inciſion is to be made as above directed. When the cure is nearly completed, a tube formed of ſilver or elaſtic gum, or a hollow bougie, may be uſed to keep the uretha of a proper ſize.

The worſt part of the urethra for a ſtone to ſtick in is that immediately behind the ſcrotum; for then the urine is apt to paſs by the inciſion into the cellular ſubſtance of the ſcrotum, ſo as to occaſion large ſwellings there. To prevent this, a ſtone ſo ſituated ought, if poſſible, to be puſhed forwards with the fingers; or if this be impracticable, it ſhould be puſhed back into the perinæum by means of a ſtaff. If both methods fail, a cut is to be made at the under part of the ſcrotum, which is to be well ſupported, and at one ſide of the ſeptum, and continued upwards till the ſtone is felt, when an inciſion is to be made into the urethra, and the ſtone extracted as before directed.

Chap. XXVIII. *Of Incontinence and Suppreſſion of Urine.*

Incontinence of urine may ariſe from various cauſes, Cau as, from a loſs of power in the ſphincter of the bladder, inc while the natural tone of that organ remains unimpaired; or from irritation about the neck of the bladder, produced rine. by the friction of ſtones contained in it; or from a laceration of parts by the operation of lithotomy; or from the preſſure of the uterus in a ſtate of pregnancy.

When the diſeaſe is owing to a want of tone in the ſphincter, the cure is very difficult, becauſe the conſtitution Tre in general is frequently affected. The moſt uſeful remedies are tonics, eſpecially peruvian bark, chalybeate waters, and the

the cold bath, both generally and locally applied. Cold substances applied to the perinæum are perhaps of greater service than any thing else, as cloths wet with vinegar and cold water, or with a strong solution of saccharum saturni in vinegar; but the best method of applying cold is to dash water immediately from the fountain upon the pubes and perinæum. When it arises from the irritation of stones in the bladder, opiates and mucilaginous liquors plentifully used frequently give great relief. When incontinence of urine is owing to a laceration of parts in performing the operation of lithotomy, the disease is nearly of the same nature as that from the cause first mentioned, and therefore the same remedies are of service. When these remedies fail in either of the cases, compression of the urethra prevents any inconvenience arising from the constant dripping of the urine; and for this purpose an instrument termed *jugum penis* (fig. 90.) is applied to the penis; or, to press against the urethra of the female, pessaries (fig. 91. and) are contrived, which are made in such a way as to be introduced into the vagina, and there to press upon the urethra. They are sometimes made of sponge, but those of ivory or wood well polished are more generally preferred. A small bottle made of elastic gum, and open at both ends for the passage of the menstrual discharge, answers the purpose equally well. Certain cases however occur where pressure upon the urethra is improper, especially where there is a constant desire to pass water; and here much relief is obtained from the use of receivers, which are now suited to both sexes. Fig. 92. represents one for the male, and fig. 93. one for the female.

We shall here treat only of that species of suppression of urine where the urine is collected in the bladder, but from some obstructing cause is prevented from being discharged. It arises from a variety of causes.

When it arises from a want of tone in the body of the bladder, it is often connected with palsy of the lower extremities; it is frequently owing also to retaining urine too long. The catheter, in this case, is commonly an effectual remedy, and ought to be employed as soon as the suppression is evidently formed, and repeated from time to time, till the tone of the system is recovered by the use of proper remedies. The method of introducing the catheter is the same with that already directed for founding for the stone. Fig. 94. a catheter for the male, fig. 95. one for the female.

When the affection arises from spasm about the neck of the bladder, opiates, warm water thrown into the rectum, and afterwards the warm bath, are the best means of producing relief. When it proceeds from scirrhus of the prostate gland, or from other tumors, or from obstructions of the urethra in consequence of gonorrhœa, the treatment to be afterwards described will be found best suited for such complaints. When the suppression arises from the pressure of the uterus in the latter months of pregnancy, change of posture is sometimes found to have some effect; but if this fail, immediate relief can commonly be given by the introduction of the catheter, which in women is for the most part readily done.

Suppression of urine from inflammation affecting the neck of the bladder is one of the most alarming varieties of the disease, as it produces pain, and such a degree of swelling in the parts as to render the introduction of the catheter inadmissible. It may arise from the matter in gonorrhœa passing backwards along the course of the urethra. The use of injections has likewise frequently produced this species of the disease. The treatment is nearly the same as in inflammatory complaints in other parts of the body. Blood-letting should be employed, and particularly leeches should be applied to the perinæum. Opiates ought to be given in large doses. Injections of warm water should be frequently thrown up the rectum, and the whole body should be immersed in the warm bath. If these means be properly used, they will very seldom fail of success; but when they do not prove effectual, when the bladder becomes painfully distended, and when every attempt to introduce the catheter has failed, nothing is to be depended upon but a puncture made into the body of the bladder, in order to discharge the water contained in it. Inflammatory and suppression of urine.

342 Various methods have been proposed for effecting this operation. Puncturing the bladder above the pubes has been recommended by many respectable authors. The following is the method of doing it: A lancet-pointed trocar, about two inches long, is to be at once introduced through the integuments, about an inch and half above the pubes, into the body of the bladder. The stilette is to be removed as soon as the water begins to flow through a groove formed in it, and the urine allowed to flow through the canula, which is secured to the body by means of a bandage. A cork is to be fitted to the canula, that the urine may pass off at intervals only. The canula is to be retained till the cause which produced the obstruction is so far removed that the patient can discharge the urine in the natural way. It ought to be removed every three or four days, and cleaned from the matters which adhere to it, otherwise it soon becomes covered with a calculous crust, which renders the extraction exceedingly difficult. On these occasions a small probe, or bougie, ought to be passed through it into the bladder, upon which it may again be easily returned as soon as it is properly cleaned. Method of puncturing the bladder above the pubes.

This method of puncturing the bladder is not altogether free from objections: the bladder being suspended for a long time on the canula, its tone is sometimes destroyed; and if it happen to slip off the canula, the operation must be repeated: besides, the urine may be diffused in the surrounding cellular substance.

343 When the bladder is to be punctured from the perinæum, the trocar, which ought to be longer than the one for puncturing above the pubes, is to be introduced at a little distance from the raphe perinæi, and then passed into the body of the bladder, a little to the upper and outside of the prostate gland, carrying the point of the instrument a little upwards, to avoid wounding the ends of the ureter or feminal vessels. Punctures from the anus, or the vagina in females, are attended with so many inconveniences that they ought never to be attempted. Method of puncturing in the perinæum.

Chap. XXIX. *Diseases of the Penis.*

Sect. I. *Of Obstructions of the Urethra.*

344 Obstructions of the urethra frequently occur after repeated or severe attacks of the venereal disease. They may be owing to caruncles or fleshy excrescences in the urethra; to tumors in the lining membrane, or parts contiguous to the urethra, in consequence of inflammation; to spasmodic affections of the urethra; or to stricures properly so called. Causes of obstruction in the urethra.

Till of late years almost every instance of obstruction in the urethra has been attributed to caruncles, but their occurrence is much less frequent than was formerly imagined. They are rarely found except near the point of the urethra. They are considered to be nearly of the same nature with the warts which grow upon the prepuce or root of the glans in venereal cases. Tumors obstructing the passage in the urine may be occasioned either immediately by inflammation, or in consequence of old sores within the urethra;

Of struc-tions of the urethra. thrat or tumors, from whatever cause, may be seated in the corpora cavernosa contiguous to the urethra, and may press upon it in such a manner as to cause an adhesion of its sides, and thereby produce stoppage of the urine. Spasmodic strictures of the urethra sometimes arise from stone in the bladder. Sometimes in gonorrhœa there is such a degree of contraction that neither staff nor bougie can enter. This variety of obstruction is known by its coming on suddenly, and going off sometimes almost completely in the space of a few hours. Of the permanent stricture, or stricture properly so called, Mr Hunter observes, that in most of the cases of this kind which he has seen the disease extends no farther in breadth than if the part had been surrounded with a piece of packthread. He has however seen the urethra irregularly contracted for above an inch in length, owing to its coats or internal membrane being irregularly thickened and forming a winding canal. He farther observes, that a stricture does not arise, in all cases, from an equal contraction of the urethra all round; but in some, from a contraction of one side, which throws the passage to the opposite side, and often makes it difficult to pass the bougie. In some few cases, he says, there are more strictures than one; he has seen half a dozen in one urethra, and finds that the bulbous part is much more subject to strictures than the whole of the urethra besides; that they are sometimes on this side of the bulb, but very seldom beyond it; and that they are often slow in forming, it being frequently years from the time they are perceived before they become very troublesome. Contrary to the opinion of others, Mr Hunter doubts very much if the stricture commonly, or even ever, arises from the effects of the venereal disease, or the method of cure; for strictures are common to other passages, and sometimes happen in the urethra where no venereal complaint had ever been.

345 Methods of cure. When obstructions are occasioned by caruncles in the urethra, bougies (fig. 96.) should be introduced rubbed over with bland oil until a resistance is met with. When a bougie cannot be introduced far enough, one with a smaller point is to be used, but not till the day following, lest the part be too much irritated. They ought not to be allowed to remain long at first, particularly when they occasion a considerable degree of pain.

When suppression of urine arises from swellings in or about the urethra, in consequence of inflammation, an attempt should be made to discuss these immediately, or bring them into a state of suppuration, and discharge the pus as soon as it is formed. But when the nature of the tumor is such as not to terminate in either of these ways, extirpation of the diseased parts, when this is found practicable, is the only probable means of relief. Bougies should at the same time be used to assist in the cure.

When spasmodic affections are present in the urethra, the remedies to be employed are, warm emollients, as rubbing the part with warm oil; anodynes, as opium given by the mouth, but more especially by the anus; blood-letting in plethoric habits, and this to be generally and locally applied; blisters put to the penis or perinæum; electricity, after plethora has been removed. Some cases may be treated with bougies; but where the disease is purely spasmodical, they are generally found to be hurtful; though in other cases, when the violence of the disease is so far removed, if they can be introduced, they are of service, by relieving any obstructions which may remain after the remedies above-mentioned have been exhibited. Costiveness ought likewise to be guarded against. The permanent stricture is to be cured by bougies.

Bougies act solely by pressure, and by supporting the part; hence they should be so large as to fill the passage, and sufficiently flexible to be easily introduced. They are formed of various materials, as a composition of diachylon plaster, oil, and wax melted and put upon linen, which is afterwards properly rolled up; or they are formed of leather catgut, &c. properly prepared: but the best of any are those which are formed of elastic gum. Bougies, when properly made, can sometimes be kept in for six or eight hours together; but the length of time proper for their retention must depend much upon the feelings of the patient. At all times when they give much pain they ought to be removed, and not introduced again till the part is in a state fit for receiving them. They should be gradually increased in their size, till the passage returns to its natural dimensions. They ought to be continued for some time after, till it appear that there is no danger of a return of the complaint.

Sect. II. *Of Phymosis and Paraphymosis.*

In phymosis the prepuce is thickened, and contracted before the glans, so that it cannot be readily drawn behind it. In some people there is a constitutional phymosis from the natural straitness of the prepuce. Sometimes it arises from the matter secreted by the odoriferous glands at the root of the glands being confined and becoming acrid; sometimes from an anasarcous swelling of the scrotum and penis; but most frequently from venereal virus. 3. Causes of phym

The cure must depend upon the nature of the cause producing the disease. If the symptoms be inflammatory and of no long continuance, fomenting the parts frequently with warm emollient decoctions, or bathing them in warm milk, and then applying emollient poultices, or keeping the diseased parts constantly moist with a cold astringent solution, and turning the penis upwards and supporting it against the belly, commonly give relief. If the inflammation has arisen from a venereal cause, part of the fluid ought frequently to be injected, by means of a syringe, between the prepuce and glans, so as to wash off any matter which may there be concealed; but if the inflammation still continues to increase, blood-letting is necessary, both general and local. The veins of the penis are sometimes advised to be opened with a lancet; but this is unsafe on account of the nerves. Leeches may be applied; but care must be taken, in venereal cases, lest the bites of these animals, by absorbing venereal matter, turn into chancres. Along with the remedies already advised, gentle laxatives, low diet, and abstinence, ought to be prescribed. But if, after a due perseverance in these means, it is found that they have had little effect in removing the disorder, or perhaps that the symptoms are constantly increasing, and that chancres are confined under the prepuce; in that case it is necessary to slit open the prepuce, which is best done by a sharp-pointed bistoury, concealed in a grooved directory, fig. 98. This is to be introduced between the prepuce and glands, till the director is found by the finger to have reached the upper or back part of the prepuce. The operator is now to keep the director firm with one hand, while with the other he pushes forward the knife, till its point passes through the prepuce; then drawing the instrument towards him, he cuts the prepuce through its whole length. 3. Cu

The operation being performed, the parts are to be washed and cleaned with warm water, and the sore dressed with a little soft lint, and a compress of linen laid over it. The whole may be retained by a small bag properly adapted, and secured by two straps to a bandage put round the body. This bag may be left open at the under end, to allow the patient to make water, without removing the dressings; but if this be found impracticable, the dressings may be removed with little inconvenience. If the glans be much

much inflamed and excoriated, care should be taken to insert lint spread with emollient ointment between the glans and prepuce, otherwise troublesome adhesions are apt to ensue. It is evident, that when this disease is of the venereal kind, the sore will not readily heal till the poison be eradicated from the constitution.

In some cases of phymosis the preputium is so remarkably long, and the contraction so much confined to the point, that a circular incision is preferable to a longitudinal one; and it is easily effected, by separating such a portion as may be found necessary of the whole circumference of the prepuce. The dressings in this case are the same as when the prepuce is slit open.

Paraphymosis is the reverse of phymosis, being formed by a retraction of the prepuce, producing stricture behind the glans of the penis. Like the former disease, it arises most frequently from a venereal infection, but may be produced from whatever preternaturally enlarges the glans or constricts the prepuce.

In the incipient state, the patient may generally be relieved by the surgeon pushing the glans gently back with his thumbs, while with his fingers he brings the prepuce gradually forward. But a more effectual method than this is to inclose the glans with one of the hands, and press gently on all sides, by which the fluids forming the enlargement will be pushed into the body of the penis behind the stricture. If this method be persevered in for a considerable time, it will generally be found to answer the purpose: but should it prove ineffectual, we may try the effects of cold applications; and the best seem to be those of the saturnine kind. When the penis is evidently much swelled and inflamed, the patient should be kept cool, gentle laxatives and low diet should be prescribed, and a number of leeches applied to the penis. Should the disease still continue to increase, and an œdematous swelling appear about the under part of the prepuce, an operation is necessary to prevent a mortification from taking place in the glans. An incision is to be made on each side of the penis immediately behind the glans, so large as completely to divide the stricture. The wound ought to be allowed to blood freely; after which a pledget spread with simple ointment is to be applied, and an emollient poultice laid over the whole.

Sect. III. *Of an Incomplete Urethra.*

In children, especially males, the urethra is sometimes incomplete, ending before it reaches the usual place of termination. Sometimes it does so without any external opening, at other times it opens at a distance from the common termination. In the first case, a small trocar is to be introduced in the direction the urethra ought to take, till the urine be discharged; after which, the passage is to be kept open by the use of bougies, till the sides be rendered callous and an opening preserved. In the other case, as the opening which is already found affords a temporary passage for the urine, it will be better to delay doing any operation till the patient be farther advanced in life, when it is to be performed as in the former case.

After the operation, a piece of flexible catheter may be introduced, as well for the purpose of rendering the passage free and callous, as for carrying off the water till a cure is made.

Sect. IV. *Of Amputating the Penis.*

This operation is found necessary in certain diseases which will not yield to other remedies: as in cases of mortification and cancer. The following is the method of performing it:

A circular incision is first to be made through the sound skin a little beyond the diseased parts; the skin is then to be drawn back by an assistant, and the body of the penis divided by one stroke of the knife (fig. 99.) immediately at the edge of the retracted skin. The principal arteries, which are two or three on each side, are next to be secured by ligatures; and if an oozing of blood still continue, the surface of the sore ought to be dusted with some styptic powder. To allow the patient to make water, a silver canula (fig. 99. *a*) is to be introduced into the urethra, and retained there by two small ligatures fixed to the side of the canula, their other extremities being fastened to a bandage put round the body. The wound is to be dressed with soft lint, kept in its place by a piece of linen previously perforated for the introduction of the canula. The dressings are to be kept on by a narrow roller passed a few times round the penis, which, by gently compressing the penis upon the instrument, will effectually prevent any farther discharge of blood. The after treatment of the sore should be similar to wounds in other parts of the body. But it will not be necessary to make any farther compression of the penis upon the canula, as the discharge of blood will, previous to this time, be entirely stopped. The tube is to be allowed to remain in the urethra during the whole time of the cure.

Before any operation of this kind is attempted, the surgeon ought to examine attentively, whether the disease be in the penis itself, or only in the skin, as the prepuce alone is frequently so much enlarged and otherwise diseased as to give cause for suspicion that the glans and body of the penis are likewise affected. This precaution is the more necessary, as several instances have occurred where the glans and body of the penis have been removed, and, after the operation, have been found perfectly sound. Previous to amputation, therefore, where there is any cause for suspicion, the prepuce should be slit open, and the glans examined, so as to avoid amputating more than what is absolutely diseased.

350 Of shortness of the frænum.

It sometimes happens that the frænum of the penis is so short as to give considerable uneasiness in time of an erection. When this is the case, it may be safely divided by a pair of scissars, or by a sharp-pointed bistoury, and the wound dressed with a little charpie.

Sect. V. *Of Fistula in Perinæo.*

The term implies a sinuous ulcer in the perinæum, commonly communicating with the urethra, but sometimes opening into the bladder. The same term is also applied to similar sores opening into the scrotum, or into any part of the penis.

351 Causes of fistula in perinæo.

The disease may arise from wounds in the bladder, and of the urethra, from external violence; from a laceration of parts when performing the operation of lithotomy; from incision into the urethra for the extraction of calculi impacted there; from sinuses producing matter capable of corroding the membranous part of the urethra; from suppuration in the perinæum in consequence of inflammation; from the urine passing through an opening in the urethra into the perinæum or other neighbouring parts, and rendering the edges of the sore callous; and most frequently the disease is occasioned by venereal complaints.

352 Treatment.

In the treatment of this disease, when it is the consequence of a general affection of the system, a removal of the primary disorder is necessary before a cure can be attempted. When the complaint is of a local nature, a simple incision into the sinus is all that is necessary; and for this purpose a staff is to be introduced into the urethra, so as to pass the opening at which the urine is discharged. A probe, or a small director, is now to be passed at the external opening of the

Hemorrhoids or Piles.

the ſore till it reach the ſtaff; and cutting upon it, the ſinus is to be laid open through its whole length till it terminate either in the urethra, or, if neceſſary, in the bladder itſelf. When more openings than one are preſent, they are to be treated in the ſame manner; and if the ſinuſes are found to be remarkably hard, the removal of a ſmall portion of the diſeaſed part will expedite the cure, though the conſequent inflammation and ſuppuration will render this ſeldom neceſſary. After the operation, the wound is to be dreſſed with pledgets of emollient ointment, ſo as to allow it to fill up completely from its bottom. The whole is to be covered with a pledget of emollient ointment; and proper compreſſes being applied over it, the dreſſings are to be ſupported by a T bandage.

If ſymptoms of inflammation be violent, an emollient poultice is to be applied in the courſe of twenty-four hours after the operation; and as ſoon as free ſuppuration is formed, light eaſy dreſſings are to be uſed till the ſore is completely healed.

Chap. XXX. *Diſeaſes about the Anus.*

Sect. I. *Of Hemorrhoids or Piles.*

The treatment of piles has been already conſidered under the article Medicine; but it ſometimes happens, that although the means mentioned there have been employed, the diſeaſe becomes ſo violent as to require the aſſiſtance of the ſurgeon. Where the diſcharge of blood is ſo great as to endanger the life of the patient, we ought to attempt to ſtop it either by compreſſion, or by ſecuring the bleeding veſſels by a ligature; and here the tenaculum is preferable to the needle, becauſe, when the latter is uſed, a portion of the rectum is apt to be included in the ligature. When piles arrive at ſuch a ſize as to obſtruct the paſſage of the fæces, or to produce great irritation, the removal of them by the knife or by ligature becomes neceſſary. The firſt of theſe may be uſed when their ſize is of ſuch a nature as not to threaten a dangerous hemorrhagy; but when this is the caſe, they ought to be removed by ligature, the manner of applying which has been conſidered under the treatment of *Polypi*. The dreſſings are to be of a ſimple nature.

Sect. II. *Of Condylomatous Excreſcences, &c. of the Anus.*

Excrescences are ſometimes produced about the anus, which from their figure get the name of *fici*, *ariſtæ*, &c; but they are all of the ſame nature, and to be cured by the ſame means. They ſometimes grow within the gut itſelf, but more frequently are ſituated at the verge of the anus. They vary conſiderably in their colour, figure, and conſiſtence. Sometimes they are only one or two in number, but commonly all the ſkin about the anus becomes covered with them. They vary in ſize from that of ordinary warts to that of ſplit garden beans. They ſeem originally to be productions of the ſkin, though at laſt they ſometimes proceed as deep as the muſcles. They frequently remain long without producing much uneaſineſs. When this is the caſe, they ought not to be touched; but ſometimes they become ſo troubleſome as to render their removal neceſſary.

The ſofter kinds can frequently be removed by rubbing them often with gentle eſcharotics, as crude ſal ammoniac, or pulvis ſabinæ; but the harder kinds are to be removed chiefly by lunar cauſtic, or by the knife; the latter of which is greatly preferable, and may be done with the utmoſt ſafety.

The ſores are afterwards to be treated like wounds produced by any other cauſe. If cauſtic is to be uſed, care ought to be taken that it do not injure the rectum.

Fiſtula in Ano.

Sect. III. *Of Fiſtula in Ano.*

The fiſtula in ano is a ſinuous ulcer in the neighbourhood of the rectum. When it opens externally, and has likewiſe a communication with the gut, it is termed a *complete fiſtula*; but if it has no communication with the rectum, it is called *incomplete*. When the ulcer communicates with the gut, but has no external opening, it is named an *internal* or *occult fiſtula*. It is likewiſe diſtinguiſhed into ſimple and compound. The firſt is where one or more ſinuſes communicate with the internal ulcer, but where the parts in the neighbourhood are ſound. The compound fiſtula is where the parts through which the ſinus runs are hard and ſwelled, or where the ulcer communicates with the bladder, vagina, os ſacrum, and other contiguous parts.

35 Cauſe of fiſtula in ano.

The cauſes producing the diſeaſe may be, whatever tends to form matter about the anus, piles, condylomatous tumors, hardened fæces, or any cauſe which produces irritation and inflammation, ſo as to end in ſuppuration. As ſoon as a ſwelling about the anus appears to terminate in ſuppuration, every thing ought to be done which can accelerate the formation of matter. A proper degree of heat, warm poultices, fomentations, and the ſteams of warm water, are the means beſt ſuited for this purpoſe; and as ſoon as matter is formed, it ought to be diſcharged by a free inciſion in the loweſt part of the tumor. Much depends upon the proper treatment here; for if the opening be made too ſmall, or if long delayed, the matter gets into the looſe cellular ſubſtance, and inſtead of producing one, produces many ſinuſes, and theſe ſometimes running to a great depth. The parts ought then to be covered with ſoft lint ſpread with mild ointment, and an emollient poultice kept conſtantly over the whole. By this any remaining hardneſs will be removed, the cavity will fill up like impoſthumous tumors in other parts, and a complete cure will in general ſoon be made.

36 Treat[ment] durin[g the] firſt [stage] of the ſimpl[e fiſ]tula.

It more frequently happens, however, that the practitioner is not called in till the abſceſs has burſt of itſelf, and till matter has inſinuated into the ſurrounding cellular ſubſtance, and formed one or more real fiſtulæ.

The firſt thing to be done now is to diſcover the real courſe of the different ſinuſes, and the probe is the beſt inſtrument for this purpoſe. If there be openings in the external ſurface, there is commonly little difficulty in this. If they run along the perinæum or the muſcles, the probe will generally detect them. If they follow the direction of the gut, the beſt method is to introduce the fore finger oiled into the rectum, while the probe is entered at the external orifice. If there be a communication between the gut and the ſinus, the probe may be made to paſs till its point is felt by the finger in the rectum. We diſcover with certainty if a ſinus communicate with the gut, when air or fæces are diſcharged, or when any mild fluid injected returns by the anus.

Trea[tment] after ... are ...

After the courſe of the ſinus has been diſcovered, the method of cure is next to be conſidered. Aſtringent or eſcharotic injections, preſſure, and ſetons, are inſupportable, on account of the violent pain which they produce. The only method therefore of bringing on a proper degree of inflammation is a free inciſion along the whole courſe of the ſinus. The courſe of the different ſinuſes having been previouſly diſcovered, a laxative ought to be given on the day preceding this operation, and a clyſter an hour or two before performing it. The patient is to be placed with his back

back towards a window, while his body leans upon a bed, table, or chair. The finger of the surgeon is to be rubbed over with oil, and introduced into the rectum. The end of a crooked probe-pointed bistoury (fig. 100.) is then to be passed into the fistula, and pushed against the finger in the rectum, if the fistula be complete. But in cases of incomplete fistulæ, the point of the instrument must be made to perforate the gut before it can reach the finger. Some make the perforation with a sharp-pointed bistoury, which can be made to slip along the side of a probe-pointed one, as at fig. 101. After the bistoury has reached the cavity of the rectum, the point of it is then to be brought out at the anus, and a cut made downwards to lay the sinus completely open. In this operation the sphincter ani muscle is commonly cut, if the sinus be high; but no inconvenience is found to arise from this circumstance. It sometimes, though rarely, happens, that the sinus goes beyond the reach of the finger, and even as high as the upper end of the sacrum. The only thing which can be done in this case is to cut as high as the finger can go, so as to give a free and easy vent to the matter.

Some practitioners, with a view to prevent troublesome hemorrhagies, and others to free the patient from the dread of the knife, have proposed to open the sinuses by means of ligature (fig. 102.). By introducing one end of a piece of silver or leaden wire into the sinus, then bringing it out at the anus, and twisting the ends together, the contained parts may be so compressed as to produce a complete division of them. But this is both more painful and tedious than the scalpel, and appears to be by no means necessary.

When the presence of an occult fistula is suspected, its existence ought first to be fully ascertained, by examining whether the matter which is passed by stool proceeds from an ulcer in the bowels or from an abscess at the side of the anus. It is discovered by matter from the bowels being mixed with the fæces, and no pain about the anus. In occult fistula, a hardness, swelling, and discoloration, are observed upon some spot near the anus, and there is a sensation of considerable pain upon pressure being made upon it. The operation in this is the same with that in the other two varieties of the disorder; only that an opening is previously to be made, by a lancet or scalpel, in that spot where the matter appears to be lodged. By this the sore will be reduced to a complete fistula, and the rest of the operation will be easily performed.

In this manner the different sinuses are to be operated upon, when in a simple state; but in those of a compound nature, where the parts in the vicinity of the sores have been separated from each other by an effusion of matter into the cellular substance, and where all the under end of the rectum has, in some rare cases, been attached from the surrounding parts, two modes of operating have been recommended; either to remove a considerable portion of the external integuments, so as to give free vent to the matter; or to extirpate all the lower end of the rectum which is found to be detached from the surrounding parts. But from the pain and subsequent distress which they occasion, these methods are judiciously laid aside. All that is necessary to be done here is to lay the detached portion of gut completely open, as in cases of simple fistulæ; but if this be insufficient for allowing the gut to apply properly to the contiguous parts, another incision should be made on the opposite side. If the neighbouring bones be found sound, and the constitution in other respects be unimpaired, a complete cure will probably be obtained.

The matter sometimes insinuates itself between the skin and muscles of the perinæum, or of the hip. When this is observed, the sac produced by it should be laid open from one end to the other by one or more incisions as circumstances may require. Sometimes, from neglect or improper treatment, the matter collected does not find a proper outlet, and then the parts most contiguous to it inflame, become painful, and gradually acquire such a morbid callosity as to put on a scirrhous appearance. In such cases a cure may be effected by giving free vent to the matter, preventing every future collection, and inducing and preserving a suppuration in the substance of the parts chiefly affected. To accomplish this last circumstance, however, it may sometimes be necessary not only to lay the sinuses freely open, but to cut in upon the obdurated parts.

358
Treatment after laying open the sinuses.

The different sinuses having been laid open, care must be taken to apply the necessary dressings. Upon this much of the success attending the operation depends. Dry lint, till lately, was much used by practitioners; but it has been found to produce so much irritation, especially when too much crammed in, as to be one of the causes of that diarrhœa which is frequently so troublesome after operations of this kind. Instead, therefore, of this sort of dressing, pledgets, lint, or soft old linen spread with any simple ointment, are to be preferred. After the sores have been cleared from clotted blood, the pledgets are to be gently insinuated between their edges, but not to such a depth, or with such force, as to give any uneasiness. This being done, and a compress of soft linen with a T bandage being applied over the whole, the patient is to be carried to bed; and the dressings being renewed, either after every stool, or, when these are not frequent, once in the twenty four hours, the sores will generally fill up from the bottom, and will at last cicatrize in the same manner as wounds in any other part of the body. Sometimes, however, they acquire a soft, flabby, unhealthy aspect, and the matter discharged from them is thin, fetid, and occasionally mixed with blood. These appearances may sometimes arise from some part of a sinus having been overlooked. In this case advantage may follow from the part being laid completely open. But it more usually proceeds from some affection of the general system; and till this is eradicated the sores cannot be expected to heal

In the cure of sores in other parts of the body, practitioners have sometimes found great advantage to arise from the use of issues. The same thing is now found to be applicable here. Wherever therefore fistulæ are of long standing, while any disorder existing in the constitution is properly attended to, practitioners recommend, that an issue, in proportion to the quantity of the matter discharged by the sores, should be immediately employed In this way, if the bones in the neighbourhood are not diseased, there will be reason to expect that a complete cure will be obtained.

Sect. IV. *Of Prolapsus Ani.*

This is a protrusion of part of the rectum beyond the anus. It is often occasioned by debility of the parts, but is most frequently owing to violent exertions made in the rectum in consequence of irritation. The reduction should be effected as soon as possible; for although this part of the intestine can bear exposure to air much longer than any of the rest, yet allowing it to remain a long time out would be attended with great uneasiness, and probably with danger. In the reduction, the tumor ought to be supported with the palm of one hand, while with the fingers of the other the part of the gut last protruded is to be returned. If the gut has been long exposed previous to the reduction, venesection may become necessary, and gentle astringents may be applied to the part. The patient during the reduction is to be kept in a reclined posture. As soon as the bowels are

Imperforated Anus

are returned, a proper bandage (fig. 103.), is to be applied. Such remedies are afterwards to be exhibited as moſt tend to recover the tone of the parts.

Sect. V. *Of Imperforated Anus.*

This diſorder, though not frequent, now and then occurs; and when preſent, unleſs ſpeedy relief be given, muſt prove fatal. In ſome caſes, the end of the rectum protrudes at the uſual ſituation of the anus, and is only covered with the common integuments; but in others, no termination of that gut is diſcoverable. Sometimes the rectum ends within an inch of the uſual ſeat of the anus; at others, it reaches no farther than the top of the ſacrum. In ſome caſes it terminates in the bladder; in others, in the vagina. In the moſt favourable caſes, where the rectum protrudes, an opening may be readily made by a ſcalpel or lancet; but when no direction of this kind is met with, an inciſion is then to be made in the place where the anus is uſually ſituated, and is to be continued in the direction of the os coccygis and ſacrum, which is the courſe the inteſtine commonly takes. The finger is to be uſed as a director along it; the parts are to be cut either till fæces are obſerved, or till the inciſion has been made the length of the finger. If ſtill the fæces do not appear, a lancet-pointed trocar is to be puſhed forward upon the finger in ſuch a direction as the operator thinks will moſt probably reach the gut. An artificial anus is likewiſe to be attempted, where the gut terminates in the bladder or vagina. After the operation, the greateſt attention is neceſſary to preſerve the opening which has been made. Subſtances which irritate leaſt are the moſt uſeful; ſuch as doſſils of lint moiſtened in oil, and rolls of ſoft bougie plaſter.—We ſhall conclude this chapter with two ſhort ſections of imperforated hymen and prolapſus uteri, though they do not properly come under it.

Sect. VI. *Of an Imperforated Hymen.*

When the hymen is imperforated, the moſt troubleſome ſymptoms, at a certain period of life, may be produced by the accumulation of that fluid, which ought to be diſcharged; for then a tumor is formed, by which the moſt violent bearing-down pains are occaſioned. Theſe increaſe in ſeverity to ſuch a degree, as ſometimes to be miſtaken for labour-pains. They diſappear, however, during the intervals of the accuſtomed periods. In the treatment of this diſeaſe, all that is neceſſary is to make either a ſingle or a crucial inciſion into the obſtructing membrane, and then to prevent the accretion of its edges by doſſils of lint ſpread with ſome emollient ointment till the parts are healed.

Sect. VII. *Of Prolapſus Uteri.*

This is a falling down of the uterus, occaſioned by debility or by exceſſive ſtraining in the time of parturition. The diſorder ſeldom occurs before child-bearing, and is commonly met with in thoſe who are ſomewhat advanced in life. The parts protruding are to be reduced by gentle preſſure, while the patient is put in an horizontal poſture. Peſſaries (fig. 91. *a* and *b*) are to be employed, which ought to be made of the lighteſt materials, finely poliſhed, and ſomewhat compreſſible; and none poſſeſs theſe qualities in a more perfect degree than a peſſary made of the elaſtic gum-bottle. This, or whatever elſe may be uſed to anſwer the purpoſe, is to be retained by a proper bandage till by tonic medicines the parts recover ſtrength to retain their natural ſituation.

Chap. XXXI. *Of Luxations.*

Sect. I. *Of Luxations in general.*

Lux[illegible] in ge[illegible]

A bone is ſaid to be luxated when that part of it forming a joint is moved out of its place. When the bone is forced entirely out of its cavity, the luxation is termed *complete;* when this is not the caſe, it is *partial* or *incomplete.* When there is alſo a wound of the ſoft parts communicating with the joint, it is called a *compound,* and when there is no wound, a *ſimple luxation.*

3. Sym[illegible] of lu[illegible]

The common ſymptoms of a diſlocated bone are, inability to move the injured limb; pain, tenſion, deformity in the part affected; and ſometimes inflammation, ſubſultus tendinum, and fever: and theſe three laſt are greateſt in partial diſlocations. The ſwelling which firſt appears is always inflammatory; but afterwards a ſecondary ſwelling comes on, ſeemingly œdematous, and probably owing to the preſſure of the lymphatics by the diſlocated bone.

3 Prog[illegible]

In judging of the practicability of reducing a luxation, we ought to attend to its nature and extent, the other circumſtances with which it may be complicated, and the length of time which it has continued. When a bone is only partially diſlocated, it is evident that it may be reduced with much more eaſe and certainty than where it is completely diſplaced. It is evident alſo that fracture attending diſlocation muſt render reduction much more difficult and uncertain. Indeed, when both the bones forming the joint are broken, there is the greateſt hazard of its remaining ſtiff during life, even when the greateſt attention has been paid. Luxated bones are moſt eaſily reduced immediately after they are diſplaced: the difficulty indeed of reducing them is generally proportional to the time that has intervened ſince the accident happened. When a bone has been ſome time lodged among the contiguous muſcles, it forms a ſocket for itſelf, and is firmly graſped by the ſurrounding ſoft parts. The cavity, too, from which it was diſlodged may be partially filled with ſome of the ſurrounding ſoft parts, or at leaſt diminiſhed by the conſtant action of the contiguous muſcles on its cartilaginous brim. Diſſections, however, ſhow, that inſpiſſated ſynovia does not, as was formerly ſuppoſed, fill up this cavity. In delicate conſtitutions and advanced periods of life, when the muſcles give little reſiſtance, diſlocations are more eaſily reduced than in the vigour of youth or in robuſt conſtitutions.

Tre[illegible] of [illegible] luxa[illegible]

In the treatment, we ought, 1. To reduce the diſlocation with as much eaſe and expedition as poſſible; 2. Retain the bone in its ſituation till the parts have recovered their tone; and, 3. Obviate all uneaſy ſymptoms.

1. When the ſurrounding ſkin and muſcles are much contuſed and inflamed, we ſhould endeavour to remove the inflammation by local blooding, ſaturnine applications, and laying the limb in an eaſy poſture, before we attempt to reduce the bone, as conſiderable injury may be done by ſtretching a limb while the parts ſurrounding the joint are inflamed. The upper part of the limb ſhould be kept ſteady while the ſurgeon endeavours to replace the under bone, which alone is commonly diſplaced. This is not eaſily done; for the contractile power of the muſcles acts ſtrongly againſt every attempt, and not only draws it beyond the contiguous bone againſt which it ſhould be placed, but frequently forces it out of its natural ſituation, and fixes it firmly in ſome neighbouring cavity, from which it is with difficulty removed. To prevent this reſiſtance as much as poſſible, the muſcles ought to be put into a ſtate of relaxation. If this is properly done, the force neceſſary for reducing a luxated bone may generally be obtained from aſſiſtants alone; ſometimes, however, machinery is required, and various inſtruments have been invented for this purpoſe. Freke's machine is the moſt generally uſed. The force ought always to be applied in a gradual manner, and to the diſlocated bone alone, and not to any more diſtant parts of the limb. After the end of the diſlocated bone is brought into a line with that to which it is

is oppoſed, the reduction is eaſily completed either by the action of the muſcles alone, or, if that is not ſufficient, by gentle preſſure.

2. After the reduction there is ſeldom any difficulty in retaining the bone in its place, unleſs it has often been diſlocated before. All that is neceſſary is to place the limb in a relaxed poſture, and to ſupport the bone with a bandage till the parts have recovered their tone.

3. The moſt urgent ſymptoms which accompany diſlocations are, pain, inflammation, and ſwelling. Theſe uſually abate ſoon after the reduction. If any degree of inflammation remain, the uſe of leeches is the beſt remedy.

When diſlocated bones are accompanied with fracture near the joint, the fracture muſt be allowed to heal before reduction be attempted. This, however, is not always neceſſary in very ſmall bones, as thoſe of the fingers. When the fracture is at a diſtance from the joint, the diſlocation may generally be reduced immediately. Compound luxations are to be treated nearly as compound fractures. After the bone is replaced, leeches ſhould be applied to abate the inflammation; after which the ſore ſhould be dreſſed with Goulard's cerate, or any other mild ointment, and the pain moderated by opiates and a low regimen: care ought alſo to be taken that no matter lodge about the joint. When luxations are produced by tumors or collections of matter in the neighbourhood of the joints, they may be conſidered as incurable: when they proceed from too great a relaxation of the ligaments and tendons of the joint, the bone can hardly be prevented from being now and then diſplaced; but the inconvenience may be ſomewhat obviated by ſupporting the limb with a proper bandage, by the uſe of the cold bath, and by electricity.

Sect. II. *Luxations of the Bones of the Head and Neck.*

If the bones of the cranium be ſeparated by external injury, all that can well be done is, to ſupport the parts by a bandage, to prevent inflammation, to keep the patient quiet, and in a proper poſture during the cure. The bones of the noſe are ſeldom luxated without fracture: when they are, the injury is eaſily diſcovered by the touch. When one of the bones is driven inwards, it may be raiſed and reduced by puſhing a tube of a proper ſize, and covered with ſoft lint, into the noſtril; which may be afterwards retained till there is no danger of the bone being again diſplaced. If the bone be luxated outwards, it may be reduced by the fingers, and retained by a double-headed roller. The lower jaw is luxated moſt frequently when the mouth is opened widely; it can only take place forwards and downwards, which are leaſt ſurrounded by the neighbouring parts: both ſides are generally luxated at once; and in that caſe the mouth is opened wide, the chin thrown forwards and towards the breaſt. When only one ſide is diſlocated, the mouth is diſtorted, and wideſt on the ſound ſide of the jaw, which is drawn a little towards the contrary ſide. The patient ſhould be ſeated, and his head ſupported. The ſurgeon ſhould puſh his thumbs, protected by a covering of ſtrong leather, as far as poſſible between the jaws, and then with his fingers, applied on the outſide of the angle of the jaw, endeavour to bring it forward till it move a little from its ſituation. He ſhould then preſs it forcibly down, and the condyles will immediately ſlip into their place. The thumbs ought to be inſtantly withdrawn, as the patient is apt to bite them involuntarily. The patient ſhould for ſome time avoid much ſpeaking or opening his mouth wide.

When the head is luxated, it commonly falls forward on the breaſt, the patient is inſtantly deprived of ſenſe and motion, and ſoon dies if the luxation be not quickly reduced. In reducing the luxation, the patient ſhould be placed on the ground, and ſupported by an aſſiſtant: the ſurgeon ſtanding behind ſhould gradually pull up the head, while the ſhoulders are preſſed down by the aſſiſtant till the bones are brought into their place, which is known by a ſudden crack or noiſe: if the patient be not dead, he immediately recovers his faculties, at leaſt in ſome meaſure. He ſhould then be put to bed with his head elevated and retained in one poſture. He ſhould loſe a quantity of blood, and live for ſome time on a low diet.

Luxations of the Spine, Os Coccygis, Clavicle, and Ribs.

Sect. III. *Luxations of the Spine, Os Coccygis, Clavicle, and Ribs.*

367 Luxations of the vertebræ.

The vertebræ are ſometimes partially, but hardly ever completely, diſlocated without fracture. When they occur high up, they are attended with the ſame ſymptoms as diſlocation of the head: when farther down, beſides diſtortion of the ſpine, paralyſis enſues of every part of the body ſituated under the luxated bone; there is commonly alſo either a total ſuppreſſion of urine, or it is diſcharged involuntarily together with the fæces. As luxations of this kind are generally owing to falls or violent blows, the diſplaced vertebra is driven either forwards or to one ſide; it is therefore very difficult to reduce it. The beſt, as well as the ſimpleſt method, is to lay the patient on his face over a cylindrical body, as a large caſk, and at the ſame time to attempt to replace the bone with the fingers. If the bone be very much diſplaced, there is very little reaſon to hope for ſucceſs.

368 Of the os coccygis.

The os coccygis is more liable to diſlocation than any other part of the ſpine. It is ſometimes forced outwards in laborious births. This is diſcovered by the great pain which is felt at the connection of the os coccygis with the ſacrum, and by the bone appearing to be diſplaced when examined. It may generally be eaſily reduced by preſſure with the fingers. The beſt ſupport afterwards is a compreſs, with the T bandage. When the coccyx is luxated inwardly, the patient complains of ſevere pain, teneſmus, and a ſenſe of fulneſs in the rectum; the fæces are paſſed with difficulty, and in ſome caſes a ſuppreſſion of urine takes place. The injury is eaſily diſcovered by introducing the finger into the anus. In this caſe the bone ſhould be preſſed outwards, by introducing the fore and middle fingers of one hand dipped in oil into the rectum, and ſupporting the parts which correſpond with it externally till the reduction is accompliſhed. Diſlocations of theſe bones are apt to excite inflammation, which often terminates in dangerous abſceſſes; it ought therefore to be guarded againſt by every means in our power.

369 Of the clavicle.

The clavicle is moſt frequently luxated at its junction with the ſternum; becauſe the violence which produces the injury is generally applied to the ſhoulder. The luxation is diſcovered by pain in the part, by the projection of the bone, and by the immobility of the ſhoulder. It is eaſily reduced by puſhing the bone into its place with the fingers, while an aſſiſtant draws back the arms and ſhoulders. It is not ſo eaſy to retain the bone in its place. When it is the inner extremity of the clavicle which has been diſlocated, the ſhoulder ſhould be kept in its natural ſituation, neither raiſed nor depreſſed: the fore arm ſhould be ſupported, as ſhould alſo the head and ſhoulders, and a moderate preſſure ſhould be made upon the diſplaced end of the bone. For this purpoſe the machine repreſented fig. 104. the invention of Mr Park of Liverpool, anſwers beſt. But when the outer extremity of the clavicle has been diſlocated, the ſhoulder muſt be conſiderably raiſed, the arm ſupported in a ſling, and the bone kept in its proper ſituation by a ſmall compreſs placed over its end, and ſecured by a roller forming the figure 8; or it may be retained by the machine

Luxations of the [illegible] machine above mentioned. The bandage ought to be retained for a conſiderable time.

Luxations of the ribs are exceedingly rare. The ſymptoms are nearly the ſame with thoſe ariſing from fracture, only that the pain is more ſevere at the articulation, and that no other ſpot but that will yield to preſſure. All that

370 Of the ribs. can be done is to bend the body forward over a caſk or ſome ſuch body, in order to aſſiſt the viſcera in preſſing out the rib. Bandages are of little uſe. The patient ſhould be kept quiet, and fed on a low diet: inflammation ſhould be prevented, and opiates given if he has a troubleſome cough.

Sect. IV. *Luxation of the Bones of the Superior Extremities.*

371 Luxation of the head of the os humeri. The head of the os humeri is moſt frequently diſlocated forwards and downwards, ſometimes downwards and backwards, but never upwards without a fracture of that part of the ſcapula which is placed above the joint. The luxation is diſcovered by the patient's inability to raiſe his arm, by violent pain attending the attempt, by the luxated arm being of a different length from the other, by the head of the humerus being felt out of its natural ſituation, while a vacuity is perceived under the acromion, and by the flatneſs of the injured joint, while the ſound one has its natural fulneſs. When the luxation is of long ſtanding, the whole arm is apt to become œdematous.

372 Method of reduction. The patient ſhould be ſeated on a chair, and his body ſecured by a broad belt paſſed round it, and held by aſſiſtants. The elbow ſhould be bent, in order to relax the muſcles on the fore part of the luxated joint. A firm leather belt four or five inches broad, with ſtrong ſtraps, and lined with flannel, is to be tied round the arm immediately above the elbow: aſſiſtants are to extend the arm gradually, by pulling theſe ſtraps, while another aſſiſtant draws back the ſcapula. The ſurgeon ſtands on the outſide of the arm, directs the aſſiſtants, and varies the direction of the extenſion, according to the ſituation of the head of the bone. As ſoon as the head of the bone has cleared the brim of the ſocket, the muſcles draw it into its place, a crack is heard, the patient is relieved, and the anterior part of the ſhoulder acquires its uſual fulneſs.

373 Various methods of extending the arm. Various other methods of extending the arm have been propoſed in difficult caſes; as, ſuſpending the patient by the luxated arm over the ſtep of a ladder or the top of a door, raiſing him up by the arm with ropes running over pulleys fixed in the ceiling of a room, &c. The jerk produced by the body being ſuddenly raiſed and let down again on a feather bed, has ſometimes ſucceeded when other means have failed. A gentler method is to lay the patient on the floor, while two or three ſtout men ſtanding on a table lay hold of him by the arm and pull him up. But all theſe methods are in danger of lacerating the ſoft parts by the ſuddenneſs with which the force is applied, and even ſometimes of breaking the end of the humerus if it be preſſed againſt the neck of the ſcapula. Mr Freke's improvement on the ambé of Hippocrates has been conſidered as the beſt machine for extending the arm. But machinery is very ſeldom neceſſary; even caſes of long ſtanding may by proper management be reduced by means of aſſiſtants, provided reduction be at all practicable. Inflammation after the operation ſhould be obviated by the uſual remedies. If the bone be apt to ſtep out again, which ſometimes happens after repeated diſlocations, the arm ſhould be ſupported in a ſling till the parts have recovered their tone. Bliſters, friction, ſtimulating medicines applied to the ſhoulder; and cold water poured on it, have ſometimes been uſeful in reſtoring the ſtrength of the joint.

Luxations at the elbow moſt commonly happen upwards and backwards; and then the fore-arm is ſhortened, the end of the ulna projects behind, and is higher than uſual, while the extremity of the humerus can be felt in the bend of the elbow. The ſurgeon ſhould take hold of the wriſt with one hand, and the upper part of the fore-arm (which is to be moderately bent) with the other, and gradually pull the top of the fore-arm downwards, while at the ſame time he increaſes the curvature of the elbow to diſengage the ends of the bones from each other. He ſhould then pull the bones forward into their ſituation. When the luxation happens upwards and forwards, it ſhould be reduced while the arm is extended. After the reduction, the muſcles of the fore-arm ſhould be kept relaxed by bending the elbow a little till the parts have recovered their tone. When the bones of the fore-arm are diſlocated from each other, which happens moſt frequently at the wriſt, the rotatory motion of the hand is deſtroyed. After the reduction, the bones ſhould be bound together by a tight flannel roller, or a couple of ſplints ſhould be applied along the fore-arm, and the arm ſupported in a ſling.

The bones of the wriſt are not ſo often luxated as might be expected from the ſmallneſs of their ſize. When they are, great ſwelling and pain enſues, and the motion of the joint is entirely deſtroyed. Great attention is neceſſary, leſt luxation ſhould be miſtaken for a ſprain. The arm and hand ſhould be ſupported by aſſiſtants, but not ſtretched; and then the bones ſhould be puſhed into their place, and afterwards retained by proper bandages and ſplints.

he bones of the metacarpus, when they happen to be diſlocated, which is very ſeldom, are to be reduced in the ſame manner. Diſlocations of the thumb or fingers are eaſily diſcovered. To reduce them, an aſſiſtant ſhould hold the phalanx from which the diſlocation happened, while the ſurgeon endeavours to elevate the bone from the one contiguous to it, and to paſs it into its place.

Sect. V. *Luxations of the Bones of the inferior Extremities.*

From the great ſtrength of the hip joint, it was formerly believed that the head of the thigh-bone was never luxated by external violence; but it is now known that it happens by no means unfrequently. The ball in ſtarting from its ſocket generally paſſes forwards and downwards into the foramen thyroideum. When this happens, the limb is conſiderably lengthened, the head of the bone is lodged near the under and fore part of the pelvis, the large trochanter is obſerved on the fore part of the thigh, a vacancy is perceived where the head of the bone and the trochanter ſhould be, and the toes are turned outwards. When the bone is diſlocated upwards and backwards, the limb is ſhortened, the great trochanter higher than uſual, the knee and foot turned inwards. When it is diſlocated upwards and forwards, the leg is ſhortened, the ball of the bone is felt on the os pubis in the groin, and the great trochanter on the upper and lower part of the thigh; a vacancy is diſcovered in the correſponding part of the hip; the knee and toes are turned outwards. When the ball ſlips downwards and backwards, the leg is lengthened, the toes turned inwards, and the great trochanter is lower than that of the other limb. If the ball ſlip directly downwards, the leg is lengthened, but the knee and toes keep nearly their natural ſituation. It is ſometimes difficult to diſtinguiſh between luxation and fracture of the neck of the bone. In fractures the bone is moſt frequently puſhed upwards, and the leg ſhortened, the knee and point of the toes are turned inwards, and may be moved much more readily outwards and inwards than when the bone is diſlocated.

6 For

For reduction, the patient ſhould be laid on a mattreſs on the ſound ſide, and a wooden roller covered with ſeveral folds of flannel placed between his thighs, and fixed firmly by ſtraps to the wall. A ſtrong bandage of buff leather, or ſomething ſimilar, ſhould be applied to the under end of the thigh, with ſtraps fixed to it to make the extenſion. The trunk of the body ſhould be properly ſecured, and the joint of the knee bent. The extenſion ſhould be made at firſt gently, and increaſed gradually, while, at the ſame time, the thigh is made to roll in different directions. When the extenſion is ſufficient, two aſſiſtants ſhould lay hold of the roller, and attempt to raiſe the bone; the extending force ſhould then be ſlackened, and the ſurgeon ſhould puſh the head of the bone upwards and outwards, while an aſſiſtant preſſes the knee forcibly inwards. The muſcles themſelves will then commonly bring the bone into its place; and this is done with ſuch a jerk and noiſe, that it is heard by the byſtanders. If the reduction be not obtained, the extenſion muſt be repeated with greater force. Inſtead of the roller a broad ſtrap or table cloth is frequently uſed. The limb ſhould not be uſed for ſome time after reduction, and inflammation ſhould be prevented by the proper remedies.

The patella can neither be luxated upwards or downwards, without rupture of the tendons of the extenſors muſcles, or of the ſtrong ligament which fixes it to the tibia; but it may be luxated to either ſide. The luxation produces lameneſs, and much pain on attempting to move the joint. In recent caſes the injury is eaſily diſcovered; but when the ſurgeon is not called immediately, the ſwelling may be ſo great as to render it more difficult. For reduction, the limb ſhould be kept extended; the ſurgeon, by depreſſing the edge of the patella moſt diſtant from the joint, is enabled to raiſe the other, and puſh the bone into its place.

It may be neceſſary to remain a day or two in bed till the knee recover its tone. Sometimes, after the bone has been diſplaced, returns of the ſame complaint become frequent. In ſuch caſes, proper machinery applied to the ſide of the tumor, where the bone is apt to ſtart out, is uſed with advantage.

From the ſize of the joint, and the great ſtrength of the ligaments, luxations of the tibia from the os femoris rarely occur. When it does, it is eaſily diſcovered by the pain, lameneſs, and deformity of the limb. The patient ſhould be laid on a table, the muſcles relaxed, and the thigh ſecured by aſſiſtants; the limb ſhould then be extended, and the bones cleared of each other, when they will be eaſily replaced. After the reduction, the limb ſhould remain for ſome time perfectly at reſt; and inflammation, which is very apt to enſue, and is attended with very bad conſequences, ſhould be aſſiduouſly guarded againſt.

If the ankle joint be diſlocated forwards, the fore part of the foot is lengthened; if backwards, the foot is ſhortened and the heel lengthened (this is the moſt common variety); if to either ſide, there is an uncommon vacancy on the one ſide, and a prominency on the other. Diſlocation, however, can hardly take place outwardly without fracture of the end of the fibula.

For reduction, the limb ſhould be firmly held by aſſiſtants, the muſcles relaxed, and extenſion made till the bones are cleared of each other, when the aſtragulus will eaſily ſlip into its place.—The ſame rules ſhould be obſerved in reducing diſlocations of the bones of the foot. Luxations of the metatarſal bones and toes are reduced exactly in the ſame manner as the bones of the metacarpus and fingers.

Chap. XXXII. *Of Fractures.*

Fractures in general.

Sect. I. *Of Fractures in general.*

The term *fracture* is generally confined to ſuch diviſions in bones as are produced by external injury. When the integuments remain ſound, the fracture is called *ſimple*; when it communicates with a wound, it is called *compound*. 382

Symptoms of fracture.

The general ſymptoms of fracture are pain, ſwelling, and tenſion in the contiguous parts. A grating noiſe when the part is handled, diſtortion, and a certain degree of loſs of power in the injured part, accompany almoſt every fracture, except when it runs longitudinally, and the divided parts are not completely ſeparated from each other. When there is only a ſingle bone in a limb, a fracture is eaſily detected; but where only one of two bones of a limb has ſuffered, it is often difficult to judge with certainty, eſpecially if the contiguous ſoft parts be tenſe and painful before the practitioner is called. In that caſe, the opinion muſt be regulated, not only by the attendant ſymptoms, but, 1ſt, By the age and habit of the patient; for bones are more eaſily fractured in old than in young perſons. Different diſeaſes, too, induce brittleneſs of the bones, as the lues venerea and ſea-ſcurvy. 2d, By the ſituation of the part; for bones are more apt to be fractured in the ſolid parts of their bodies than towards their extremities, where they are more ſoft and pliant. 3d, By the poſture of the limb; for a weight may fracture a bone lying on an unequal ſurface, which it would have ſuſtained without injury if equally ſupported. Fractures are ſometimes attended with a great degree of echymoſis, occaſioned by the ends of the fractured bones wounding ſome of the contiguous blood-veſſels. 383

Prognoſis.

In giving a prognoſis of fracture, various circumſtances are to be attended to. It is evident that ſmall fractured bones are more eaſily healed than large ones, and that the fracture of the middle of a bone is not near ſo dangerous as near the extremity. A cure is effected much more readily in youth than in old age, and in good conſtitutions than in bad. We ought alſo to attend to the concomitant ſymptoms, and the injury which the neighbouring parts may have ſuſtained. The more moderate the ſymptoms, the more favourable our prognoſis may be. 384

Treatment.

The treatment of fractures conſiſt of three particulars; replacement, retention, and obviating bad ſymptoms.

1. When bones are fractured directly acroſs the parts, they are often very little moved from their natural ſituation; but when the fracture is oblique, they are apt to paſs over each other, and to produce much uneaſineſs and deformity; the contiguous muſcles are ſeverely injured, and the pain is aggravated by the ſlighteſt motion. The ſurgeon ſhould put the limb into the beſt poſture for relaxing all the muſcles connected with it, according to the practice firſt introduced by Mr Pott. If it be properly attended to, the ends of the bones will in general be eaſily replaced. When any difficulty occurs, a ſmall degree of extenſion may be made, taking care to keep the muſcles as relaxed as poſſible. Much attention ſhould be paid to replacing the bones properly, otherwiſe the limb will remain for ever after diſtorted.

2. After the bones are replaced, the limb ſhould be laid in the eaſieſt poſture, and the bones afterwards retained in their ſituation by proper compreſſes and bandages, not applied too tightly, till the cure be completed. The time neceſſary for this purpoſe depends on the ſize of the bone, the age and habit of the patient, the ſteadineſs with which the limb has been retained in its place, and the violence of the

Fractures in general. the attending ſymptoms. In middle-aged perſons, and under favourable circumſtances, a fracture of the thigh bone, or of the bones of the leg, may be cured in two months; of the arm bone, or bones of the fore arm, in ſix weeks; of the ribs, clavicles, and bones of the hand, in three weeks. In infancy the cure will take a ſhorter, and in old age a longer, time than this.

3. In ſimple fractures the inflammatory ſymptoms generally ſubſide in a few days. When they become worſe, which is ſometimes the caſe, aſtringent applications ſhould be employed. If theſe fail, blood ought to be drawn from the parts affected. This is of ſo much advantage, that it ought never to be omitted where the ſurrounding ſoft parts are much injured. Friction with emollient oils, warm bathing, the uſe of Bath and other ſimilar waters, are alſo of much ſervice. The limb ſometimes puts on a clumſy appearance from an overgrowth of callus. When this tendency appears, ardent ſpirits and other aſtringents are conſidered as uſeful; ſometimes preſſure on the part by a thin plate of lead fixed by a bandage may be advantageous. Many inſtances occur, however, where no remedies prove ſucceſsful: The patient ought therefore to be acquainted beforehand with the probable event, to prevent unpleaſant reflections afterwards.

Sometimes the ends of the bone remain looſe long after they might have been reunited. This may be owing to ſome conſtitutional diſeaſe, to the bones not being kept ſteadily in contact, to ſome of the ſoft parts getting in between them, or to the bone being broken in different places, and the intermediate fractures being too ſmall to adhere. Pregnancy has alſo been mentioned as a cauſe. By removing theſe obſtructions, a perfect union may in recent caſes be accompliſhed. But where the caſe is of long ſtanding, callus of the bones becomes ſo hard and ſmooth as to move with the eaſe of a joint, ſo that no advantage can be derived from laying them together. In that caſe, an inciſion ſhould be made through the ſoft parts, and a ſmall portion of the ends of the bone removed with a ſaw. If this be properly performed, nature will ſupply the deficiency. When ſmall pieces of bone remain long looſe, they ſhould be extracted by making an opening. The intervention of muſcles or other ſoft parts is known by the very ſevere pain and tenſion, and by particular motions of the limb cauſing great pain and twitching of the muſcles which move it. The limb ſhould be put into all the variety of ſituation; and if this does not ſucceed, an opening muſt be made, and the ſoft parts removed. Sometimes in fractures blood-veſſels are ruptured by the ſharp ſpiculæ of the bone: this happens moſt commonly in compound fractures. When the effuſion of blood is great, the part ſwells ſo much that it is neceſſary to lay it open, and to ſecure the divided veſſels by a ligature. When the ſwelling is not great, the abſorption of the blood is truſted to nature. When the blood remains long in contact with the fractured bone, it ſometimes prevents the formation of callus; the perioſteum ſeparates from a conſiderable portion of the bone, and a thin fetid ſanies is diſcharged at the wound. When this happens, no cure can be expected till the parts of the bone deprived of perioſteum have exfoliated, or have been ſeparated by a ſaw.

Sect. II. *Fractures of the Bones of the Face.*

385 Fracture of the noſe. Fractures of the noſe may impede reſpiration, affect the ſpeech and ſenſe of ſmelling, give riſe to polypi and tedious ulcers, and may beſides be dangerous from their vicinity to the brain. When any part of the bones of the noſe has been raiſed above the reſt, it is to be preſſed into its place with the fingers; if it has been puſhed into the noſtril, it is to be raiſed with the end of a ſpatula or other ſimilar inſtrument. If any portion be almoſt entirely ſeparated from the reſt, it ſhould be removed; but if it adheres with conſiderable firmneſs, it is to be replaced. If the bones, after being replaced, do not remain in their proper ſituation, they are to be retained either by tubes introduced into the noſtrils, or by a double-headed roller, with proper compreſſes as the caſe may require. Inflammation ſhould be prevented by the proper remedies.

Much care is neceſſary in replacing the fractured bones of the face, and in dreſſing them, in order to prevent deformity. The dreſſings may be retained by adheſive plaſters. Inflammation, by which the eyes, noſe, or antrum maxillare is apt to be injured, ſhould be prevented. When matter collects in the antrum, it is to be removed by the methods formerly deſcribed.

For replacing fractures of the lower jaw, the patient ſhould be ſeated in a proper light, with his head firmly ſecured. The ſurgeon ſhould preſs with one hand on the inſide of the bone, while with the other he guards againſt inequalities on the outſide. If a tooth come in the way, it ſhould be extracted; when any of the others are forced out of their ſockets, they ſhould be replaced, and tied to the neighbouring teeth till they become firm. The fractured parts being kept firm by an aſſiſtant, a thick compreſs of linen or cotton ſhould be laid over the chin, and made to extend from ear to ear over it; a four-headed roller ſhould be applied firm enough to keep the fractured parts in contact. The patient ſhould be kept quiet during the cure, and fed upon ſpoon-meat. The dreſſings ſhould be removed as ſeldom as poſſible. When the fracture is accompanied with an external wound, the parts ſhould be ſupported by an aſſiſtant during the dreſſing of it.

Sect. III. *Fractures of the Clavicles, Ribs, Sternum, and Spine.*

A fracture of the clavicle is eaſily diſcovered by the grating noiſe in the fractured bone upon moving the arm freely, by the ends of the bone yielding to preſſure, and by the motion of the humerus being impeded. All that can be done is to raiſe the arm, and ſupport it at a proper height, either by a ſling, or, which is better, by the leather caſe recommended in caſe of luxation of this bone. By this the fractured parts will be brought together, ſo far at leaſt as to prevent deformity, and render the bone ſufficiently ſtrong.

Fractures of the ribs are diſcovered by preſſures with the fingers. The ſymptoms are commonly moderate, and the patient ſoon gets well. In ſome caſes, however, the pain is ſevere, the breathing becomes difficult, attended with cough, and perhaps with ſpitting of blood, and the pulſe is quick, full, and ſometimes oppreſſed. Theſe ſymptoms ariſe from the ribs being beat in on the lungs.

In the treatment, it is proper in every caſe to diſcharge ſome blood. If one end of the rib riſe, it ought to be repreſſed by moderate preſſure; and to prevent its riſing again, a broad leather belt ſhould be applied pretty tight, and continued for ſome weeks. When a portion of the rib is forced inwards, an opening ſhould be made over it with a ſcalpel, and then it ſhould be elevated with the fingers or a forceps. When diſtreſſing ſymptoms proceed from air or blood collected in the cavity of the cheſt, theſe fluids ought to be diſcharged by an operation.

The ſymptoms of a fractured ſternum are nearly the ſame with thoſe of the ribs. It requires great attention from the vicinity of the heart and large blood-veſſels. The patient ought to loſe a quantity of blood, and be kept on an antiphlogiſtic regimen. If the pain, cough, and oppreſſed breathing, do not yield to theſe remedies, an inciſion ſhould be made

ure of Bones. made on the injured part, and the depressed piece raised with a levator. Should this be insufficient, it may be effected by means of the trepan: this indeed requires the greatest caution, but it may certainly be attended with advantage when the patient's life is in danger.

90 ie vertebrae. Fractures of the vertebrae generally end fatally. We judge of the existence of fracture there by examining the parts, by the severity of the pain, and by palsy occurring in the parts situated below the injured part.

When any parts of the vertebrae near the integuments are loose, they may be replaced with the fingers, and retained by proper bandages. When this is impossible, some of the latest authors think it advisable to make an incision, and raise any portions of the bone which may be depressed.

Sect. IV. *Fracture of the Bones of the Superior Extremities.*

91 ure of apula. The scapula is seldom fractured; when it is, the fracture is easily discovered by the pain, the immobility of the arm, and by the touch. The parts may be replaced with greater ease if the muscles connected with them be relaxed. They are retained with difficulty. A long roller should be employed for this purpose, with which the head and shoulders are also to be supported. The arm should also be suspended to relax the muscles as much as possible, and inflammation particularly guarded against by local bloodings.

92 e of ri; Fractures of the humerus are easily discovered by the pain, the immobility of the arm, and a grating noise on handling the parts. In reducing the fracture, the muscles should be completely relaxed by bending the arm and raising it to a horizontal posture. Extension, if necessary, may be made by one assistant grasping the arm between the fracture and the shoulder, and another between the fracture and the elbow. After the reduction, one splint covered with flannel should be laid along the whole outside, and another along the whole inside of the arm; and then a flannel roller applied sufficiently tight to support the parts without interrupting the circulation. The arm may either be supported in a sling or Mr Park's leather case, (fig. 104). The bandages should not be removed for several days, unless some urgent symptoms render it necessary. In about a week, however, the arm should be examined to see whether the bones have been properly set.

93 e of re- When both of the bones of the fore-arm are broken, the fracture is easily discovered; but when only one bone is fractured, especially if it be the radius, the firmness of the other renders the discovery more difficult; the grating noise, however, on moving the bone in different directions, will generally be a sufficient symptom that a fracture has taken place. When the fracture happens near the wrist, particular attention is necessary in order to prevent a stiff joint. In order to replace the parts, the muscles are to be relaxed by bending the joints of the elbow and wrist, and the limb extended a little above and below the fracture. After reduction, a splint reaching from the elbow to the ends of the fingers is to be applied along the radius, and another along the ulna; and both are to be secured with a roller or twelve-tailed bandage. When the splints are applied, the palms should be turned towards the breast as the most convenient posture. The arm should be hung in a sling. A partial dislocation of the bones of the wrist sometimes attends a fracture of the radius, by which a stiff joint, under the best practice, is apt to ensue, or permanent painful swellings of the fore-arm. In such cases, the patient ought to be warned of the danger, that no blame may be afterwards incurred.

4 Of olecran n; When the olecranum is fractured, the arm must be kept in an extended state during the cure, by applying a splint opposite to the joint of the elbow, reaching from the middle of the humerus to the points of the fingers. The arm should be hung by the patient's side, to which it should be fixed by means of straps. To prevent the consequences of a stiff joint, the dressings should be removed about the eighth or tenth day, the fore-arm for some time slowly moved backwards and forwards, and the joint rubbed with an emolient oil. By a repetition of this at proper intervals, a stiff joint may be prevented. Fracture of the Bones, &c.

Anchylosis, or stiffness of the joint, commonly succeeds fractures of the bones of the wrist, owing to the great inflammation which ensues, and to their not readily reuniting from their smallness. To prevent this as much as possible, after replacing the bones, the injured parts should be leeched freely, and in proportion to the violence of the symptoms. Splints should be applied exactly as in fractures of the fore-arm, and the arm supported by a sling. 395 Of the bone of the wrist;

In fractures of the metacarpal bones, a firm splint should be applied over the whole palm and inside of the arm, from the points of the fingers to the elbow, in order to prevent the action of the flexors of the fingers. The best splint for a fractured finger is a piece of firm pasteboard properly fitted and softened in water till it can be readily moulded into the form of the part. This should be applied along the whole length of the finger, and secured with a narrow roller. At the same time, a large roller should be applied over the inside of the hand to prevent the parts from being moved. To prevent stiffness, the dressings should be removed about the end of the second week, and the joint cautiously bent; and this should be repeated daily till the cure be completed. 396 Of the bones of the fingers.

Sect. V. *Fractures of the Bones of the inferior Extremities.*

Fractures of the body of the thigh-bone are readily discovered by the grating noise when the ends of the bones are forcibly rubbed together, by the shortness of the limb if the fracture be oblique, and by the limb being unable to sustain the body. But fractures of the neck of the bone are often not easily distinguished from dislocation of the joint. In general they may be distinguished by the circumstances mentioned in treating of luxations of this bone. In forming a prognosis, we ought to consider that no fractures are more apt to disappoint our expectations than those of the thigh, especially when the neck of the bone is broken, owing to the difficulty of discovering the place of the fracture, and of retaining the bones even after they have been replaced. In order to reduce fractures of the thigh, the muscles are to be relaxed by moderately bending the joints of the thigh and knee: when this is done, unless there be much pain and tension, the bones are easily replaced by one assistant holding the upper part of the thigh, while another supports and gently pulls down its lower extremity, while the surgeon is employed in adjusting the fractured pieces. It is more difficult to reduce fractures of the neck of the bone, on account of the great strength and various directions of the surrounding muscles. In general, however, we shall succeed by moderate extension, if we take care previously to relax all the muscles as much as possible: if we do not succeed, we must have recourse to machinery. 397 Fracture of the thigh-bone.

The greatest difficulty is to retain the bones in their situation after they are replaced. The limb must be firmly secured by splints made of thin slips of wood glued to leather (fig. 105. *a* and *b*), or of thick pasteboard. One splint, broad enough to cover half of the thigh, should reach from the top of the hip joint to a little below the knee, and another, covering about a third part of the thigh, from the groin to a little below the knee. The splints should be lined with flannel. They are to be secured by a twelve-tailed bandage, and over all a thin pillow should be put nearly as long as the

Fractures of the Bones, &c.

the thigh. The splints and bandages may be put on in the following manner: The patient being placed on a firm hair mattress, with his knee moderately bent, the long splint bandage and pillow are to be applied to the outside of the thigh, and the patient should be turned somewhat towards the affected side, with the knee and leg raised a little higher than the body: the short splint should then be applied along the inside of the thigh, and the bandage already placed without the other splint applied so tight as to make an equal moderate pressure over the whole: (See fig. 106.). To make the part still more secure, it is proper to insert a long firm splint of timber under the middle of the pillow, and to fix it by two broad straps to the upper part of the limb. To prevent the limb from being affected by involuntary startings, the pillow should be fixed to the bed by straps: to keep off the weight of the bed-clothes, a frame with hoops should be placed over the thigh. The parts should be examined after some time to see that the bones be not displaced. When there is pain, swelling, and inflammation, leeches and other remedies should be applied. To render the situation of the patient as easy as possible during the cure, he may be allowed after the second week to turn a little more towards his back, and at the same time to extend the joint of the knee in a small degree: after this time a little flexion and extension of the limb may be daily repeated to preserve the use of the joint.

The method here described generally succeeds. Sometimes, however, notwithstanding all our care, the ends of the bone slip over each other. To prevent the deformity which this occasions, it has been attempted to make extension and counter-extension by machines: but the pain and irritation have always been so great that little advantage has yet been derived from such means. The invention (fig. 107.) of the late Mr Gooch of Norwich, improved by the late Dr Aitken of Edinburgh, has been recommended as one of the best machines for oblique fractures of the thigh. After endeavouring to remove the pain, swelling, and inflammation, which are sometimes so great as to preclude the application of the simplest bandage, this machine may be tried. But if it be found impracticable to use it, the cure must be conducted in the usual way with the chance of the fractured pieces overlopping one another, and of course the limb being somewhat shortened.

398 Fracture of the patella.

The *patella* is most frequently fractured transversely, sometimes lengthwise, and sometimes into several pieces. Fractures of this bone have been said commonly to end in a stiff joint; but this is perhaps most frequently owing to the limb being kept too long in an extended posture. In the treatment of fractures of this bone, the leg should be extended to relax as much as possible the soft parts connected with the bone. The patient should be placed on a firm mattress, and a splint be placed under the limb long enough to reach from the top of the thigh to the under end of the leg, to which the limb should be fixed by a number of straps to keep it in a state of extension. The fractured bones are then to be brought together, and such a number of leeches applied to the joint as will remove as much blood as the patient can bear; and as long as much pain and tension continue, saturnine and other astringents are to be used for removing them. When this is accomplished, and the parts properly adjusted, a large pledget of Goulard's cerate should be laid over the joint, and a hooped frame employed to keep off the bed-clothes. In a longitudinal fracture the parts are easily kept together by a common uniting bandage or adhesive plaster; but in transverse fractures more force is necessary. Various bandages have been employed for drawing the pieces together in such fractures; one of the best of these is that represented fig. 108. We need not be anxious, however, about bringing the pieces very close together, as a cure may be made though they remain at a considerable distance. The bandages, unless particular symptoms occur, should not be removed till the end of the second week; after which the joint should be cautiously bent every second day to prevent stiffness.

399 Of the leg.

The leg is commonly fractured near the lower end, this being the weakest part of the bones. In the treatment of a fractured leg the same rules apply which were given for a fractured thigh-bone. The muscles should be relaxed by bending the knee; but little advantage can be derived from bending the foot, for in proportion as the muscles behind are relaxed those before are put on the stretch: the patient may be therefore allowed to keep the foot in the easiest posture. The bones are commonly replaced by the gentle extension of the upper part of the limb by an assistant, while another supports it at the ankle. The bones being replaced, and the limb laid on its outside with the knee bent, two splints (fig. 109.) are to be applied, long enough to reach from the upper part of the knee to the edge of the sole, so as to prevent the motion both of the knee and ankle. The splints are to be retained by a twelve-tailed bandage, as in the case of fractured thigh bone. See fig. 106.

If the patient be either very restless or troubled with spasmodic affections of the muscles of the leg, an additional splint, shaped to the form of the leg, should be applied along the outside of it, and fixed by a strap at the upper, and another at the under part of the leg. When the patient cannot rest when lying on either side, he may be placed on his back, and the curved state of the knee still preserved by raising the leg a little above the level of the body on a frame made for the purpose. This variety of posture may likewise be used in fractures of the thigh. The patient may from the first be laid in this posture, or he may alternately change from the one to the other. No change of posture, however, should be allowed for the first ten or twelve days. When the fibula only is fractured, it is apt to be considered as a sprain of some of the muscles; but this ought to be particularly attended to, as the mistake may be followed by bad consequences. When both the bones of the leg are broken, the portion next the foot is commonly drawn towards the back part of the leg, so that a prominency is produced by the fractured part of the upper portion of the bone; and this is improperly termed the rising end of the fractured bone. The appearance is entirely produced by the inferior portion falling back. Hence no advantage is derived from pressure being made on the upper end of the bone: the inferior portion should be raised so as to bring the parts into contact, and then by proper bandages they ought to be supported till they are perfectly united.

400 Of the bones of foot and toes.

Fractures of the bones of the foot and toes are treated nearly in the same manner as fractures of the hand and fingers. Besides the splint which may be necessary for the particular part, a large one should be appled over the sole; nor should any motion be allowed for a considerable time either in the foot or ankle, otherwise the bones may be displaced, and a proper cure prevented.

Sect. VI. *Of Compound Fractures.*

401 Whether amputation should be performed in cases of compound fractures.

By compound fracture is now generally meant a fracture of a bone communicating with an external wound in the integuments. They are much more dangerous than simple fractures. The generality of authors have considered amputation as indispensable in cases of compound fractures; while a few, particularly Mr Bilguer, surgeon-general to the armies of the late king of Prussia, affirm that it is scarcely ever necessary. Both seem to have carried matters too far. Some of the latest and best surgeons have recom-

 mended

Compound fractures. mended never to amputate immediately in private practice, unleſs when the bones are ſo much ſhattered that they cannot reunite, or the texture of the ſoft parts completely deſtroyed; becauſe, even if amputation be at laſt neceſſary, the patient will have a greater chance of recovering than if it had been performed immediately after the accident: for the ſtate of weakneſs to which he is generally reduced render the attendant ſymptoms leſs violent. On the other hand, it has been conſidered as no bad rule in the army or navy, where patients cannot be kept in a proper ſituation, and where ſufficient attention cannot be given, to amputate immediately in caſes of compound fractures of the large bones of the extremities. When amputation is not performed immediately, it is not, for ſeveral days at leaſt, admiſſible. It may afterwards be rendered neceſſary by hemorrhagies, which cannot be ſtopped but by means more dangerous than amputation itſelf; by extenſive mortification; or by the ends of the fractured bones remaining long diſunited, while a great diſcharge of matter endangers the patient's life.

402 Treatment of compound fractures. In treating compound fractures, all extraneous bodies ſhould be removed, as alſo all thoſe ſmall pieces of bone which will probably not unite with the reſt. For this purpoſe the opening, if neceſſary, ſhould be enlarged with a ſcalpel. The next ſtep is to replace the bones by relaxing the muſcles as in ſimple fractures. Sometimes part of a bone projects ſo far through the integuments that it cannot be replaced without either ſawing off the end of it, or enlarging the wound. If the fractured bone be long, ſharp, and projecting much, it is beſt to ſaw it off; for though it were reduced, it would not readily reunite, and it would be apt to excite much pain and inflammation: But if it be broad at the baſe, and of no great length, it ought certainly to be ſawed, even though it cannot be reduced without enlarging the wound. For the moſt part, it is only the ſkin which it is neceſſary to cut; but even the muſcles ought to be divided, though as much as poſſible in the direction of their fibres, when the bone cannot otherwiſe be replaced. After the reduction, a pledget of ſome emollient ointment is to be laid over the wound, and the limb placed on a firm ſplint, and ſtill kept in a relaxed poſture. In dreſſing the wound, the limb ought not to be moved: the many-tailed bandage, therefore, ſhould be uſed rather than a roller. Various contrivances have been fallen upon to allow the limb to be at reſt while the ſurgeon is dreſſing it. The fracture box, invented by the late Mr Rae ſurgeon in Edinburgh, is one of the beſt. When the leg is laid on this, it may be dreſſed with tolerable facility without moving it. We are happy to have it in our power to announce to the gentlemen of the medical faculty, that another machine has lately been invented by Mr Samuel James ſurgeon in Hoddeſden, Herts, which, we are told, will effectually relax the muſcles, and retain the bones in their natural ſituation, without pain to the patient or the leaſt inconvenience to the Plate CCCXII operator. See fig. 110.

It is of the greateſt importance to prevent inflammation, which is apt either to produce mortification, or to give riſe to extenſive abſceſſes. The dreſſings ſhould be removed once or twice daily according to the quantity of matter. The common application of warm poultices, on account of their inconvenience, may be deferred till they become neceſſary by the approach of inflammation, which they are to be conſidered as the ſureſt means of preventing by exciting a diſcharge of matter. Whenever the inflammation ſubſides, and a free diſcharge of pus is produced, the poultices ought to be laid aſide, leſt they do harm by relaxing the parts too much, and exciting too copious a diſcharge. The ſore ought then to be dreſſed with mild aſtringents, and the patient kept on a nouriſhing diet with tonic medicines. A free paſſage ſhould be given to the matter by putting the limb in a favourable poſture, and by making a counter opening, if neceſſary, to the moſt depending part. But this may be frequently avoided, by covering the ſore with ſoft lint or ſponge to abſorb the matter. If the diſcharge become exceſſive, and cannot be leſſened by the means above-mentioned, it will be found to proceed from a portion of looſe bone which has not been earlier noticed, by the removal of which it may be ſtopt. If, inſtead of producing matter, the inflammation terminate in gangrene, the danger is ſtill greater than under the moſt extenſive abſceſſes. For the treatment of this, the reader is referred to Chap. III. Sect. 2d.

Chap. XXXIII. *Of Diſtortions.*

Diſtortions.

Distortions of the bones may ariſe from external injuries, from diſeaſed conſtitutions, from a morbid ſtate of the bones, or a contracted ſtate of the muſcles, or both; but the affection is moſt frequently owing to a weakly, delicate conſtitution, as in rickety or ſcrophulous caſes. 403 Cauſes of diſtortion.

In the treatment of diſtortions of the ſpine, particular attention ought to be paid to the cauſe of the diſorder. If it appear to ariſe from the patient continuing too long in any particular poſture, every habit of this kind ſhould be guarded againſt on the firſt appearance of the diſeaſe. If the patient has turned too much to one ſide, the reverſe of this ſhould be adviſed. He ought to ſleep upon a firm hair mattreſs, that his body may lie upon an equal ſurface. He ſhould uſe an invigorating diet, the cold bath, bark, and other tonics. By a ſtrict attention to the uſe of theſe remedies the diſeaſe has ſometimes been retarded in its progreſs. Various machines have been invented for removing diſtortions of the ſpine by preſſure; but conſiderable caution is here required, otherwiſe much injury may ariſe from it. Some advantage, however, in certain caſes, has been derived from the uſe of the common collar (fig. 111.); or the ſtays and machinery adapted to them (fig. 112.), invented in France, and afterwards brought into uſe in this country by Mr Jones of London, are found to be ſtill better ſuited to this purpoſe. 404 Treatment of diſtortion of the ſpine.

The ſame cauſes which produce diſtortions of the ſpine may likewiſe produce diſtortions of the limbs. Sometimes the diſtortion takes place with the original formation of the bones, at other times it occurs in infancy, and now and then at a more advanced period of life. In early infancy the bones are ſo pliable as to be readily affected by the poſtures of the body. When a child is too ſoon allowed to attempt to walk, its legs are apt to become crooked from their inability to ſupport the weight of the body. Certain diſeaſes likewiſe, eſpecially rickets, ſoften the bones ſo much, that they yield to the poſture of the body, and to the common action of their muſcles. 405 Of the limbs.

When the diſtortion of a limb is owing to a curvature in a bone, if the caſe be recent, and eſpecially if it occur in childhood, it may frequently be removed, without much difficulty, by making a gradual but conſtant preſſure, by the uſe of machinery, on the convex ſide of the limb, till it recover its natural appearance. When the deformity occurs in the leg, a method has been uſed, in ſeveral inſtances, which is to fix a firm ſplint of iron, lined with leather, in the ſhoe, on the concave ſide of the leg, the other end of the ſplint to reſt againſt the under end of the thigh; when, if a broad ſtrap or two be applied round the leg and ſplint, an eaſy gradual preſſure may be made, and conſiderable advantage derived from it. See fig. 113.

Along with the curvature above mentioned, it commonly happens that the feet and ankles are affected. When the bones of the leg are bent outward, the fore part of the foot is turned inward, and the inner edge upwards; and the reverſe, if the leg be bent inward. In theſe caſes the affections

Amputation.

tions of the feet are generally owing to the curvature of the bones of the leg. By removing the curvature of these, the foot will commonly regain its natural situation, and the splint above mentioned will for the most part be sufficient for the purpose. But in cases where the sole of the foot is turned much out of its natural direction, it may be necessary to fix the splint and shoe to a frame (fig. 114.), which will render the cure still more effectual.

Besides the instrument already mentioned, some have used a kind of boot, cut lengthwise, made of hardened leather or of metal, &c. which may in some cases sufficiently answer the purpose.

In cases of club foot, where the distortion is in the middle of the foot, a pair of shoes, such as are represented in fig. 115. have been found useful. After the feet are fixed in the shoes, the fore part of the feet may be separated by means of a screw in two plates, which are fixed to the sole.

Chap. XXXIV. *Of Amputation.*

Sect. I. *Of Amputation in general.*

In amputation, which in surgery signifies cutting off a limb, the great end to be aimed at is, the procuring of a handsome stump, in which the bone may not protrude, but be well covered with flesh; so that no excoriation or rawness may be apt to take place. As long ago as the year 1679, it was proposed by Jacob Young, an English surgeon, in a treatise intitled *Currus Triumphalis ex Terebinthino*, to preserve a flap of flesh and skin, which was to be folded over the bone, and which, uniting to the parts of the wound after amputation, would effectually cover the bone, and prevent the inconveniences above mentioned. No traces of the success of this method, however, can be found till the year 1696; when a Latin dissertation was published upon it by P. Adrians Verduin, an eminent surgeon in Amsterdam. The most sanguine expectations were formed of its success; and it was even thought that the flap would prevent the necessity of tying up the blood-vessels. However, it does not appear that the method as at that time practised either did or could succeed; and accordingly it was entirely laid aside; but it has been lately revived with considerable improvements.

406 Causes rendering amputation necessary.

Amputation may be rendered necessary when a member is so much diseased as to be useless, or when it puts life in danger.

The causes in general rendering this operation necessary are, bad compound fractures; extensive lacerated and contused wounds; part of the limb being carried off by a cannon ball or otherwise, the bones being unequally broken and not properly covered; extensive mortification; white swellings of the joints; large exostoses; ulcers attended with extensive caries; cancer or other incurable ulcers; varicose kinds of tumors; particular distortions of the bones.

Amputation may also be sometimes necessary from violent hemorrhagies of some principal artery during the cure of a fractured limb, or from such a profuse discharge of matter taking place that the strength of the patient is exhausted. Lacerated and contused wounds may require amputation, on account of hemorrhagy ensuing which cannot be stopped. Extensive mortification may take place, and such large quantities of matter be formed, that the patient will be unable to bear up under the discharge

Where part of the limb is carried off, it is necessary to amputate higher up, so as to cut the bone, as well as the soft parts, in such a manner as may admit of a much speedier and safer cure. When mortification occurs, every thing ought to be done for the support of the patient till the disease be stopped; the first sign of which is, the appearance of an inflamed circle between the diseased and sound parts. As soon as the diseased begin to separate from the sound parts, amputation of the limb ought to be performed, and no time ought now to be lost, lest the patient suffer from the absorption of putrescent matter.

No part of surgery is brought to greater perfection than the manner of performing amputation. Before the invention of the tourniquet, and the method of securing the vessels by ligature, the operation was seldom undertaken; and a great proportion of those upon whom it was performed died soon after. In the present improved method, one death does not happen in twenty, or even thirty cases. In performing the operation, particular attention is to be paid to the spot where the incision is to be made; the quantity of skin and cellular substance necessary to be saved, so as to cover the muscles and bone completely, without being stretched; cutting the muscles in such a manner that they may unite with each other and entirely cover the end of the bone; the prevention of hemorrhagies during the operation; the tying of the arteries alone, without including the nerves or any of the contiguous parts; securing the integuments so as to prevent them from retracting after the operation; and a proper subsequent treatment of the case.

407 Method of performing amputation.

The following are the general steps of the operation: The patient being properly placed, with assistants to attend, and the apparatus in proper order, the flow of the blood to the limb is to be stopped by the tourniquet (fig. 16.). The first incision is to be made through the skin and cellular substance by one, or rather by two, strokes of the amputating knife represented in fig. 116. These are next to be separated from the muscles, as far as may appear sufficient for covering the stump. The separated skin or flap should be strongly drawn up, or what perhaps answers better, turned up all round the limb, leaving this part of the muscles quite bare. The flap is to be kept in this situation by an assistant, while the operator makes the next incision at the edge of the reflected skin, and cuts till he comes to the bone. This incision should be begun on the lower side of the limb, that the blood may not prevent the eye from readily following the edge of the knife during the whole cut. The muscles are now to be separated from the bone as high as may enable them afterwards completely to cover it. The soft parts in general are then to be drawn up by retractors, which may be either of leather, as in fig. 117. or metal, as in fig. 118. *a* and *b*. The periosteum is to be divided at the place where the saw is to be applied; but no part of the bone is to be denuded of this membrane, which is afterwards to cover the stump, otherwise troublesome exfoliations may ensue. At this place the saw (fig. 119.) is to be applied, and the bone divided with long steady strokes. In this part of the operation a good deal depends upon the steadiness of the assistant who holds the limb; for if it be held too high, the motion of the saw will be impeded; while the bone may be splintered if it be not sufficiently raised. Any points or splinters which may be left should be immediately removed with the pincers (fig. 120.). The retractors are now to be laid aside, and the principal arteries separated from the nerves, and secured by the tenaculum (fig. 17.), or forceps (fig. 120. *a*), and ligatures.

The tourniquet should next be a little slackened, to allow the different branches to be discovered: The clotted blood is to be cleared away with a warm sponge. The patient should get some warm cordial drink, and all the arterial branches which can be discovered ought to be taken up. The ends of the ligatures are then to be cut of such a length as to allow them to hang without the lips of the wound. The muscles and skin are now to be drawn down, and brought

into

into close contact, that the stump may be completely covered. The parts are next to be secured by proper bandaging; and if the operation has been properly performed, the cure will commonly be made by the first intention, and may be completed in the course of three or four weeks, and sometimes in a shorter period. This however must depend much upon the constitution of the patient, as well as the manner of performing the operation.

Sect. II. *Of Amputating the Arm and Fore-arm.*

Amputation of the arm is performed according to the rules already laid down. No more of it should be removed than is diseased; for the longer the stump is, the more useful it proves. The tourniquet is to be applied a little above the part where the operation is to be performed: As much of the integuments should be saved as may be perfectly sufficient for covering the sore. In taking up the artery, after the bone has been divided, the operator ought to be attentiven ot to include the radial nerve, which may be readily discovered and separated, as it lies close upon the fore part of the artery. The fore-arm is to be amputated nearly in the same manner as the leg; only that the stump may be covered by amputating with the double incision, without the assistance of a flap, which it is necessary to form in the leg.

Sect. III. *Of Amputating the Thigh.*

In performing this operation, the patient ought to be placed upon a table of ordinary height, with the diseased limb supported and secured by an assistant seated before him, while other assistants take care of the other leg and the arms. The course of the blood is to be stopped by applying the tourniquet over the trunk of the femoral artery, near the upper part of the thigh. No more of the thigh ought to be removed than is rendered necessary by the disease, as the more of it is left, the more useful it will be to the patient. An assistant should grasp the limb with both hands a little above the place where the skin is to be divided, and draw it up as far as possible; while the operator, standing on the outside of the limb, makes a circular incision down to the muscles by one or two strokes of the knife. As much of the integuments is then to be dissected with a scalpel from the muscles as may cover the stump completely; and this part of the skin may either be turned back, or drawn tightly up by an assistant. The muscles may then be divided quite across to the bone by the edge of the skin, in the common way, or cut obliquely upwards, according to the method of Allanson, so as to lay the bone bare two or three fingers-breadth higher than is done in the common way. The muscles are next to be separated from the bone with a scalpel a little way, that a sufficient quantity may be left for covering the end of it. The rest of the operation is to be performed exactly according to the general rules laid down in the first section of this chapter. The muscles and integuments are to be drawn over the end of the bone, and applied closely together, that the skin may completely cover the stump, and retained in this situation by an assistant till a flannel or cotton roller, according to the season of the year, which has been previously fixed round the body, be applied in such a manner as to support and fix them. For which purpose it should be passed two or three times, in a circular direction, round the top of the thigh, and should afterwards, with spiral turns, be brought down near to the end of the stump and fastened with pins; and it should not be tighter than may be sufficient to assist the plasters in preventing retraction.

409 The ends of the divided muscles are now to be laid exactly over the bone; and the edges of the skin are to be brought into contact, either so as to form a straight longitudinal line, according to the method of Mr B. Bell, &c.; or they are to be placed horizontally, "that the wound may appear only in a line with the angles at each side," as advised by Allanson. The ligatures may either hang over the edges of the wound, or be brought to the angles. After the edges of the skin are in this manner exactly applied to each other, either a few slips of adhesive plaster are to be laid across the face of the stump, or two large pieces of adhesive plaster, with several pieces of tape fixed to them, are to be applied to the surface of the skin. The tapes are then to be tied with a running knot immediately over the wound; by which the parts will be kept so closely together as to prevent any collection of matter from being formed. The whole surface of the stump should next be covered with a large pledget spread with an emollient ointment, over which a compress of fine tow is to be put, and retained in its place by a broad cross strap of old linen, passing some way up the thigh, so as to be secured by the roller, which is now to be passed two or three times round the stump; and the pressure formed by the cross strap may afterwards be increased or diminished at pleasure, by drawing it with more or less tightness, and fixing it with pins to the roller. While the stump is dressing, the tourniquet is removed, but replaced again loosely to enable the attendants to check any hemorrhagy which may afterwards ensue.

Amputating the Thigh.

The patient is now to be laid to rest, and the limb is to be placed upon a little tow covered with linen, or upon a thin soft pillow; and to prevent the patient from involuntarily moving the limb, and to guard against spasmodic startings, which frequently happen after this operation, it may be fixed to the bed by two straps. A basket or hooped frame ought to be placed over the stump to protect it from the bed clothes. The patient should immediately get an anodyne draught, which will generally procure ease through the rest of the day. For this purpose, no more light should be let into the room than is merely necessary for allowing the attendants to pay attention to the stump. As hemorrhagies sometimes appear several hours after the operation, the person who takes the charge of the patient should watch this circumstance with the greatest attention. If there be only a slight oozing of blood, there is no occasion for being alarmed; but whenever it appears to proceed from a large artery, it must be secured. The spasmodic affections which frequently occur after amputation are seldom troublesome, unless some nerve has been included in securing the arteries; but when they do appear, laying the limb in the easiest posture, and giving opiates, are the principal means of procuring relief. 410

Treatment of the patient after the operation.

To prevent inflammation as much as possible, the patient is to be kept upon a strict antiphlogistic regimen, and his bowels kept open by laxative clysters, till the inflammatory stage is over, which will generally be in a few days. If, notwithstanding this treatment, the stump swells, and the patient complain of pain and tightness, we ought to endeavour to discover from what cause the uneasiness originates. If it be owing to the straps being too tightly fixed, they must be slackened. If the stump be found much swelled, a saturnine solution should be applied by means of several folds of linen; and if the patient be young and plethoric, he ought to lose a few ounces of blood from the arm; but if he is weak and emaciated, a different mode of treatment must be followed.

At the end of the third, or fourth day at farthest, the stump should be examined; and if it appear somewhat open and flaccid, the parts must be brought closer together and secured more firmly. After this time the dressings should be renewed every day, or every second day. In about a week

Amputating the Leg.

week after the operation the ligatures may generally be removed with eaſe; but if they do not ſeparate readily, they may be gently pulled at every dreſſing, when they will, in a ſhort time, be brought away, and the wound will be ſoon healed by the firſt intention. The roller ſhould be cleaned and renewed as often as it is found ſullied; nor ſhould it be laid entirely aſide till the end of the third or fourth week after the operation. When the roller is removed, we may depend upon the ſtraps or tapes for keeping the parts together till the cure be quite accompliſhed. When the inflammatory ſymptoms are entirely gone, no medicines ought to be given which would debilitate the patient, nor is any thing more neceſſary than to keep the bowels gently open till a complete cure be made.

Sect. IV. *Of Amputating the Leg.*

The leg may be amputated for a diſeaſe in the foot at two different parts; the one a hand-breadth under the knee, the other a little above the ankle. The former makes a ſufficient ſupport for the body to reſt upon an artificial leg; but the latter does that equally well, and likewiſe preſerves the motions of the knee.

411 Amputation of the leg near the knee.

In performing the operation a little way under the knee, the patient is to be placed and ſecured in the ſame manner as in operating upon the thigh. The tourniquet is to be placed a little above the knee, with the cuſhion upon the artery in the ham. The ſurgeon places himſelf upon the inſide of the leg, and makes a circular inciſion through the integuments down to the muſcles. The place where the inciſion ſhould be made muſt depend upon the length of the limb; but in general it may be between ſix and ſeven inches under the top of the tibia in an adult, or far enough down upon the limb to ſave as much integuments as will cover the ſtump. After the integuments are cut through in the manner already directed, as much of the muſcles are to be divided by the knife as can be done by a circular inciſion; and the interoſſeous parts are to be divided by a ſcalpel or catline, (fig. 121.). The retractors are then to be applied, and the bone ſawed off immediately below the inſertion of the tendons of the flexor muſcles. In ſawing, the operator ought to begin upon both bones at the ſame time, that he may finiſh upon the tibia, leſt ſplinters ſhould be formed. The veſſels are next to be ſecured; the ſoft parts drawn over the bones; the adheſive plaſters and other bandages applied in the ſame manner as directed for amputating the thigh, only that here the roller need not be applied ſo high as in the former operation. Two or three turns above the knee, however, are neceſſary to prevent the dreſſings from ſlipping down.

412 At the ankle.

In amputating upon the ankle, the operator ſhould fix upon that ſpot which will leave the ſtump of ſuch a length as may be moſt convenient for being fitted with an artificial machine reſembling the other leg. Nine inches from the joint of the knee, in a leg of ordinary length, was found by Mr Wilſon, a late ingenious artificial limb-maker in Edinburgh, to be the beſt part ſuited to this purpoſe, on account of the equal preſſure it makes upon the ſurface of the leg, without making any upon the end of the tender ſtump. The operation is performed in the ſame manner as that a little below the knee.

Sect. V. *Of Amputating at the Joints of the Extremities.*

The circumſtances moſt to be attended to in performing amputation at the joints are, firſt to ſtop the circulation by the tourniquet; or, where that is impracticable, to take up the trunk of the artery by a ligature; to make a circular inciſion in ſuch a place as may, after the operation is over, be ſufficient to cover the wound: Then a longitudinal inciſion is to be made upon the oppoſite ſides of the limb, extending from the joint to the circular cut, and as deep as the bone, by which two flaps will be formed to cover that part of the joint which remains after the operation is finiſhed. The ligaments of the joint are next to be divided, and the affected limb or part of the limb removed.

After this part of the operation, it was formerly a frequent practice to ſcrape off the remaining cartilage, to unite the parts more firmly together. But this is now found to be unneceſſary; for when the fleſh is applied properly to the bone, if it do not grow to it, the union at leaſt is ſo cloſe that it afterwards gives no inconvenience to the patient.

Any branches of arteries which may have been cut during the operation are now to be ſecured; clotted blood is to be removed; and the muſcles and ſkin are to be brought into cloſe contact with the ends of the ligatures hanging out of the wound. The parts are to be retained by adheſive plaſters, or twiſted ſuture, or both; and proper bandages applied in ſuch a way that a cure may be made by the firſt intention.

Amputating the arm at the ſhoulder-joint has always been conſidered as a dangerous as well as a difficult operation. It ſhould never be attempted, when the ſame purpoſe can be accompliſhed by operating lower down. But caſes occaſionally occur, where the life of the patient cannot, in any other manner, be ſaved.

Amputation may become neceſſary here in conſequence of abſceſſes of the joint; caries of the humerus reaching to the joint; compound fractures, eſpecially thoſe from gunſhot wounds, extending to the head of the bone; and of mortification.

In performing the operation, the patient ſhould be laid upon a table of convenient height, covered with a mattreſs. He is then to be brought as near to the edge of it as poſſible, and ſecured by aſſiſtants. The circulation of the blood in the arm is next to be ſtopped, by an aſſiſtant preſſing ſtrongly with a firm compreſs over the ſubclavian artery where it paſſes over the firſt rib; or an inciſion may be made along the courſe of the artery, which may be ſecured after ſeparating from it the contiguous nerves. When the artery is compreſſed, it will readily be known whether the compreſſion proves effectual, by obſerving when the pulſe at the wriſt is entirely ſtopped. As ſoon as this is the caſe, a circular inciſion is to be made through the integuments at the inſertion of the deltoid muſcle into the humerus. An aſſiſtant then draws the ſkin a little back, and at the edge of the retracted ſkin the muſcles are to be cut in a circular direction to the bone.

If the artery has not been taken up at the beginning of the operation, it is now to be ſecured, as well as any branches which come in the way.

The amputation-knife is now to be laid aſide, and the reſt of the operation finiſhed with a ſtrong ſcalpel. A perpendicular inciſion is next to be made at a little diſtance from the outſide of the artery, beginning at the acromion, and terminating in the circular inciſion, cutting as deep as the ſurface of the bone. A ſimilar inciſion is to be made upon the back part of the arm, ſo that the flaps may be nearly of an equal breadth. The arterial branches are here to be ſecured; the flaps are to be ſeparated from the bone, guarding againſt wounding the trunk of the artery; the flaps are to be ſupported by an aſſiſtant; and the capſular ligament of the joint is to be cut from the ſcapula: and thus the arm will be entirely ſeparated.

After the arm has been ſeparated, any arteries which appear about the joint are to be tied, and all the ligatures brought over the edges of the wound. The parts are to be cleared of clotted blood, and the two flaps drawn over the wound,

wound, and secured by the twisted suture. A pledget of any emollient should then be applied, and a sufficient cushion of lint, with a compress of old linen, put over the whole. A moderate pressure is next to be applied by a flannel roller; by which the parts will be supported, their union facilitated, and matter most likely prevented from being lodged. The treatment is then the same with that after amputation in other parts of the extremities. For two or three days after the operation, it is necessary that an assistant sit with the patient to compress the artery in case a bleeding should ensue.

When it is necessary to amputate the whole hand, the operation may be performed at the wrist, so as to leave as much of the member as possible; and the same rules hold here as in amputating at any of the rest of the joints. The tourniquet is to be applied to the artery in the arm, and the cure is to be completed by the first intention. When any of the carpal bones are affected, the sore will not heal till they either work out by suppuration, or are cut out by the knife. When the middle of any of the metacarpal bones is diseased, while their extremities are sound, the trepan may be applied, and the diseased parts removed, while the remaining sound parts are preserved. But if the whole bodies of one or two of these bones be affected, while the rest remain sound, all the affected bones ought to be removed. In performing the operation, an incision is to be made along the course of the part affected; and if the operator have it in his choice, the incision should be made upon the back part, so as to save the great vessels and nerves situated in the palm. The integuments are then to be dissected, and turned to each side; after which the diseased bones or parts of bones are to be removed, guarding as much as possible against wounding the principal arteries or nerves which lie near them.

The diseased parts are next to be separated; any arteries which happen to be cut are to be secured; and, on account of the free communication which they have with neighbouring branches, they ought to be tied at both cut ends. If after this a bleeding still continue, compress, styptics, and other remedies proper for stopping blood, are immediately to be used. The sides of the wound are to be brought together, and an attempt made to cure them by the first intention.

In amputating the fingers, it was formerly the practice to operate upon the bodies of the bones in the same manner as in the larger extremities; but at present the removal at the joints is more frequently practised.

In performing the operation, it is necessary to save as much skin as may cover the stump, and this ought to be done upon the side next the palm, so as to guard against the effects of friction. The general steps of the operation are the same with those for amputation of the larger joints.

A circular incision is to be made on the finger by a crooked bistoury, about the middle of the phalanx, and it may be carried at once to the bone. Another incision is to be made with a common scalpel at each side of the finger, beginning at the circular one and continuing it to the joint, by which two flaps will be left to cover the stump. The ligaments of the joint are now to be divided, and the bone removed. The blood-vessels are to be secured by ligature, and the flaps exactly applied to each other; but in order to protect the end of the bone completely, a small portion may be cut from the uppermost flap. The flaps are to be retained by adhesive plaster, or by the twisted suture; but if the latter be used, the tendons ought to be avoided. Over the sore an emollient pledget is to be applied, and then a compress and roller. If the disease be so situated, that instead of amputating at the cavity of the joint, the surgeon shall think proper to operate upon the body of the bone, flaps are to be formed as above, and the bone is to be divided by means of a small spring saw, fig. 122. Amputating at the Joints of the Extremities.

The amputation of the thigh, at the hip joint, has always been considered as one of the most formidable operations in surgery; so much so, that very few cases appear on record of its having ever been put in practice. In the Medical Commentaries of Edinburgh, an instance is recorded where the thigh was amputated at this joint, and where the patient survived the operation 18 days, and then died from a different cause, when all risk of hæmorrhagy was over, and when the sore had even a favourable appearance, which shows at least that the operation has been done with safety. It certainly ought never to be done, however, unless as the last resource, and when the life of the patient is in absolute danger; and then only when as much skin and muscles can be saved as will cover the sore, and when there is also a probability of being able to stop the hemorrhagy, and prevent it from returning. 416 At the hip joint.

When the operation is to be performed, the patient is to be laid upon his back on a table, and properly secured by assistants; one of whom should be ready with a firm cushion to press, if necessary, upon the top of the femoral artery, just after it passes from behind Poupart's ligament to the thigh. A longitudinal incision is now to be made through the skin, beginning immediately under the ligament, and continuing it downwards along the course of the artery for about six or seven inches. The aponeurosis of the thigh is then to be divided by gentle scratches till a furrowed probe can be introduced, when the opening is to be dilated by means of a scalpel, till two or three inches of the artery be laid bare. A strong ligature is now to be put under the artery by the assistance of a curved blunt-pointed needle.

The part where the ligature should be passed is immediately above the origin of the arteria profunda; for if that artery be not affected by the ligature, the patient might suffer by the loss of blood during the rest of the operation. The ligature is now to be secured by a running-knot: Another ligature is to be introduced a little below the former, and likewise secured; the artery is then to be divided between the ligatures. A circular incision is now to be made through the integuments of the thigh, about six inches from its upper end. The retracted skin is then to be pulled at least an inch upwards; and at the edges of it the amputating knife is to be applied, so as to cut the muscles down to the bone. This being done, a cut is to be made upon the posterior part of the thigh, beginning a little higher than the great trochanter, and continuing it down to the circular incision, and as deep as the joint. A similar cut is to be made on the anterior part of the thigh, at a small distance from the artery, and this reaching likewise down to the bone. The two muscular flaps are to be separated from the bone and joint, and held back by an assistant. Every artery which appears is now to be secured. Then the capsular ligament, and next the round one, are to be separated from the acetabulum; by which means the limb will be removed from the body. The acetabulum and neighbouring bone are next to be examined; and if they appear sound, the case will be more favourable; but at any rate, a cure is to be attempted by the first intention. For which purpose, after removing all the clotted blood from the surface of the wound, and bringing the ligatures over the edges of the skin, the muscles are to be placed as nearly as possible in their natural situation; and drawing the flaps together, so as to cover the wound in the most accurate manner, they are to be kept in this situation by adhesive plaster, and

Removing the Ends of Carious Bones in the Joints.

by the twisted suture and other dressings, as in amputating at the under part of the thigh. The dressings are to be retained by a broad flannel roller passed three or four times round the body, and spirally over the stump, and secured. The patient is then to be laid in bed on the sound side, and treated as for amputation in other parts of the body; only that greater attention is necessary, as there is no assistance from a tourniquet. Uncommon attention will also be necessary to prevent inflammation, and every symptom of fever which may succeed to the operation.

417 At the joints of the foot.

When the foot is so much diseased as to require amputation, the operation might be performed at the point of the ankle; but for the reasons given, when treating of amputation of the leg, it is found better to do it above the ankle. When a considerable part remains sound, it ought to be saved. If any of the tarsal bones are affected, these are to be removed. When the middle or whole body of any of the metatarsal bones are diseased, they are to be removed in the same manner as directed for similar operations in bones of the hand; and if even two of them remain sound, provided they be so placed as to support the toes, they ought to be preserved, as it is known that, by proper treatment, an osseous matter may afterwards fill a considerable part, if not the whole, of the void; or if any cavity remain, it may be so stuffed that the use of the foot may still be enjoyed.

In performing an operation of this kind, the patient should be laid upon a table, and the tourniquet applied in the ham to prevent hemorrhagy. An incision is then to be made along the affected part: and if the seat of the disease admit it, the incision should be made upon the upper side of the foot so as to save the sole. The teguments are to be separated and turned to each side, to allow the affected parts to be completely removed.

The principal vessels and nerves are to be saved as much as possible; but if any particular artery be cut, it is to be secured, and the part treated as after the removal of similar parts of the hand.

418 Of the toes.

The amputation of the toes is exactly similar to that of the fingers.

Sect. V. *Of removing the Ends of Carious Bones in the Joints.*

In compound fractures, the ends of bones, when they protruded in such a manner that they could not otherwise be returned, have frequently been sawed through; and their place has frequently been supplied by a renewal of bone, so as to preserve the ordinary use of the limb. Many cases have likewise happened, where a large part of the body of the bone has been thrown out by suppuration, and its place supplied; and a few are upon record, where either the whole of a bone, or that end next the joint, has been thrown out, and its place filled up with callus, so that no inconvenience has been felt. From these circumstances, Mr White of Manchester was led to preserve an arm by sawing off the head of a diseased humerus; and Mr Park of Liverpool, to save a limb, by sawing off the ends of the bones, in a case of white swelling of the knee. When therefore it happens that the end of a bone is diseased, while the other parts are sound, the diseased part may be removed, and the sound one saved, so as in a great measure to preserve the free use of the limb.

In performing the operation, the first step should be, to use such means as may enable the operator to have a full management of the circulation of the part affected. Then a longitudinal incision of sufficient length, and perhaps another across it, may be necessary to be made through the soft parts of the joint; and this opening ought to be at a distance from the large blood-vessels, that they may be in no danger of being injured. After the end of the diseased bone is sufficiently laid bare, it is either to be brought out of the joint, or a spatula or some other proper substance is to be introduced between the bone and soft parts, so as to defend the latter in time of sawing the bone. After the diseased part of the bone is removed, the arterial branches are to be secured, and the wound treated like any other wound of equal size.

During the cure the limb ought to be kept in the posture most favourable for the removal of the bone, and afterwards for the preservation of the natural motion of the joint.

In this way a limb may sometimes be saved which would otherwise have been removed. But though the removal of the diseased end of one bone may be readily effected, the removal of all that part of the bones which enters into the composition of a joint must be attended with so much inconvenience, that it can seldom be useful, unless it be where the ends of bones are destroyed by external violence; for then it appears that this operation may be performed with considerable success.

Diminishing Pain in Surg. Operat.

Chap. XXXV. *Of Diminishing Pain in Surgical Operations.*

The pain induced by surgical operations may be lessened in two different ways. The first is, by diminishing the natural sensibility of the system; and for this purpose narcotics of different kinds, and particularly opium, have been used; but these are apt to induce disagreeable symptoms, especially sickness and vomiting, which might be attended with bad consequences after some operations. They are therefore seldom employed before an operation. When, however, they are given immediately after it, and repeated as circumstances may require, they often give great relief.

The other method of diminishing pain is, by lessening the sensibility of a particular part of the body. It has long been known, that the sensibility of any part may not only be lessened, but entirely suspended, by compressing the nerves which supply it. From a knowledge of this circumstance, an instrument (fig. 123.) was invented some years ago by Mr James Moore of London, by which the principal nerves of a member might be so compressed as to render the parts below perfectly insensible. A difficulty, however, arises here; for as the nerves must be compressed at least an hour previous to the operation, in order to render the parts quite insensible, and as it is extremely difficult to compress the nerves without at the same time affecting the veins, the latter are therefore in danger of being burst. To prevent this inconvenience, Mr Moore proposes to open a vein; but this might be attended with bad consequences in weakly constitutions. Besides, it is said, that by compressing the nerves in this manner, although less pain may be felt in the time of the operation, it is proportionally greater after the compression is removed. In certain parts of the body, however, where sufficient compression can be made upon the nerves without acting much upon the veins, it would appear that the method may be practised with advantage; though it has not yet been done, excepting in a few instances.

Chap. XXXVI. *Of Bandages.*

The proper application of bandages is an object of great importance in surgery: and though dexterity is only to be acquired in this branch by practice, yet a few general rules may be found useful. Bandages are employed for the retention of dressings, for stopping hemorrhagies, for removing

moving deformities, and for effecting the union of divided parts. They ought to be formed of such materials as are sufficiently firm, while, at the same time, they give no uneasiness to the parts to which they are applied. They may be composed either of linen, cotton, or flannel. Of late years the two last have been preferred by many for their warmth and elasticity, on which account they are certainly most proper, especially in winter; and likewise in cases where the parts are liable to swelling and inflammation, as in wounds, luxations, and fractures. Besides, they more readily absorb any moisture which may be discharged from the sores.

When first applied, they should be clean, sufficiently strong, and as free of seams as possible. They should be so tightly applied as to answer the purpose for which they are intended, without being in danger of impeding the circulation. They should be applied in such a manner that they may be easily loosened, and the parts examined with as much accuracy as possible; and they should be laid aside as soon as the purpose for which they are intended is accomplished; for when longer continued, they frequently impede the growth of the parts upon which they are applied.

With respect to bandages for particular parts, we shall begin with the head, and then proceed to the trunk and extremities. The *couvre chef* of the French, which is a square napkin folded cornerwise, is most frequently used where a bandage is wanted for the head; but a nightcap, having a band to go round the head, and another to tie under the chin, appears to be more suitable for this purpose. For making compression on any particular part of the head, as for stopping of bleeding vessels, the radiated bandage may be employed.

For keeping the edges of wounds together, as in cases of longitudinal cuts of the head, or of any other parts, the uniting bandage is usually employed, and is always to be preferred to sutures, where it retains the edges of the wound with sufficient exactness. For retaining dressings upon the eyes, several turns of a roller have been used, and it is termed *monoculus* or *binoculus* according to its being applied to one or both eyes; but the *couvre chef*, and the nightcap already mentioned, are less apt to slip, and therefore found more convenient for this purpose.

For fractures of the nose, or wounds there, or on any other part of the face, the uniting bandage answers best. And in cases of fracture of the lower jaw, a four-headed roller is most convenient: the hole in the centre of the roller receives the chin, and assists in preventing the bandage from shifting. The two upper heads are to be carried backwards; and being made to pass each other at the occiput, they are afterwards brought once or twice round the head. The two under heads of the roller being reflected over the chin, are then to be turned upwards and fixed on the upper part of the head.

The bandages necessary for the neck are, the machine already mentioned after the operation of bronchotomy, and one used in cases of wry neck. For every other purpose of bandaging a common roller may answer perfectly well.

For fractures of the scapula the application of a long roller may be of service.

For retaining dressings upon the thorax the napkin and scapulary are commonly, and very properly used; and when the napkin is employed merely for retaining dressings, it need not be longer than to pass once round the body; but if it be used for making pressure over a fractured rib, it ought to pass two or three times round. For both purposes its breadth ought to be six or seven inches for an adult.

The same kind of bandages is also used for making pressure on the abdomen, as in cases of umbilical or ventral hernia; and to keep the bandage properly placed, a scapulary is used for preventing it from slipping down, and one or two straps connected with it behind, are brought between the thighs, and fixed to it before to prevent it from moving up. A bandage of flannel, and different kinds of belts, are contrived for compressing the abdomen in the operation of tapping; and trusses of various constructions are used for the retention of the protruded bowels in cases of hernia. 423 For the belly.

Bandages of cotton or flannel are used for supporting the scrotum in the various diseases which may occur there, as well as after the operations performed upon it. 424 For the scrotum and penis.

One of the best bandages for the penis is a linen or cotton bag, fixed by a roller round the body.

For retaining dressings about the anus, or between that part and the scrotum, the T bandage is commonly used; and it is made either with one or two tails, according to the situation of the part to which it is to be applied. 425 For the anus.

In simple fractures, and most of the other diseases of the arm, fore-arm, and hand, the roller is the bandage commonly used; but in compound fractures of these parts, as well as in the different kinds of fractures of the lower extremities, the 12 or 18 tailed bandage is necessary. 426 For fractures.

For longitudinal wounds of the extremities, the uniting bandage is used with the same advantage as has been already mentioned for wounds of a similar nature upon the head. 427 For wounds of the extremities.

Chap. XXXVII. *The Method of opening a dead Body.*

Method of opening a dead body.

Surgeons are often called, in order to investigate the cause and seat of diseases and death, either by the relations of the deceased, or the magistrates to whom a report is to be made; therefore, at the time of performing this operation, minutes should be taken of what is observed. The instruments, and all things necessary, should be disposed in order, as for any other operation; as knives, a razor, a great and small saw, scissars straight and curved, elevators, needles threaded, sponges, tow, saw-dust or bran, basons with water, towels, and receivers for the viscera when they are to be taken out of their cavities. The body is to be laid upon a suitable table, advantageously placed for the light, having a cloth thrown over the parts which decency demands should be concealed, especially in females.

When it is intended only to inspect the abdomen and its contents, a longitudinal incision from the xiphoid cartilage to the os pubis, intersected by a transverse one at the navel, will give a fair opportunity of answering these purposes, when the angles are reversed. Should it be required to examine all the three cavities, and the parts contained in them, we are to begin by opening the head, making an incision quite cross to the bone, from ear to ear; which section is preferable to the crucial, commonly made on this occasion: then the scalp may be easily dissected from the skull, and turned down over the face, and towards the neck, giving room for the saw. The head must be held very steadily by an assistant during the sawing, which should be begun on the middle of the frontal, proceeding to each temporal bone, and so to finish the circle upon the middle of the occipital bone; which may generally be done conveniently enough, by raising the head and inclining it forward after having proceeded as far as this bone; or the body may then be turned prone, should that posture be found more convenient to complete the circle. The cap of the skull is then to be raised with the elevator, occasionally cutting the adhesions of the dura mater; after this the encephalon is to be removed, carefully separating the other attachments of the membrane. 428 Method of opening the cranium.

In order to bring the thorax and abdomen, with the parts contained

Method of opening a dead Body.

429
Of opening the thorax and abdomen.

contained in these cavities, under one view, an incision is to be made on each side of the sternum, in the course of the cartilages of the ribs which are annexed to it; dissecting from thence the muscles with the teguments, the space of two or three inches towards the spine; then cutting through the cartilages, which will be seen, and easily divided with a knife a little curved near the point; then the incisions are to be continued from the sternum through the abdominal cavity, in an oblique direction, to each ilium or inguen; after which the clavicles are to be separated from the sternum, or this bone divided at its superior cartilaginous junction, with a strong knife, dissecting it from the mediastinum, and turning it downwards with the muscles, &c. of the abdomen. This is the most eligible manner of opening these cavities, and gives an opportunity of sewing them up with a better appearance for any person's view afterwards. That kind of stitch called by sempstresses the *herring-bone* or *flat seam* has a very pretty and neat effect upon these occasions.

If it is proposed to take out the thoracic and abdominal viscera together, for further examination, the diaphragm is first to be cut down to the spine on both sides; then, to avoid being incommoded with blood, &c. two very strong ligatures are to be passed round the œsophagus and large blood-vessels, in which the trachea may be included; tying them strait, and then dividing these parts between the ligatures: the same measures are to be taken in respect to the inferior vessels upon the lumbar region, a little above the bifurcation of the aorta, including the vena cava; and also upon the rectum. After having observed these precautions, the viscera, with the diaphragm, are to be removed by a wary dissection, all the way close to the spine; and by gently drawing them at the same time, the separation will be greatly facilitated.

When the thoracic and abdominal viscera are to be taken out separately, in the first case ligatures must be made, as have been described upon the vessels, &c. just above the diaphragm, and in the other just below it, and upon the rectum.

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When the body is become putrid, how it is to be managed.

Should we be called upon to perform this office when the body is become very putrid, it will be absolutely necessary to have such parts of it well washed with warm vinegar and brandy, and then sprinkled with lavender-water or some such odoriferous antiputrescent liquor, before the examination, in order to correct the stench, and defend us against the noxious quality of the effluvia; a precaution, the neglect of which may be attended with very direful effects.

Chap. XXXVIII. *Of Embalming dead Bodies.*

In the early ages of the world, the practice of embalming dead bodies was very common, particularly among the Egyptians; but it has long been disused in almost all countries, except for great personages. See Embalming. The following directions are taken from Mr Gooch, to whom they were communicated by a person of great character, and well acquainted with the modern practice of embalming in this kingdom.

Embalming dead Bodies.

After evisceration, as has been directed in opening a dead body, and continuing the incision farther upwards, even into the mouth, and, if practicable, without cutting the skin of the neck, all the cavities are to be well cleansed, and the humidity sucked up with sponges, then washed with *tinct. myrrhæ*, and filled with a species compounded of fragrant herbs, aromatic drugs, and gums reduced to powder not very fine, first restoring the heart to its former residence, after having opened its ventricles, cleansed and washed them with the tincture, stuffed them with the spices, and sewed them up; and then the cavities are to be stitched very close with the glover's or spiral suture. Large and deep incisions are also to be made in all the most fleshy parts, cleaning and washing them with the tincture in the same manner, filling them with the antiseptic spices, and stitching them up. Then the head, trunk, and limbs, are to be perfectly well covered with cerecloth; putting a piece under the chin, to be secured by sewing on the top of the head, after having well adjusted the cap of the skull, sewed the scalp together, and cleaned the mouth, as has been directed for the other parts, and putting in some of the spices. The cerecloth is to be prepared, according to art, with a composition made of wax, rosin, storax, and painter's drying oil. After the application of the cerecloth, with great care and exactness, cut into suitable pieces according to the respective parts, and closing them well everywhere, the face being close shaved, is to be covered with some of the above composition melted, and laid on with a brush of a proper degree of heat, and of a moderate thickness; which may have a faint flesh-colour given it with vermilion; and when it is grown cold and stiff upon this part, it may be lightly covered with hard varnish; or this varnish, applied thick, may here serve the purpose alone. A cap is to be well adapted to the head, falling down upon the neck, and to be sewed under the chin, making a few circular turns about the neck with a roller of a proper breadth. All the rest of the corpse is to be inclosed in a sheet, to be artfully cut, and sewed on very close and smooth, with the finest tape, and the *flat seam* mentioned in the preceding chapter; over which an appropriate dress is to be put, as the relations or friends think fit to direct and appoint, and then laid into the coffin, which should be in readiness: but when it is some great personage, who is to lie in state for public view before the funeral rites are solemnized, the dress must be appropriated to his dignity and character. The brain and other viscera are to be put with some of the spices into a leaden box. Sometimes the heart, prepared as has been directed, to preserve it from putrefaction, is deposited in an urn by itself.

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K.

SURINA[...]

SURINAM, the capital of the Dutch settlements in Guiana, situated on a river of the same name, in N. Lat. 6. 16. W. Long. 56. 0. It gives name to the country for 100 miles round; and stands on a river of the same name, which is navigable for 30 leagues up the country. A settlement was formed at Surinam in 1650 by the Dutch, who preserved possession of it ever since. The chief trade consists in sugar, cotton, coffee of an excellent kind, tobacco, flax, skins, and some valuable drugs for dyeing. Four hundred and thirty plantations have been already formed on the banks of the Surinam and the adjacent country, which in 1775 yielded 24,120,000 weight of rough sugar, which were sold in Holland for 347,225 l. Serling; 15,000,387 lb. weight of coffee, which sold for 357,538 l.; 970,000 lb. weight of cotton; 790,854 lb. weight of coccoa; 152,844 lb. weight of wood for dyeing. The sum total of these productions amounted to 822,905 Sterling, and was brought into the harbours of the republic in 70 vessels. The number of slaves employed in the same year was 60,000, who belonged to 2824 masters, exclusive of the women and children. The white people were of different countries and different religions.

Connected with Surinam, we may mention the colonies of Demerary, Issequibo, and Berbice, which lie a little to the west. The two first surrendered to the British troops in 1781; but being left defenceless, were retaken by a French frigate. Demerary has lately been taken a second time by the army of Great Britain. It is considered as a valuable acquisition, being a flourishing colony. In 1769 there were established on the banks of the Demerary 130 habitations, in which sugar, coffee, and cotton were successfully cultivated, and since that period the number of plantations hath increased much.

Issequibo is a very inconsiderable settlement. Berbice, which lies between Demerary and Surinam, contains about 104 plantations, most of them small, and scattered at great distances from one another upon the banks of the Berbice or of Conje. When Raynal published the last edition of his History of Settlements and Trade in the East and West Indies, the population consisted of 7000 slaves of every age and sex, 250 white men, exclusive of the soldiers. The coffee, sugar, and cotton produced was conveyed to Holland in four or five ships, and sold for about 40 or 50,000 l.

SURMOUNTED, in heraldry, is when one figure is laid over another.

SURMULLET. See MULLUS.

SURNAME, that which is added to the proper name for distinguishing persons and families. It was originally distinguished from *sirname*, which denotes the name of the *sire* or progenitor: thus Macdonald, Robertson are sirnames expressing the son of Donald, the son of Robert. The word *surname*, again, signified some name superadded to the proper name to distinguish the individual, as Artaxerxes *Longimanus*, Harold *Harefoot*, Malcolm *Canmore*. From this it is evident that every sirname was a surname, though the reverse was not so. In modern times they are confounded; and as there is now no occasion to preserve the distinction, Dr Johnson has rejected the word *sirname* altogether. See NAME.

Surnames were introduced among all nations at an early period, and seem to have been formed at first by adding the name of the father to that of the son. This was the practice among the Hebrews, as appears from the scriptures. Caleb is denominated the son of Jephunneh, and Joshua the son of Nun .That the same thing was customary among the Greeks, every one who has read the poems of Homer must remember. We have an instance of it in the very first line of the Iliad: Αχιλλησς Πηληιαδεω, "Achilles the son of Peleus." This is perhaps the general origin of surnames, for it has been common among most nations (A). Surname.

The Romans generally had three names. The first called *prænomen* answered to our Christian name, and was intended to distinguish the individuals of the same family; the second called *nomen* corresponded to the word *clan* in Scotland, and was given to all those who were sprung from the same stock; the third called *cognomen* expressed the particular branch of the tribe or clan from which an individual was sprung. Thus Publius Cornelius Scipio, *Publius* corresponded to our names John, Robert, William; *Cornelius* was the name of the clan or tribe, as Campbell was formerly the name of all the Duke of Argyle's clients, and Douglas the name of the retainers of the Duke of Hamilton's progenitors. *Scipio* being added, conveyed this information, that Publius, who was of the tribe of the Cornelii, was of the family of the Scipios, one of the branches or families into which that tribe was divided. Respecting the three names which were common among the Romans, we may say that the first was a name and the other two surnames.

Du Chesne observes, that surnames were unknown in France before the year 987, when the lords began to assume the names of their demesnes. Camden relates, that they were first taken up in England, a little before the conquest, under King Edward the Confessor: but he adds, they were never fully established among the common people till the time of Edward II.; till then they varied with the father's name; if the father, *e. gr.* was called *Richard*, or *Roger*, the son was called *Richardson*, or *Hodgson*; but from that time they were settled, some say, by act of parliament. The oldest surnames are those we find in Domesday-Book, most of them taken from places, with the addition of *de*; as Godefridus *de* Mannevilla, Walterus *de* Vernon, Robert *de* Oyly, &c. Others from their fathers, with *filius*, as Gulielmus *filius* Osberni; others from their offices, as Eudo *Dapifer*, Gulielmus *Camerarius*, Gislebertus *Cocus*, &c. But the inferior people are noted simply by their Christian names, without any surnames at all.

They seem to have been introduced into Scotland in the time of William the Conqueror by the English who accompanied Edgar Atheling when he fled into that kingdom. These had their proper surnames, as Moubray, Lovell, Lisle, using the particle *de* before them; which makes it probable that these surnames had been derived from the lands which their ancestors or they themselves had possessed. In Kenneth II's. time in 800 the great men had indeed begun to call their lands by their own names; but the ordinary distinctions then used were only personal, and did not descend to succeeding generations, such as those employed by the Hebrews and Greeks: For example, *John the son of William*; or the names of office, as Stewart; or accidental distinctions from complexion or station, as Black, White,

(A) This might be supported by examples borrowed from many nations. The old Normans used *Fitz*, which signifies son; as Fitzherbert, Fitzsimmons, the son of Herbert, the son of Simmons. The Irish used *O*; as O'Neal, the son of Neal. The Scotch Highlanders employed *Mac*; as Macdonald, the son of Donald. The Saxons added the word *son* to the end of the father's name, as Williamson.

Surname || Surrender.

White, Long, Short; or the name of their trade, as Taylor, Weaver.

It was long before any surnames were used in Wales, except that of son, as Evan ap Rice, Evan the son of Rice; Evan ap Howel, Evan the son of Howel: but many of them have at length formed separate surnames, as the English and Scots, by leaving out the *a* in *ap*, and joining the *p* to the father's name: thus Evan ap Rice becomes Evan Price; Evan ap Howel, Evan Powel.—We are told, surnames were unknown in Sweden till the year 1514, and that the common people of that country use none to this day; and that the same is the case with the vulgar Irish, Poles, and Bohemians.

When we come to inquire into the etymology of surnames, we must allow that many of them were originally significant of the qualities of mind, as Bold, Hardy Meek; some of the qualities of body, as Strong, Low, Short; others expressive of the trade or profession followed by the persons to whom they were applied, as Baker, Smith, Wright; Butler, Page, Marshal. But the greatest number, at least of the ancient surnames, were borrowed from the names of places. Camden says, that there is not a village in Normandy but has given its name to some family in England. He mentions as examples, Percy, Devereux, Tankervil, Mortimer, Warren, &c. They were introduced with William the Conqueror. Several have been derived from places in the Netherlands, as Gaunt, Tournay, Grandison; and many from the names of towns and villages in England and Scotland, as Wentworth, Markham, Murray, Aberdeen. Many have been formed from the names of animals, as quadrupeds, birds, fishes; from vegetables, and parts of vegetables, as trees, shrubs, flowers, and fruits; from minerals of different kinds. Others are formed from such a variety of accidents that it is impossible to particularize them.

SURPLICE, the habit of the officiating clergy in the church of England. By Can. 58, every minister saying the public prayers, or ministering the sacrament or other rites of the church, shall wear a decent and comely surplice with sleeves, to be provided at the charge of the parish. But by 1 Eliz. c. 2. and 13 and 14 Car. II. the garb prescribed by act of parliament, in the second year of king Edward the Sixth, is enjoined; and this requires that in the saying or singing of matins and even songs, baptizing and burying, the minister in parish churches and chapels shall use a surplice. And in all cathedral churches and colleges, the archdeacon, dean, provosts, masters, prebendaries, and fellows, being graduates, may use in the choir, besides their surplices, such hoods as pertain to their several degrees. But in all other places every minister shall be at liberty to use a surplice or not. And hence in marrying, churching of women, and other offices not specified in this rubric, and even in the administration of the holy communion, it seems that a surplice is not necessary. Indeed for the holy communion the rubric appoints a white ALB plain, which differs from the surplice in being close-sleeved, with a vestment or cope.

SURREBUTTER, in law, is second rebutter; or the replication of the plaintiff to the defendant's rebutter.

SURREJOINDER, is a second defence of the plaintiff's declaration, by way of answer to the defendant's rejoinder.

SURRENDER, in common law, a deed or instrument, testifying that the particular tenant of lands and tenements, for life or years, doth sufficiently consent and agree, that he who has the next or immediate remainder or reversion thereof, shall have the present estate of the same in possession; and that he hereby yields and gives up the same to him, so that the estate for life or years may merge or drown by mutual agreement of the parties. Of surrenders there are three kinds; a surrender properly taken at common law; a surrender of copyhold or customary estates; and a surrender improperly taken, as of a deed, a patent, &c. The first is the usual surrender, and it is usually divided into that in deed, and that in law.

SURRENDER, in deed, is that which is really made by express words in writing, where the words of the lessee to the lessor prove a sufficient assent to surrender his estate back again.

SURRENDER, in law, is that wrought by operation of the law, and which is not actual.—As if a man have a lease of a farm for life or years, and during the term he accepts a new lease; this act is, in law, a surrender of the former.

SURRENDER of a bankrupt. See *COMMISSION of Bankruptcy*.

SURRENDER of Copyholds is the yielding up of the estate by the tenant into the hands of the lord, for such purposes as are expressed in the surrender: as to the use and behoof of A and his heirs, to the use of his own will, and the like. This method of conveyance is so essential to the nature of a copyhold estate, that it cannot possibly be transferred by any other assurance. No feoffment, fine, or recovery (in the king's courts) hath any operation upon it. If I would exchange a copyhold with another, I cannot do it by an ordinary deed of exchange at the common law, but we must surrender to each other's use, and the lord will admit us accordingly. If I would devise a copyhold, I must surrender it to the use of my last will and testament; and in my will I must declare my intentions, and name a devisee, who will then be entitled to admission.

SURRENDER of Letters Patent and Offices. A surrender may be made of letters patent to the king, so that he may grant the estate to whom he pleases, &c. and a second patent for years to the same person for the same thing is a surrender in law of the first patent. 10 Rep. 66. If an officer for life accepts of another grant of the same office, it is in law a surrender of the first grant; but if such an officer takes another grant of the same office to himself and another, it may be otherwise.

SURREPTITIOUS. See SUBREPTITIOUS.

SURROGATE, in law, denotes a person that is substituted or appointed in the room of another.

SURRY, a county of England, bounded on the west by Berkshire and Hampshire, on the south by Sussex, on the east by Kent, on the north by Middlesex, from which it is parted by the Thames, whence it had the name of *Suth-rey* from the Saxons, *i. e.* the country on the south side of the river. It is 38 miles in length from east to west, 23 in breadth from north to south, and 112 in circumference. It contains 13 hundreds, 140 parishes, of which 35 are vicarages, 13 market-towns, 450 villages, 592,000 acres, and about 170,000 inhabitants. The members sent from it to parliament are 14, of which two are sent by each of the following boroughs, viz. Southwark, Bleechingley, Ryegate, Guildford, Gatton, Haslemere, and two for the county.

The air of this county, towards the middle, which consists mostly of hills and heath, is sharp, but pure and wholesome. About the skirts, where it is more level, and the soil richer, the air is milder, but also salubrious. In the middle parts the soil is barren enough in general; but towards the extremities, and where the country is open and champaign, it is fruitful in grass and corn, particularly on the south side in Holmsdale, in which meadows, woods, and corn-fields, are agreeably intermixed. The soil is also very fertile along the Thames, especially towards London, where it greatly contributes to maintain plenty in the London

don markets. It has several rivers, abounding with fish, the chief of which are the Wye, the Mole, and the Wandle.

SURSOLID, or Surdesolid, in arithmetic, the fifth power of a number, or the fourth multiplication of any number, considered as a root.

SURVEYING, the art of measuring land; that is, of taking the dimensions of any tract of ground, laying down the same in a map or draught, and finding the content or area thereof. See Geometry.

SURVEYOR, a person who has the oversight and care of considerable works, lands, or the like.

Surveyor, likewise denotes a gauger; as also a person who surveys lands, and makes maps of them.

SURVIVOR, in law, signifies the longest liver of joint tenants, or of any two persons jointly interested in a thing.

SURVIVORSHIP, is that branch of mathematics which treats of reversions payable provided one or more particular persons survive certain others. By reversions are meant payments not to take place till some future period. Survivorship forms one of the most difficult and complicated parts of the doctrine of reversions and life-annuities. It has been very fully treated of by Mr Thomas Simpson in his Select Exercises; and brought to a state of very great perfection by Dr Price and Mr Morgan, who have bestowed a great deal of attention on this subject.

The calculations are founded on the expectation of lives at different ages, deduced from tables formed from bills of mortality, of which see several examples under the article *Bills of Mortality*. By the expectation of life is meant the mean time that any single or joint lives at a given age is found to continue; that is, the number of years which, taking one with another, they actually enjoy, and may be considered as sure of enjoying; those who survive that period enjoying as much more time in proportion to their number as those who fall short of it enjoy less. Thus, supposing 46 persons alive all 40 years of age, and that one will die every year till they are all dead in 46 years, half 46 or 23 will be the *expectation* of each of them. If M. de Moivre's hypothesis were true, that men always decrease in an arithmetical progression, the expectation of a single life is always half its complement (A), and the expectation of two joint lives one-third of their common complement. Thus, supposing a man 40, his expectation would be 23, the half of 46, his complement; the expectation of two joint lives, each 40, would be 15 years 4 months, or the third part of 46.

The number expressing the expectation, multiplied by the number of single or joint lives (of which it is the expectation), added annually to a society, gives the whole number living together, to which such an annual addition would in time grow. Thus, since 19, or the third of 57, is the expectation of two joint lives, whose common age is 29, twenty marriages every year between persons of this age would in 57 years grow to 20 times 19, or 380 marriages, always existing together. And since the expectation of a single life is always half its complement, in 57 years 20 single persons added annually to a town will increase to 20 times 28.5, or 570; and when arrived at this number, the deaths every year will just equal the accessions, and no farther increase be possible. It appears from hence, that the particular proportion that becomes extinct every year, out of the whole number constantly existing together of single or joint lives, must, wherever this number undergoes no variation, be exactly the same with the expectation of those lives, at the time when their existence commenced. Thus, was it found that a 19th part of all the marriages among any bodies of men, whose numbers do not vary, are dissolved every year by the deaths of either the husband or wife, it would appear that 19 was, at the time they were contracted, the expectation of these marriages. In like manner, was it found in a society, limited to a fixed number of members, that a 28th part dies annually out of the whole number of members, it would appear that 28 was their common expectation of life at the time they entered. So likewise, were it found in any town or district, where the number of births and burials are equal, that a 20th or 30th part of the inhabitants die annually, it would appear that 20 or 30 was the expectation of a child just born in that town or district. These expectations, therefore, for all single lives, are easily found by a table of observations, showing the number that die annually at all ages out of a given number alive at those ages; and the general rule for this purpose is, to divide the sum of all the living in the table, at the age whose expectation is required, and at all greater ages, by the sum of all that die annually at that age and above it; or, which is the same, by the number (in the table) of the living at that age; and half unity subtracted from the quotient will be the required expectation. Thus, in Dr Halley's table, given in the article Annuity, the sum of all the living at 20 and upwards is 20,724, which, divided by 598, the number living at the age of 20, and half unity subtracted from the quotient, gives 34.15 for the expectation of 20.

Survivorship.

In calculating the value or expectation of joint lives, Mr de Moivre had recourse to the hypothesis, that the probabilities of life decrease in a geometrical progression; believing that the values of joint lives, obtained by rules derived from it, would not deviate much from the truth. But in this he was greatly mistaken; they generally give results which are near a quarter of the true value too great in finding the present value of one life after it has survived another in a single payment, and about $\frac{2}{5}$ths too great when the value is sought in annual payments during the joint lives. They ought therefore to be calculated upon the hypothesis (if they are calculated on hypothesis at all), that the probabilities of life decrease in arithmetical progression, which is not very far from the truth. Even this hypothesis never corresponds with the fact in the first and last periods of life, and in some situations not in any period of life. Dr Price and Mr Morgan therefore have given tables of the value of lives, not founded on any hypothesis, but deduced from bills of mortality themselves. Some of these we shall give at the end of this article. Mr Morgan has likewise given rules for calculating values of lives in this manner.

M. de Moivre has also fallen into mistakes in his rules for calculating the value of reversions depending on survivorship: these have been pointed out by Dr Price in the third essay in the first volume of his Treatise on Reversionary Payments; who has also given proper rules for calculating these values, the most important of which are comprehended in the following paragraphs.

1
Method of finding the number of annuitants that will come on a society.

Suppose a set of married men to enter into a society in order to provide annuites for their widows, and that it is limited to a certain number of members, and constantly kept up to that number by the admission of new members as the old ones are lost; it is of importance, in the first place, to know the number of annuitants that after some time will come upon the establishment. Now since every marriage produces either a widow or widower; and since all marriages taken together would produce as many widows as widowers, were every man and his wife of the same age, and the chance equal which shall die first; it is evident, that the number

(A) By the complement of a life is meant what it wants of 86, which M. de Moivre makes the boundary of human life. Thus if a man be 30, the complement of his life is 56.

Survivorship. number of widows that have ever existed in the world, would in this case be equal to half the number of marriages. And what would take place in the world must also, on the same suppositions, take place in this society. In other words, every other person in such a society leaving a widow, there must arise from it a number of widows equal to half its own number. But this does not determine what number, all living at one and the same time, the society may expect will come to be constantly upon it. It is, therefore, necessary to determine how long the duration of survivorship between persons of equal ages will be compared with the duration of marriage. And the truth is, that, supposing the probabilities of life to decrease uniformly, the former is equal to the latter; and consequently that the number of survivors, or (which is the same, supposing no second marriages) of widows and widowers alive together, which will arise from any given set of such marriages constantly kept up, will be equal to the whole number of marriages; or half of them (the number of widows in particular) equal to half the number of marriages. Now it appears that in most towns the decrease in the probabilities of life is in fact nearly uniform. According to the Breslaw Table of Observation (see ANNUITY), almost the same numbers die every year from 20 years of age to 77. After this, indeed, fewer die, and the rate of decrease in the probabilities of life is retarded. But this deviation from the hypothesis is inconsiderable; and its effect, in the present case, is to render the duration of survivorship longer than it would otherwise be. According to the London Table of Observations, the numbers dying every year begin to grow less at 50 years of age; and from hence to extreme old age there is a constant retardation in the decrease of the probabilities of life. Upon the whole, therefore, it appears that, according to the Breslaw Table, and supposing no widows to marry, the number inquired after is somewhat greater than half the number of the society; but, according to the London Table, a good deal greater. This, however, has been determined on the supposition that the husbands and wives are of equal ages, and that then there is an equal chance who shall die first. But in reality husbands are generally older than wives, and males have been found to die sooner than females, as appears incontestably from several of the tables in Dr Price's Treatise on Reversions. It is therefore more than an equal chance that the husband will die before his wife. This will increase considerably the duration of survivorship on the part of the women, and consequently the number which we have been inquiring after. The marriage of widows will diminish this number, but not so much as the other causes will increase it.

2 When the number of annuitants arrives at its maximum. If the society comprehends in it from the first all the married people of all ages in any town, or among any class of people where the numbers always continue the same, the whole collective body of members will be at their greatest age at the time of the establishment of the society; and the number of widows left every year will at a medium be always the same. The number of widows will increase continually on the society, till as many die off every year as are added. This will not be till the whole collective body of widows are at their greatest age, or till there are among them the greatest possible number of the oldest widows; and therefore not till there has been time for an accession to the oldest widows from the youngest part.

Let us, for the sake of greater precision, divide the whole medium of widows that come on every year into different classes according to their different ages, and suppose some to be left at 56 years of age, some at 46, some at 36, and some at 26. The widows, constantly in life together, derived from the first class, will come to their greatest age, and to a *maximum*, in 30 years, supposing, with M. de Moivre, 86 to be the utmost extent of life. The same will happen to the second class in 40 years, and to the third in 50 years. But the whole body composed of these classes will not come to a *maximum* till the same happens to the fourth or youngest class; that is, not till the end of 60 years. After this the affairs of the society will become stationary, and the number of annuitants upon it of all ages will keep always nearly the same.

If a society begins with its complete number of members, but at the same time admits none above a particular age: If, for instance, it begins with 200 members all under 50, and afterwards limits itself to this number, and keeps it up by admitting every year, at all ages between 26 and 50, new members as old ones drop off; in this case, the period necessary to bring on the *maximum* of annuitants will be just doubled.

3 What man ought to pay in a single payment to entitle a widow to a certain annuity. To determine the sum that every individual ought to pay in a single present payment, in order to intitle his widow to a certain annuity for her life, let us suppose the annuity 3l. *per annum*, and the rate of interest four *per cent*. It is evident, that the value of such an expectation is different, according to the different ages of the purchasers, and the proportion of the age of the wife to that of the husband. Let us then suppose that every person in such a society is of the same age with his wife, and that one with another all the members when they enter may be reckoned 40 years of age, as many entering above this age as below it. It has been demonstrated by M. de Moivre and Mr Simpson, that the value of an annuity on the joint continuance of any two lives, subtracted from the value of an annuity on the life in expectation, gives the true present value of annuity on what may happen to remain of the latter of the two lives after the other.

In the present case, the value of an annuity to be enjoyed during the joint continuance of two lives, each 40, is, by Table II. 9.826, according to the probabilities of life in the Table of Observations formed by Dr Halley from the bills of mortality of Breslaw in Silesia. The value of a single life 40 years of age, as given by M. de Moivre, agreeably to the same table, is 13.20; and the former subtracted from the latter, leaves 3.37, or the true number of years purchase, which ought to be paid for any given annuity, to be enjoyed by a person 40 years of age, provided he survives another person of the same age, interest being reckoned at four *per cent. per annum*. The annuity, therefore, being 30 l. the present value of it is 30 multiplied by 3.37, or 101 l. 2 s.

4 What ought to pay in annual payments. If, instead of a single present payment, it is thought preferable to make annual payments during the marriage; what these annual payments ought to be is easily determined by finding what annual payments during two joint lives of given ages are equivalent to the value of the reversionary annuity in present money. Suppose, as before, that the joint lives are each 40, and the reversionary annuity 30 l. *per annum*. An annual payment during the continuance of two such lives is worth (according to Table II.) 9.82 years purchase. The annual payment ought to be such as, being multiplied by 9.82, will produce 101.1 l. the present value of the annuity in one payment. Divide then 101.1 by 9.82, and 10.3 the quotient will be the annual payment. This method of calculation supposes that the first annual payment is not to be made till the end of a year. If it is to be made immediately, the value of the joint lives will be increased one year's purchase; and therefore, in order to find the annual payments required, the value of a present single payment must be divided by the value of the joint lives increased by unity. If the society prefer paying part of the value in a present single payment on admission, and the rest in annual payments; and if they fix these annual payments at

or at a particular fum, the prefent fingle payment paid on admiffion is found by fubtracting the value of the annual payment during the joint lives from the whole prefent value of the annuity in one payment. Suppofe, for inftance, the annual payments to be fixed at five guineas, the annuity to be 30 l. the rate of intereft four *per cent.* and the joint lives each 40; the value of the annuity in one prefent fingle payment is 101.1 l. The value of five guineas or 5.25 *per annum*, is (5.25 multiplied by 9.82 the value of the joint lives) 51.55; which, fubtracted from 101.1 l. gives l. 49.5, the anfwer.

If a fociety takes in all the marriages among perfons of a particular profeffion within a given diftrict, and fubjects them for perpetuity to a certain equal and common tax or annual payments, in order to provide life annuities for all the widows that fhall refult from thefe marriages; fince, at the commencement of fuch an eftablifhment, all the oldeft, as well as the youngeft, marriages are to be intitled equally to the propofed benefit, a much greater number of annuitants will come immediately upon it than would come upon any fimilar eftablifhment which limited itfelf in the admiffion of members to perfons not exceeding a given age. This will check that accumulation of money which fhould take place at firft, in order to produce an income equal to the difburfements at the time when the number of annuitants comes to a *maximum*; and therefore will be a particular burden upon the eftablifhment in its infancy. For this fome compenfation muft be provided; and the equitable method of providing it is, by levying fines at the beginning of the eftablifhment on every member exceeding a given age, proportioned to the number of years which he has lived beyond that age. But if fuch fines cannot be levied, and if every payment muft be equal and common, whatever difparity there may be in the value of the expectations of different members, the fines muft be reduced to one common one, anfwering as nearly as poffible to the difadvantage, and payable by every member at the time when the eftablifhment begins. After this, the eftablifhment will be the fame with one that takes upon it all at the time they marry; and the tax or annual payment of every member adequate to its fupport will be the annual payment during marriage due from perfons who marry at the mean age at which, upon an average, all marriages may be confidered as commencing. The fines to be paid at firft are, for every particular member, the fame with the difference between the value of the expectation to him at his prefent age, and what would have been its value to him had the fcheme begun at the time he married. Or, they are, for the whole body of members, the difference between the value of the common expectation, to perfons at the mean age of all married perfons taken together as they exift in the world, and to perfons at that age which is to be deemed their mean age when they marry.

Method of finding the prefent value of an annuity to be enjoyed by one life after the expectation of another.

Suppofe we wifh to know the prefent value of an annuity to be enjoyed by one life, for what may happen to remain of it beyond another life, after a given term; that is, provided both lives continue from the prefent time to the end of a given term of years; the method of calculating is this: Find the value of the annuity for two lives, greater by the given term of years than the given lives; difcount this value for the given term; and then multiply by the probability, that the two given lives fhall both continue the given term; and the product will be the anfwer. Thus, let the two lives be each 30, the term feven years, the annuity l. 10, intereft four *per cent.* The given lives, increafed by feven years, become each 37. The value of two joint lives, each 37, is (by Table II.) 10.25. The value of a fingle life at 37 is (by the table under the article ANNUITY) 13.67. The former fubtracted from the latter is 3.42, or the value of an annuity for the life of a perfon 37 years of age, after another of the fame age, as has been fhown above. 3.42 difcounted for feven years (that is, multiplied by 0.76 the value of 1 l. due at the end of feven years) is 2.6. The probability that a fingle life at 30 fhall continue feven years is $\frac{49}{56}$ (B). The probability, therefore, that two fuch lives fhall continue feven years, is $\frac{2401}{3136}$, or in decimals 0.765; and 2.6 multiplied by 0.765 is 1.989, the number of years purchafe which ought to be given for an annuity to be enjoyed by a life now 30 years of age, after a life of the fame age, provided both continue feven years. The annuity then being 10l. its prefent value is l. 19.89.

Survivorship.

6. Method of finding the value of an annuity for what may happen to remain of one life after another, provided the life in expectation continues a given term.

Suppofe the value is required of an annuity to be enjoyed for what may happen to remain of one life after another, provided the life in expectation continues a given time. 1. Find the prefent value of the annuity for the remainder of the life in expectation after the given time, which is done in this manner: Multiply the prefent value of the life at the given time by the prefent value of 1 l. to be received at that time, and multiply the product again by the probability that the life in expectation will continue fo long. Let the given time which the life in expectation is to continue be 15 years, and let the perfon then be arrived at 50 years of age. A life at fifty, according to M. de Moivre's valuation of lives, and reckoning intereft at four *per cent.* is worth 11.34 years purchafe. The prefent value of 1 l. to be received at the end of 15 years, is 0.5553, and the probability that a life at 35 will continue 15 years is $\frac{146}{490}$. Thefe three values multiplied into one another give L. 4.44 for the prefent value of the life in expectation. 2. Find the value of the reverfion, provided both lives continue the given time, by the rule given in parag. 5th. 3. Add thefe values together, and the fum will be the anfwer in a fingle prefent payment. We fhall now illuftrate this rule by an example.

An annuity of 10 l. for the life of a perfon now 30, is to commence at the end of 11 years, if another perfon now 40 fhould be then dead; or, if this fhould not happen at the end of any year beyond 11 years in which the former fhall happen to furvive the latter: What is the prefent value of fuch an annuity, reckoning intereft at four *per cent.* and taking the probabilities of life as they are in Dr Halley's table, given in the article MORTALITY?

The value of 10 l. *per annum*, for the remainder of the life of a perfon now 30, after 11 years is L. 69.43. The probability that a perfon 40 years of age fhall live 11 years, is, by Dr Halley's table, $\frac{335}{445}$. The probability, therefore, that he will die in 11 years, is $\frac{335}{445}$ fubtracted from unity (C), or $\frac{110}{445}$; which multiplied by l. 69.43, gives l. 17.16. — The value of the reverfion, provided both live 11 years, is 17 l. and this value added to the former, makes l. 34.16. the value required in a fingle prefent payment; which payment divided by l. 11.43, the value of two joint lives, aged 30 and 40, with unity added, gives 3 l.; or the value required in annual payments during the joint lives, the firft payment to be made immediately.

 TABLE

(B) The probability that a given life fhall continue any number of years, or reach a given age, is (as is well known) the fraction, whofe numerator is the number of the living in any table of obfervations oppofite to the given age, and denominator, the number oppofite to the prefent age of the given life.

(C) For the difference between unity and the fraction expreffing the probability that an event will happen, gives the probability that it will not happen.

TABLE I. *Showing the Present Values of an Annuity of L. 1 on a Single Life, according to M. de Moivre's Hypothesis.*

Age.	3 per Ct.	3½ per Ct.	4 per Ct.	4½ per Ct.	5 per Ct.	6 per Ct.
8	19,736	18,160	16,791	15,595	14,544	12,790
9	19,868	18,269	16,882	15,672	14,607	12,839
10	19,868	18,269	16,882	15,672	14,607	12,839
11	19,736	18,160	16,791	15,595	14,544	12,790
12	19,604	18,049	16,698	15,517	14,480	12,741
13	19,469	17,937	16,604	15,437	14,412	12,691
14	19,331	17,823	16,508	15,356	14,342	12,639
15	19,192	17,707	16,410	15,273	14,271	12,586
16	19,050	17,588	16,311	15,189	14,197	12,532
17	18,905	17,467	16,209	15,102	14,123	12,476
18	18,759	17,344	16,105	15,015	14,047	12,419
19	18,610	17,220	15,999	14,923	13,970	12,361
20	18,458	17,093	15,891	14,831	13,891	12,301
21	18,305	16,963	15,781	14,737	13,810	12,239
22	18,148	16,830	15,669	14,641	13,727	12,177
23	17,990	16,696	15,554	14,543	13,642	12,112
24	17,827	16,559	15,437	14,442	13,555	12,045
25	17,664	16,419	15,318	14,340	13,466	11,978
26	17,497	16,277	15,197	14,235	13,375	11,908
27	17,327	16,133	15,073	14,128	13,282	11,827
28	17,154	15,985	14,946	14,018	13,186	11,763
29	16,979	15,835	14,816	13,905	13,088	11,688
30	16,800	15,682	14,684	13,791	12,988	11,610
31	16,620	15,526	14,549	13,673	12,855	11,530
32	16,436	15,367	14,411	13,553	12,780	11,449
33	16,248	15,204	14,270	13,430	12,673	11,365
34	16,057	15,039	14,126	13,304	12,562	11,278
35	15,864	14,871	13,979	13,175	12,449	11,189
36	15,666	14,699	13,829	13,044	12,333	11,098
37	15,455	14,524	13,676	12,909	12,214	11,003
38	15,260	14,345	13,519	12,771	12,091	10,907
39	15,053	14,163	13,359	12,630	11,966	10,807
40	14,842	13,978	13,196	12,485	11,837	10,704
41	14,626	13,789	13,028	12,337	11,705	10,599
42	14,407	13,596	12,858	12,185	11,570	10,490
43	14,185	13,399	12,683	12,029	11,431	10,378
44	13,958	13,199	12,504	11,870	11,288	10,263
45	13,728	12,993	12,322	11,707	11,142	10,144
46	13,493	12,784	12,135	11,540	10,992	10,021
47	13,254	12,571	11,944	11,368	10,837	9,895
48	13,012	12,354	11,748	11,192	10,679	9,765
49	12,764	12,131	11,548	11,012	10,515	9,630
50	12,511	11,904	11,344	10,827	10,348	9,492
51	12,255	11,673	11,135	10,638	10,176	9,349
52	11,994	11,437	10,921	10,443	9,999	9,201
53	11,729	11,195	10,702	10,243	9,817	9,049
54	11,457	10,950	10,478	10,039	9,630	8,891
55	11,183	10,698	10,248	9,829	9,437	8,729
56	10,902	10,443	10,014	9,614	9,239	8,561
57	10,616	10,181	9,773	9,393	9,036	8,387
58	10,325	9,913	9,527	9,166	8,826	8,208
59	10,029	9,640	9,275	8,933	8,611	8,023
60	9,727	9,361	9,017	8,694	8,389	7,831
61	9,419	9,076	8,753	8,449	8,161	7,633
62	9,107	8,786	8,482	8,197	7,926	7,428
63	8,787	8,488	8,205	7,938	7,684	7,216
64	8,462	8,185	7,921	7,672	7,435	6,997
65	8,132	7,875	7,631	7,399	7,179	6,770
66	7,794	7,558	7,333	7,119	6,915	6,535
67	7,450	7,234	7,027	6,831	6,643	6,292
68	7,099	6,902	6,714	6,534	6,362	6,040
69	6,743	6,565	6,394	6,230	6,073	5,779
70	6,378	6,219	6,065	5,918	5,775	5,508
71	6,008	5,865	5,728	5,596	5,468	5,228
72	5,631	5,505	5,383	5,265	5,152	4,937
73	5,246	5,136	5,029	4,926	4,826	4,636
74	4,854	4,759	4,666	4,576	4,489	4,324
75	4,453	4,373	4,293	4,217	4,143	4,000
76	4,046	3,978	3,912	3,847	3,784	3,664
77	3,632	3,575	3,520	3,467	3,415	3,315
78	3,207	3,163	3,111	3,076	3,034	2,953
79	2,776	2,741	2,707	2,673	2,641	2,578
80	2,334	2,309	2,284	2,259	2,235	2,188
81	1,886	1,867	1,850	1,832	1,816	1,783
82	1,429	1,411	1,406	1,394	1,384	1,362
83	0,961	0,955	0,950	0,943	0,937	0,925
84	0,484	0,483	0,481	0,479	0,476	0,472
85	0,000	0,000	0,000	0,000	0,000	0,000

TABLE II. *Showing the Value of an Annuity on the Joint Continuance of Two Lives, according to M. de Moivre's Hypothesis.*

Age of the Youngest.	Age of the Eldest.	Value at 3 per Cent.	Value at 4 per Cent.	Value at 5 per Cent.
10	10	15.206	13.342	11.855
	15	14.878	13.093	11.601
	20	14.503	12.808	11.430
	25	14.074	12.480	11.182
	30	13.585	12.102	10.884
	35	13.025	11.665	10.537
	40	12.381	11.156	10 128
	45	11.644	10.564	9.646
	50	10.796	9.871	9.074
	55	9.822	9 059	8.391
	60	8.704	8.105	7 572
	65	7.417	6.980	6.585
	70	5.936	5.652	5.391
15	15	14.574	12.860	11.478
	20	14.225	12.593	11.266
	25	13.822	12.281	11.022
	30	13.359	11.921	10.736
	35	12.824	11.501	10.402
	40	12.207	11.013	10.008
	45	11.496	10.440	9.541
	50	10.675	9.767	8.985
	55	9.727	8.975	8.318
	60	8.632	8.041	7.515
	65	7.377	6.934	6.544
	70	5.932	5.623	5.364
20	20	13.904	12.341	11.067
	25	13.531	12.051	10.840
	30	13.098	11.711	10.565

Age of the Youngest.	Age of the Eldest.	Value at 3 per Cent.	Value at 4 per Cent	Value at 5 per Cent.
20	35	12.594	11.314	10.278
	40	12.008	10.847	9.870
	45	11.325	10.297	9.420
	50	10.536	9.648	8.880
	55	9.617	8.879	8.233
	60	8.549	7.907	7.448
	65	7.308	6.882	6.495
	70	5.863	5.590	5.333
25	25	13.192	11.786	10.621
	30	12.794	11.468	10.367
	35	12.333	11.093	10.067
	40	11.770	10.655	9.708
	45	11.130	10.131	9.278
	50	10.374	9.509	8.761
	55	9.488	8.766	8.134
	60	8.452	7.880	7.371
	65	7.241	6.826	6.440
	70	5.826	5.551	5.294
30	30	12.434	11.182	10.133
	35	12.010	10.838	9.854
	40	11.502	10.428	9.514
	45	10.898	9.936	9.112
	50	10.183	9.345	8.620
	55	9.338	8.634	8.018
	60	8.338	7.779	7.280
	65	7.161	6.748	6.373
	70	5.777	5.505	5.254
35	35	11.632	10.530	9.600
	40	11.175	10.157	9.291
	45	10.622	9.702	8.913
	50	9.955	9.149	8.450
	55	9.156	8.476	7.[illegible]79
	60	8.202	7.658	7.172
	65	7.066	6.662	6.294
	70	5.718	5.450	5.2[illegible]3
40	40	10.777	9.826	9.014
	45	10.283	9.418	8.671
	50	9.677	8.911	8.244
	55	8.936	8.283	7.710
	60	8.038	7.510	7.039
	65	6.951	6.556	6.198
	70	5.646	5.383	5.141
45	45	9.863	9.063	8.370
	50	9.331	8.619	7.987
	55	8.662	8.044	7.5[illegible]0
	60	7.831	7.332	6.875
	65	6.807	6.435	6.080
	70	5.556	5.300	5.063
50	50	8.892	8.235	7.600
	55	8.312	7.738	7.230
	60	7.568	7.091	6.664
	65	6.023	6.258	5.926
	70	5.442	5.193	4.964
55	55	7.849	7.332	6.873
	60	7.220	6.781	6.386
	65	6.379	6.036	5.724
	70	5.201	5.053	4.833
60	60	6.737	6.351	6.001
	65	6.043	5.730	5.444
	70	5.081	4.858	4.653
65	65	5.547	5.277	5.031
	70	4.773	4.571	4.3[illegible]5
70	70	4.270	4.104	3.952

Survivorship.

TABLE III. *Showing the Values of Annuities on Single Lives, among Males and Females, according to the Probabilities of the Duration of Life in the Kingdom of Sweden.*

	MALES.		FEMALES.		Lives in general.	
Ages.	4 per Ct.	5 per Ct.	4 per Ct.	5 per Ct.	4 per Ct.	5 per Ct.
1	16.503	14.051	16.820	14.271	16.661	14.161
2	17.355	14.778	17.719	15.034	17.537	14.906
3	17.935	15.279	18.344	15.571	18.139	15.425
4	18.328	15.624	18.780	15.951	18.554	15.787
5	18.503	15.786	18.927	16.085	18.715	15.937
6	18.622	15.901	19.045	16.203	18.833	16.052
7	18.693	15.977	19.131	16.291	18.912	16.134
8	18.725	16.021	19.162	16.335	18.943	16.178
9	18.715	16.030	19.151	16.343	18.933	16.186
10	18.674	16.014	19.109	16.325	18.891	16.169
11	18.600	15.970	19.041	16.286	18.820	16.128
12	18.491	15.896	18.952	16.229	18.721	16.062
13	18.378	15.819	18.840	16.153	18.609	15.986
14	18.246	15.724	18.707	16.059	18.470	15.891
15	18.105	15.624	18.568	15.960	18.336	15.792
16	17.958	15.517	18.424	15.856	18.191	15.686
17	17.803	15.404	18.290	15.761	18.046	15.582
18	17.643	15.285	18.151	15.662	17.897	15.473
19	17.492	15.175	18.013	15.563	17.752	15.369
20	17.335	15.[illegible]59	17.872	15.462	17.603	15.260
21	17.192	14.955	17.725	15.356	17.458	15.155
22	17.042	14.846	17.573	5.245	17.307	15.045
23	16.887	14.732	17.414	15.129	17.150	14.930
24	16.742	14.627	17.252	15.009	16.997	14.818
25	16.592	14.517	17.087	14.886	16.839	14.701
26	16.436	14.402	16.915	14.757	16.675	14.579
27	16.274	14.282	16.751	14.636	16.512	14.459
28	16.105	14.156	16.588	14.515	16.346	14.335
29	15.930	14.024	16.427	14.396	16.178	14.210
30	15.751	13.889	16.261	14.272	16.006	14.080
31	15.575	13.756	16.104	14.156	15.839	13.956
32	15.395	13.619	15.941	14.035	15.668	13.827
33	15.208	13.477	15.787	13.923	15.497	13.700
34	15.014	13.327	15.629	13.806	15.321	13.566
35	14.812	13.170	15.465	13.684	15.138	13.427
36	14.601	13.006	15.278	13.542	14.939	13.274
37	14.382	12.833	15.070	13.382	14.726	13.107
38	14.154	12.652	14.854	13.213	4.504	12.932
39	13.916	12.462	14.629	13.036	14.272	12.749
40	13.668	12.261	14.401	12.856	14.034	12.558
41	13.426	12.065	14.185	12.687	13.805	12.376
42	13.196	11.880	13.994	12.538	13.595	2.209
43	12.984	11.710	13.795	12.387	13.391	12.048
44	12.763	11.532	13.596	12.229	13.179	11.880
45	12.535	11.347	13.383	12.061	12.959	11.704
46	12.297	11.153	13.151	11.876	12.724	11.514
47	12.051	10.951	12.894	11.668	12.472	11.309
48	11.795	10.738	12.620	11.443	12.217	11.090
49	11.528	10.516	12.333	11.205	11.930	10.860
50	11.267	10.298	12.049	10.97[illegible]	11.658	10.634
51	11.030	10.100	11.769	10.737	11.399	10.418
52	10.785	9.895	11.492	10.507	11.138	10.2[illegible]
53	10.531	9.682	11.220	10.280	10.875	9.951
54	10.269	9.460	10.937	10.042	10.603	9.7[illegible]1
55	9.998	9.229	10.642	9.792	10.320	9.5[illegible]
56	9.717	8.988	10.334	9.529	10.025	9.258
57	9.425	8.736	10.012	9.253	9.718	8.99[illegible]
58	9.140	8.489	9.692	8.[illegible]6	9.416	8.73[illegible]
59	8.845	8.232	9.358	8.[illegible]87	9.101	8.458
60	8.540	7.963	9.0[illegible]9	8.406	8.789	8.184
61	8.241	7.700	8.739	8.144	8.490	7.922

Survivorship.

Ages	Males. 4 per Ct.	Males. 5 per Ct.	Females. 4 per Ct.	Females. 5 per Ct.	Lives in general. 4 per Ct.	Lives in general. 5 per Ct.
62	7.950	7.442	8.453	7.895	8.201	7.668
63	7.669	7.193	8.106	7.643	7.917	7.418
64	7.382	6.935	7.870	7.382	7.626	7.160
65	7.090	6.676	7.506	7.111	7.328	6.893
66	6.792	6.408	7.252	6.831	7.022	6.619
67	6.489	6.134	6.930	6.541	6.709	6.337
68	6.201	5.872	6.596	6.239	6.398	6.055
69	5.933	5.628	6.253	5.920	6.093	5.777
70	5.670	5.389	5.897	5.599	5.783	5.494
71	5.418	5.158	5.504	5.293	5.491	5.225
72	5.180	4.940	5.261	5.013	5.220	4.976
73	4.940	4.719	4.998	4.770	4.969	4.744
74	4.724	4.521	4.792	4.581	4.758	4.551
75	4.487	4.302	4.582	4.388	4.534	4.345
76	4.253	4.084	4.367	4.189	4.310	4.136
77	4.024	3.871	4.145	3.983	4.084	3.927
78	3.768	3.631	3.913	3.767	3.840	3.699
79	3.512	3.390	3.668	3.536	3.590	3.463
80	3.260	3.152	3.402	3.285	3.331	3.218
81	3.017	2.921	3.145	3.041	3.081	2.981
82	2.792	2.706	2.905	2.812	2.848	2.759
83	2.600	2.523	2.699	2.615	2.649	2.569
84	2.473	2.403	2.559	2.480	2.516	2.441
85	2.371	2.306	2.552	2.476	2.461	2.391
86	2.281	2.222	2.518	2.446	2.399	2.334
87	2.154	2.103	2.431	2.365	2.292	2.338
88	1.955	1.912	2.294	2.236	2.124	2.074
89	1.698	1.664	2.108	2.059	1.903	1.861
90	1.417	1.392	1.873	1.835	1.645	1.612
91	1.154	1.136	1.628	1.596	1.391	1.366
92	0.835	0.824	1.349	1.325	1.092	1.074
93	0.477	0.471	1.071	1.054	0.774	0.762
94	0.240	0.238	0.799	0.788	0.519	0.513
95	0.000	0.000	0.544	0.537		
96	0.000	0.000	0.320	0.317		

TABLE IV. *Shewing the Value of Annuities on Two Joint Lives, according to the Probabilities of the Duration of Human Life among Males and Females collectively, reckoning interest at* 4 per cent.

Interest 4 *per cent.*

Difference of 0, 6, 12, and 18 years.

Ages.	Values.	Ages.	Values.	Ages.	Values.	Ages.	Values.
1- 1	12.252	1- 7	13.989	1-13	13.894	1-19	13.389
2- 2	13.583	2- 8	14.780	2-14	14.557	2-20	14.008
3- 3	14.558	3- 9	15.323	3-15	14.988	3-21	14.417
4- 4	15.267	4-10	15.685	4-16	15.250	4-22	14.671
5- 5	15.577	5-11	15.817	5-17	15.326	5-23	14.725
6- 6	15.820	6-12	15.887	6-18	15.353	6-24	14.740
7- 7	16.003	7-13	15.914	7-19	15.351	7-25	14.727
8- 8	16.109	8-14	15.888	8-20	15.310	8-26	14.673
9- 9	16.152	9-15	15.824	9-21	15.244	9-27	14.590
10-10	16.141	10-16	15.729	10-22	15.149	10-28	14.484
11-11	16.087	11-17	15.617	11-23	15.033	11-29	14.357
12-12	15.982	12-18	15.477	12-24	14.889	12-30	14.202
13-13	15.855	13-19	15.327	13-25	14.736	13-31	14.045
14-14	15.701	14-20	15.164	14-26	14.566	14-32	13.874
15-15	15.535	15-21	15.001	15-27	14.392	15-33	13.700
16-16	15.361	16-22	14.832	16-28	14.216	16-34	13.520
17-17	15.196	17-23	14.665	17-29	14.042	17-35	13.340
18-18	15.023	18-24	14.491	18-30	13.860	18-36	13.141
19-19	14.854	19-25	14.320	19-31	13.687	19-37	12.934

Interest 4 *per cent.*

Ages.	Values.	Ages.	Values.	Ages.	Values.	Ages.	Values.
20-20	14.682	20-26	14.144	20-32	13.512	20-38	12.720
21-21	14.525	21-27	13.976	21-33	13.345	21-39	12.505
22-22	14.360	22-28	13.807	22-34	13.173	22-40	12.286
23-23	14.194	23-29	13.635	23-35	12.997	23-41	12.073
24-24	14.022	24-30	13.453	24-36	12.801	24-42	11.873
25-25	13.849	25-31	13.284	25-37	12.599	25-43	11.685
26-26	13.671	26-32	13.108	26-38	12.387	26-44	11.485
27-27	13.495	27-33	12.935	27-39	12.172	27-45	11.284
28-28	13.323	28-34	12.763	28-40	11.953	28-46	11.072
29-29	13.148	29-35	12.581	29-41	11.742	29-47	10.847
30-30	12.965	30-36	12.390	30-42	11.545	30-48	10.600
31-31	12.795	31-37	12.192	31-43	11.359	31-49	10.365
32-32	12.622	32-38	11.988	32-44	11.17	32-50	10.125
33-33	12.456	33-39	11.779	33-45	10.978	33-51	9.925
34-34	12.286	34-40	11.565	34-46	10.775	34-52	9.679
35-35	12.109	35-41	11.361	35-47	10.557	35-53	9.452
36-36	11.904	36-42	11.156	36-48	10.314	36-54	9.207
37-37	11.683	37-43	10.953	37-49	10.059	37-55	8.951
38-38	11.454	38-44	10.741	38-50	9.805	38-56	8.683
39-39	11.209	39-45	10.519	39-51	9.558	39-57	8.404
40-40	10.964	40-46	10.286	40-52	9.308	40-58	8.124
41-41	10.732	41-47	10.049	41-53	9.066	41-59	7.839
42-42	10.531	42-48	9.813	42-54	8.830	42-60	7.560
43-43	10.346	43-49	9.581	43-55	8.597	43-61	7.318
44-44	10.154	44-50	9.351	44-56	8.354	44-62	7.075
45-45	9.954	45-51	9.129	45-57	8.101	45-63	6.836
46-46	9.736	46-52	8.897	46-58	7.841	46-64	6.586
47-47	9.497	47-53	8.658	47-59	7.563	47-65	6.325
48-48	9.237	48-54	8.402	48-60	7.281	48-66	6.048
49-49	8.965	49-55	8.139	49-61	7.008	49-67	5.764
50-50	8.707	50-56	7.874	50-62	6.749	50-68	5.487
51-51	8.469	51-57	7.615	51-63	6.505	51-69	5.223
52-52	8.230	52-58	7.351	52-64	6.256	52-70	4.953
53-53	7.994	53-59	7.085	53-65	6.004	53-71	4.694
54-54	7.748	54-60	6.814	54-66	5.743	54-72	4.453
55-55	7.495	55-61	6.555	55-67	5.474	55-73	4.251
56-56	7.229	56-62	6.299	56-68	5.204	56-74	4.043
57-57	6.924	57-63	6.045	57-69	4.936	57-75	3.844
58-58	6.678	58-64	5.788	58-70	4.664	58-76	3.637
59-59	6.388	59-65	5.519	59-71	4.395	59-77	3.430
60-60	6.104	60-66	5.249	60-72	4.149	60-78	3.210
61-61	5.844	61-67	4.984	61-73	3.927	61-79	2.974
62-62	5.600	62-68	4.729	62-74	3.747	62-80	2.744
63-63	5.367	63-69	4.482	63-75	3.563	63-81	2.557
64-64	5.128	64-70	4.231	64-76	3.373	64-82	2.396
65-65	4.881	65-71	3.982	65-77	3.180	65-83	2.252
66-66	4.626	66-72	3.750	66-78	2.974	66-84	2.123
67-67	4.362	67-73	3.527	67-79	2.743	67-85	2.010
68-68	4.103	68-74	3.340	68-80	2.514	68-86	1.910
69-69	3.851	69-75	3.147	69-81	2.324	69-87	1.798
70-70	3.593	70-76	2.946	70-82	2.153	70-88	1.661
71-71	3.345	71-77	2.752	71-83	2.004	71-89	1.464
72-72	3.128	72-78	2.558	72-84	1.875	72-90	1.189
73-73	2.935	73-79	2.355	73-85	1.768	73-91	0.937
74-74	2.797	74-80	2.172	74-86	1.692	74-92	0.708
75-75	2.648	75-81	2.017	75-87	1.605	75-93	0.575
76-76	2.490	76-82	1.877	76-88	1.497	76-94	0.481
77-77	2.340	77-83	1.756	77-89	1.339	77-95	0.421
78-78	2.170	78-84	1.639	78-90	1.097		
79-79	1.967	79-85	1.524	79-91	0.803		
80-80	1.758	80-86	1.416	80-92	0.638		
81-81	1.600	81-87	1.320	81-93	0.511		
82-82	1.472	82-88	1.225	82-94	0.427		
83-83	1.364	83-89	1.094	83-95	0.379		
84-84	1.276	84-90	0.902				

Survivorship.

Intereft 4 *per cent.*

Ages.	Values.	Ages.	Values.	Ages.	Values.	Ages.	Values.
85-85	1.212	85-91	0.725				
86-86	1.172	86-92	0.556				
87-87	1.127	87-93	0.459				
88-88	1.071	88-94	0.396				
89-89	0.949	89-95	0.364				
90-90	0.718						
91-91	0.516						
92-92	0.326						
93-93	0.236						
94-94	0.19[illegible]						
95-95	0.024						

TABLE V. *Showing the Values of two Joint Lives, according to the Probabilities of the Duration of Human Life among Males and Females collectively.*

Intereft 4 *per cent.*

Difference of age 24, 30, 36, and 42 years.

Ages.	Values.	Ages.	Values.	Ages.	Values.	Ages.	Values.
1-25	12.832	1-31	12.196	1-37	11.465	1-43	10.546
2-26	13.409	2-32	12.730	2-38	11.913	2-44	10.946
3-27	13.778	3-33	13.066	3-39	12.164	3-45	11.168
4-28	14.003	4-34	13.264	4-40	12.284	4-46	11.260
5-29	14.037	5-35	13.277	5-41	12.242	5-47	11.183
6-30	14.033	6-36	13.242	6-42	12.185	6-48	11.064
7-31	14.006	7-37	13.17[illegible]	7-43	12.112	7-49	10.915
8-32	13.944	8-38	13.059	8-44	12.004	8-50	10.743
9-33	13.855	9-39	12.913	9-45	11.865	9-51	10.560
10-34	13.741	10-40	12.743	10-46	11.694	10-52	10.357
11-35	13.004	11-41	12.563	11-47	11.493	11-53	10.140
12-36	13.428	12-42	12.379	12-48	11.259	12-54	9.898
13-37	13.234	13-43	12.196	13-49	11.011	13-55	9.644
14-38	13.023	14-44	11.997	14-50	10.759	14-56	9.371
15-39	12.798	15-45	11.787	15-51	10.511	15-57	9.087
16-40	12.570	16-46	11.562	16-52	10.264	16-58	8.799
17-41	12.351	17-47	11.328	17-53	10.018	17-59	8.503
18-42	12.146	18-48	11.076	18-54	9.761	18-60	8.208
19-43	11.951	19-49	10.819	19-55	9.500	19-61	7.928
20-44	11.751	20-50	10.567	20-56	9.228	20-62	7.658
21-45	11.55[illegible]	21-51	10.332	21-57	8.953	21-63	7.396
22-46	11.335	22-52	10.092	22-58	8.67[illegible]	22-64	7.127
23-47	11.107	23-53	9.852	23-59	8.385	23-65	6.851
24-48	10.862	24-54	9.602	24-60	8.097	24-66	6.566
25-49	10.612	25-55	9.347	25-61	7.823	25-67	6.275
26-50	10.364	26-56	9.082	26-62	7.557	26-68	5.986
27-51	10.130	27-57	8.807	27-63	7.297	27-69	5.702
28-52	9.894	28-58	8.534	28-64	7.032	28-70	5.415
29-53	9.659	29-59	8.250	29-65	6.761	29-71	5.136
30-54	9.413	30-60	7.967	30-66	6.481	30-72	4.881
31-55	9.167	31-61	7.702	31-67	6.197	31-73	4.646
32-56	8.912	32-62	7.446	32-68	5.9[illegible]7	32-74	4.453
33-57	8.651	33-63	7.196	33-69	5.642	33-75	4.251
34-58	8.389	34-64	6.912	34-70	5.364	34-76	4.042
35-59	8.114	35-65	6.679	35-71	5.093	35-77	3.833
36-60	7.833	36-66	6.402	36-72	4.840	36-78	3.605
37-61	7.561	37-67	6.115	37-73	4.605	37-79	3.352
38-62	7.296	38-68	5.828	38-74	4.40[illegible]	38-80	3.098
39-63	7.033	39-69	5.543	39-75	4.195	39-81	2.889
40-64	6.763	40-70	5.251	40-76	3.9[illegible]	40-82	2.710
41-65	6.492	41-71	4.977	41-77	3.762	41-83	2.553
42-66	6.225	42-72	4.73[illegible]	42-78	5.539	42-84	2.418
43-67	5.957	43-73	4.507	43-79	3.295	43-85	2.[illegible]05
44-68	5.689	44-74	4.322	44-80	3.052	44-86	2.203

Intereft 4 *per cent.*

Ages.	Values.	Ages.	Values.	Ages.	Values.	Ages.	Values.
45-69	5.426	45-75	4.128	45-81	2.854	45-87	2.083
46-70	5.153	46-76	3.921	46-82	2.684	46-88	1.933
47-71	4.884	47-77	3.715	47-83	2.533	47-89	1.708
48-72	4.633	48-78	3.489	48-84	2.396	48-90	1.585
49-73	4.395	49-79	3.238	49-85	2.277	49-91	1.000
50-74	4.205	50-80	2.990	50-86	2.171	50-92	0.818
51-75	4.008	51-81	2.792	51-87	2.05[illegible]	51-93	0.662
52-76	3.803	52-82	2.623	52-88	1.92[illegible]	52-94	0.551
53-77	3.605	53-83	2.475	53-89	1.68[illegible]	53-95	0.468
54-78	3.389	54-84	2.344	54-90	1.36[illegible]		
55-79	3.150	55-85	2.232	55-91	1.07[illegible]		
56-80	2.909	56-86	2.130	56-92	0.810		
57-81	2.710	57-87	2.010	57-93	0.6[illegible]5		
58-82	2.539	58-88	1.864	58-94	0.54[illegible]		
59-83	2.385	59-89	1.644	59-95	0.464		
60-84	2.248	60-90	1.333				
61-85	2.135	61-91	1.050				
62-86	2.037	62-92	0.789				
63-87	1.916	63-93	0.630				
64-88	1.790	64-94	0.533				
65-89	1.585	65-95	0.456				
66-90	1.290						
67-91	1.017						
68-92	0.764						
69-93	0.617						
70-94	0.514						
71-95	0.411						

The values of joint lives in thefe tables have been computed for only one rate of intereft; and of fingle lives in Table III. for only two rates of intereft. The following rules will fhow, that it would be a needlefs labour to compute thefe values (in ftrict conformity to the obfervations) for any other rates of intereft.

ACCOUNT of a method of deducing, from the correct values (according to any obfervations) of any fingle or joint lives at one rate of intereft, the fame values at other rates of intereft.

PRELIMINARY PROBLEMS.

PROB. I. The expectation given of a fingle life by any table of obfervations, to find its value, fuppofing the decrements of life equal, at any given rate of intereft.

Solution. Find the value of an annuity certain for a number of years equal to twice the expectation. Multiply this value by the perpetuity increafed by unity, and divide the product by twice the expectation: The quotient fubtracted from the perpetuity will be the value required.

Example. The expectation of a male life aged 10, by the Sweden obfervations, is 43.94. Twice this expectation is 87.88. The value of an annuity certain for 87.88 years is (reckoning intereft at 4 *per cent.*) 24.200. The product of 24.200 into 26 (the perpetuity increafed by unity) is 629.2, which, divided by 87.88, gives 7.159. And this quotient fubtracted from 25 (the perpetuity) gives 17.84 years purchafe, the value of a life aged ten, deduced from the expectation of life at that age, according to the Sweden obfervations. (See the Tables in Dr Price on Reverfions, vol ii.).

PROB. II. Having the expectations given of any two lives by any table of obfervations, to deduce from thence the value of the joint lives at any rate of intereft, fuppofing an equal decrement of life.

Solution. Find the difference between twice the expectation

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tation of the youngeſt life and twice the expectation of the oldeſt life increaſed by unity and twice the perpetuity. Multiply this difference by the value of an annuity certain for a time equal to twice the expectation of the oldeſt life; and by twice the ſame expectation divide the product, reſerving the quotient.

From twice the perpetuity ſubtract the reſerved quotient, and multiply the remainder by the perpetuity increaſed by unity. This laſt product divided by twice the expectation of the youngeſt life, and then ſubtracted from the perpetuity, will be the required value.

When twice the expectation of the youngeſt life is greater than twice the expectation of the oldeſt life increaſed by unity and twice the perpetuity, the reſerved quotient, inſtead of being ſubtracted from twice the perpetuity, muſt be added to it, and the ſum, not the difference, multiplied by the perpetuity increaſed by unity.

Example. Let the joint lives propoſed be a female life aged 10, and a male life aged 15; and let the table of obſervations be the Sweden table for lives in general, and the rate of intereſt 4 *per cent.* Twice the expectations of the two lives are 90.14 and 83.28.

Twice the expectation of the oldeſt life, increaſed by unity, and twice the perpetuity, is 134.28, which leſſens by 90.14 (twice the expectation of the youngeſt life), leaves 44.14 for the reſerved remainder. This remainder multiplied by 24.045 (the value of an annuity certain for 83.28 years), and the product divided by 83.28 (twice the expectation of the oldeſt life), gives 12.744, the quotient to be reſerved; which ſubtracted from double the perpetuity, and the remainder (or 37.255) multiplied by the perpetuity increaſed by unity (or by 26) gives 968.630, which divided by 90.14 (twice the expectation of the youngeſt life) and the quotient ſubtracted from the perpetuity, we have 14.254 for the required value.

The value of an annuity certain, when the number of years is a whole number with a fraction added (as will be commonly the caſe) may be beſt computed in the following manner. In this example the number of years is 83.28. The value of an annuity certain for 83 years is 24.035. The ſame value for 84 years is 24.072. The difference between theſe two values is 0.37; which difference multiplied by .28 (the fractional part of the number of years), and the product (.0103) added to the leaſt of the two values, will give 24.045 the value for 83.28 years.

General Rule. Call the correct value (ſuppoſed to be computed for any rate of intereſt) the firſt value. Call the value deduced (by the preceding problems) from the expectations at the ſame rate of intereſt, the ſecond value. Call the value deduced from the expectations for any other rate of intereſt the third value.

Then the difference between the firſt and ſecond values added to or ſubtracted from the third value, juſt as the firſt is greater or leſs than the ſecond, will be the value at the rate of intereſt for which the third value has been deduced from the expectations.

The following examples will make this perfectly plain.

Example I. In the two laſt tables the correct values are given of two joint lives among mankind at large, without diſtinguiſhing between males and females, according to the Sweden obſervations, reckoning intereſt at 4 *per cent.* Let it be required to find from theſe values the values at 3 *per cent.* and let the ages of the joint lives be ſuppoſed 10 and 10.

The correct value by Table IV. (reckoning intereſt at 4 *per cent.*) is 16.141. The expectation of a life aged 10 is 45.07. The value deduced from this expectation at 4 *per cent.* by Prob. II. is 14.539. The value deduced by the ſame problem from the ſame expectation at 3 *per cent.* is 16.808. The difference between the firſt and ſecond values is 1.602, which, added to the third value (the firſt being greater than the ſecond), makes 18.410, the value required.

Example II. Let the value be required of a ſingle male life aged 10, at 3 *per cent.* intereſt, from the correct value at 4 *per cent.* according to the Sweden obſervations.

Firſt, or correct value at 4 *per cent.* (by Table III.) is 18.674. The expectation of a male life aged 10 is 43.94.

The ſecond value (or the value deduced from this expectation by Prob. I.) is 17.838.

The third value (or the value deduced from the ſame expectation at 3 *per cent.*) is 21.277.

The difference between the firſt and ſecond is .836; which (ſince the firſt is greater than the ſecond) muſt be added to the third; and the ſum (that is, 22.113) will be the value required.

The third value at 5 *per cent.* is 15.286; and the difference added to 15.286 makes 16.122 the value of a male life aged 10 at 5 *per cent.* according to the Sweden obſervations. The exact value at 5 *per cent.* is (by Table III.) 16.014.

Again: The difference between 16.014 (the correct value at 5 *per cent.*), and 15.286 (the value at the ſame intereſt deduced from the expectation), is .728; which, added (becauſe the firſt value is greater than the ſecond) to 13.335 (the value deduced at 6 *per cent.* from the expectation) gives 14.063, the value of the ſame life, reckoning intereſt at 6 *per cent.*

Theſe deductions, in the caſe of ſingle lives particularly, are ſo eaſy, and give the true values ſo nearly, that it will be ſcarcely ever neceſſary to calculate the exact values (according to any given obſervations) for more than one rate of intereſt.

If, for inſtance, the correct values are computed at 4 *per cent.* according to any obſervations, the values at 3, $3\frac{1}{2}$, $4\frac{1}{2}$, 5, 6, 7, or 8 *per cent.* may be deduced from them by the preceding rules as occaſion may require, without much labour or any danger of conſiderable errors. The values thus deduced will ſeldom differ from the true values ſo much as a tenth of a year's purchaſe. They will not generally differ more than a 20th or 30th of a year's purchaſe. In joint lives they will differ leſs than in ſingle lives, and they will come equally near to one another whatever the rates of intereſt are.

The preceding tables furniſh the means of determining the exact differences between the values of annuities, as they are made to depend on the ſurvivorſhip of any male or female lives; which hitherto has been a *deſideratum* of conſiderable conſequence in the doctrine of life-annuities. What has made this of conſequence is chiefly the multitude of ſocieties lately eſtabliſhed in this and foreign countries for providing annuities for widows. The general rule for calculating from theſe tables the value of ſuch annuities is the following.

Rule. "Find in Table III. the value of a female life at the age of the wife. From this value ſubtract the value in Table IV. of the joint continuance of two lives at the ages of the huſband and wife. The remainder will be the value in a ſingle preſent payment of an annuity for the life of the wife, ſhould ſhe be left a widow. And this laſt value divided by the value of the joint lives increaſed by unity, will be the value of the ſame annuity in annual payments during the joint lives, and to commence immediately."

Example. Let the age of the wife be 24, and of the huſband 30. The value in Table III. (reckoning intereſt at 4 *per cent.*) of a female life aged 24, is 17.252. The value in Table IV. of two joint lives aged 24 and 30, is 13.455, which ſubtracted from 17.252 leaves 3.797, the value

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value in a ſingle preſent payment of an annuity of L. 1 for the life of the wife after the huſband; that is, for the life of the widow. The annuity, therefore, being ſuppoſed L. 20, its value in a ſingle payment is 20 multiplied by 3.797, that is, L. 75.94. And this laſt value divided by 14.655 (that is, by the value of the joint lives increaſed by unity), gives 5.18, the value in annual payments beginning immediately, and to be continued during the joint lives of an annuity of L. 20 to a wife aged 24 for her life, after her huſband aged 30.

SURYA, the orb of the ſun perſonified and adored by a ſect of Hindoos as a god. He ſeems to be the ſame divinity with the Phœbus of Greece and Rome; and the ſect who pay him particular adoration are called *Sauras*. Their poets and painters deſcribe his car as drawn by ſeven green horſes, preceded by Arun, or the *Dawn*, who acts as his charioteer, and followed by thouſands of genii worſhipping him and modulating his praiſes. He has a multitude of names, and among them twelve epithets or titles, which denote his diſtinct powers in each of the twelve months; and he is believed to have deſcended frequently from his car in a human ſhape, and to have left a race on earth, who are equally renowned in the Indian ſtories with the Heliadai of Greece: it is very ſingular, that his two ſons called *Aſwinau* or *Aſwinicumarau*, in the dual, ſhould be conſidered as twin-brothers, and painted like Caſtor and Pollux; but they have each the character of Æſculapius among the gods, and are believed to have been born of a nymph, who, in the form of a mare, was impregnated with ſun beams.

SUS, the HOG, in zoology, a genus of quadrupeds belonging to the claſs of *mammalia* and order of *belluæ*. There are four cutting teeth in the upper jaw, whoſe points converge; and, for the moſt part, ſix in the lower jaw, which ſtand forwards: There are two tuſks in each jaw, thoſe in the upper jaw being ſhort, while thoſe of the under jaw are long, and extend out of the mouth. The ſnout is prominent, moveable, and has the appearance of having been cut off, or truncated. The feet are armed with divided or cloven hoofs. There are ſix ſpecies; the ſcrofa, æthiopicus, tajaſſu, babyruſſa, porcus, and africanus. The moſt remarkable are,

1. The *ſcrofa*, or common hog, having the body covered with briſtles; two large teeth above and below. In a wild ſtate, of a dark brinded colour, and beneath the briſtles is a ſoft ſhort hair; the ears ſhort, and a little rounded. TAME: the ears long, ſharp-pointed, and ſlouching; the colour generally white, ſometimes mixed with other colours. In a tame ſtate it is univerſal; except in the frigid zones, and in Kamtſchatka, where the cold is very ſevere. Since its introduction into America by the Europeans, it abounds to exceſs in the hot and temperate parts. It is found wild in moſt parts of Europe. In the foreſts of South America there are vaſt droves, which derive their origin from the European kind relapſed into a ſtate of nature; and are what Mr Bancroft, in his Hiſtory of Guiana, deſcribes as a particular ſpecies by the name of *Warree*. They cannot bear exceſſive cold; inhabit wooded countries; and are very ſwift. In America they are uſeful by clearing the country of rattle-ſnakes, which they devour without danger.

Of all quadrupeds, the hog is the moſt rude and brutal. The imperfections of his form ſeem to have an influence on his nature and diſpoſitions. All his habits are groſs; all his appetites are impure; all his ſenſations are confined to a furious luſt, and a brutal gluttony. He devours indiſcriminately every thing that comes in his way, even his own progeny the moment after their birth. This voraciouſneſs ſeems to proceed from the perpetual cravings of his ſtomach, which is of an immoderate ſize; and the groſſneſs of his appetites, it is probable, ariſes from the bluntneſs of his ſenſes of taſte and of feeling. The rudeneſs of the hair, the hardneſs of the ſkin, and the thickneſs of the fat, render theſe animals leſs ſenſible to blows. Mice have been known to lodge upon a hog's back, and to eat his ſkin and fat, without his ſhewing any marks of ſenſibility. The other ſenſes of the hog are very good. It is well known to the hunters that the wild boar hears and ſmells at a great diſtance; for, in order to ſurpriſe him, they are obliged to watch him in ſilence during the night, and to place themſelves oppoſite to the wind, that he may not perceive the ſmell, which never fails to make him turn back.

But the hog, though the moſt impure and filthy of all quadrupeds, is yet uſeful by the very ſordidneſs of its manners; thus alone devouring what is the refuſe of all others, and contributing not only to remove what would be a nuiſance to the human race, but alſo converting the moſt nauſeous offals into the richeſt nutriment: for this reaſon its ſtomach is capacious, and its gluttony exceſſive: not that its palate is inſenſible to the difference of eatables: for where it finds variety, it will reject the worſt with as diſtinguiſhing a taſte as other quadrupeds.

The parts of this animal are finely adapted to its way of life. As its method of feeding is by turning up the earth with its noſe for roots of different kinds, ſo nature has given it a more prone form than other animals; a ſtrong brawny neck; eyes ſmall, and placed high in the head; a long ſnout, noſe callous and tough, and a quick ſenſe of ſmelling to trace out its food. Its inteſtines have a ſtrong reſemblance to thoſe of the human ſpecies. The external form of its body is very unwieldly; yet, by the ſtrength of its tendons, the wild boar (which is only a variety of the common kind) is enabled to fly from the hunters with amazing agility: the back-toe on the feet of this animal prevents its ſlipping while it deſcends declivities, and muſt be of ſingular uſe when purſued. Yet, notwithſtanding its powers of motion, it is by nature ſtupid, inactive, and drowſy; much inclined to increaſe in fat, which is diſpoſed in a different manner from that of other animals, and forms a regular coat over the whole body. It is reſtleſs at a change of weather, and in certain high winds is ſo agitated as to run violently, ſcreaming horribly at the ſame time: it is fond of wallowing in the dirt, either to cool its ſurfeited body, or to deſtroy the lice, ticks, and other inſects with which it is infeſted. Its diſeaſes generally ariſe from foul feeding and intemperance; meaſles, impoſthumes, and ſcrophulous complaints, are reckoned among them. Theſe are beſt prevented by keeping the animals, as the ancients ſtrongly recommended, very clean in their ſties; allowing them air, exerciſe, and a ſufficiency of water. Linnæus obſerves, that its fleſh is wholeſome food for athletic conſtitutions, or thoſe that uſe much exerciſe; but bad for ſuch as lead a ſedentary life: it is, however, of moſt univerſal uſe; and furniſhes numberleſs materials for epicuriſm.

The boar, or male of theſe creatures, is choſen with great care, when intended for the propagation of his ſpecies; and is thus employed from the age of two to five years, and then either ſold or fatted. The males not allotted to this uſe are caſtrated, ſometimes at the age of ſix weeks, and ſometimes when they are ſix months old; and then fed to a great ſize either for ſale or for the uſe of the family. Sows are kept for breed generally from one year old to ſeven, and are then ſpayed and fatted. They have commonly more greaſe on their inteſtines than hogs, theſe being fatteſt on their backs.

As to the age of theſe animals, it is ſaid that the life of the wild boar may be extended to twenty-five or thirty years.

Sus.

Ariftotle fays, that hogs in general live twenty years; and adds, that both males and females are fertile till they arrive at the age of fifteen. They can engender at the age of nine or twelve months; but it is better to reftrain them till they be eighteen months or two years. The firft litter of the fow is not numerous; and, when only one year old, her pigs are weak, and even imperfect. She may be faid to be in feafon at all times. Though full, fhe folicits the approach of the male. This may be regarded as an excefs among animals; for almoft every other fpecies refufe the male after conception. The ardour of the fow, though almoft perpetual, is however marked by paroxyfms and immoderate movements, which always terminate by her wallowing in the mire. She, at the fame time, emits a thick whitifh fluid. She goes four months with young; brings forth in the beginning of the fifth; and foon afterwards folicits the male, is impregnated a fecond time, and of courfe brings forth twice a-year. The wild fow, which every way refembles the domeftic kind, produces only once a-year. This difference in fertility is probably owing to want of nourifhment, and the neceffity of fuckling her pigs much longer than the domeftic fow, which is never allowed to nurfe her young above fifteen days or three weeks. Only eight or nine of the litter are kept longer; the reft are fold. In fifteen days, pigs are excellent food.

As thefe creatures, though exceedingly voracious, will feed almoft on any thing, they are bred and kept everywhere, and are quickly and cheaply fatted. In miry and in marfhy grounds (from which they are not averfe) they devour worms, frogs, fern, rufh, and fedge roots. In drier and in woody countries, they feed on hips, haws, floes, crabs, maft, chefnuts, acorns, &c. and on this food they will grow flefhy and fat. They are a kind of natural fcavengers, will thrive on the trafh of an orchard, the outcafts of the kitchen, the fweepings of barns and granaries, the offals of a market, and moft richly on the refufe of a dairy. If near the fea, they will fearch the fhores for fhell fifh; in the fields, they eat grafs; and in cities and large towns they are kept in great numbers, and fupported chiefly by grains. It is evident that the facility of feeding them everywhere at a fmall expence, is a national benefit, more efpecially in a country where the people are accuftomed to eat flefh daily, and could not perhaps perform their daily labour if they did not. It is no lefs obfervable, that notwithftanding this facility of feeding, and the multitudes of fwine maintained, they feldom fail of coming to a good market. In no part of Europe is the management of thefe creatures better underftood than in Britain. The time of farrowing is adjufted to the nature of the farm, the food it can fupply; and the number of pigs fold and kept are in like manner adjufted. New kinds of food, more wholefome and nutritive than what were ufed formerly, have been introduced, fuch as turnips, carrots, clover, &c. They are in moft places regularly managed and clofely attended. Tuffer, many years fince, affirmed from his own experience, that a fow might bring as much profit as a cow. In fome counties, it is faid, a fow dependent on a dairy hath produced, all expences deducted, about 10l. in the fpace of a year. It may be fome fatisfaction to the reader to know, that, on a nice calculation, the annual profits of a fow in France are found to be between 50 and 60 livres.—In Britain, thefe animals in different counties are of very different fizes. In Leicefterfhire, Northamptonfhire, and Pembrokefhire, they are very large. In Hampfhire, Wiltfhire, and wherever they can run in the woods, and feed on maft and acorns, their flefh is firmer and better. The Chinefe fwine are common with us: they are fmaller, blacker, and their legs fhorter than ours: fo that, when fat, their bellies literally touch the ground. They thrive exceedingly well with us, are very prolific, and their flefh very fine and well tafted.

In confidering the advantages derived from thefe creatures, it is to be obferved, that the flefh of all their different kinds, and at all ages, is looked upon as a very fubftantial and agreeable aliment; and of courfe, in their proper feafons, the different forts of provifions thus fupplied are all of them very faleable. The wild boar was efteemed a prime delicacy amongft the Romans, and the flefh of the tame was much more in favour with our anceftors than with us; though BRAWN has ftill many admirers, is made in the greateft perfection, and confidered as a rarity peculiar to this country. Pork, though it might be wifely prohibited in fome warm countries, is found by experience equally nutritive and falutary here. As fuch it furnifhes a very large proportion of that food which is vended in our markets. It takes falt better, and keeps longer, than the flefh of any other animal; and the confumption of it is prodigious when pickled or falted, more efpecially in our foreign garrifons and in the fea fervice. Our bacon is differently cured, fo as to render it acceptable to all palates; and our hams are not at all inferior to thofe of other countries. Frefh pork fells nearly as dear as beef; the lard brings double or triple the price; the blood, the inteftines, the feet, and the tongue, are all prepared as food. The fat of the inteftines and web, which differs from common lard, is employed for greafing axles of wheels, and for many other purpofes. Sieves are made of the fkin; and brufhes, pencils, &c. of the briftles. The dung is reputed next in value to that of fheep. Mr Worlidge * propofes that fwine fhould be turned into a clofe well-paled, and planted with greens, pulfe, and roots, on which they may feed, and by their trampling and their dung raife a great quantity of excellent foil. Mr Mortimer † affures us that fome, on poor light fhallow land in Staffordfhire, fow a fmall white pea, which they never reap, but turn in fo many hogs to eat them as they think they will fat; and there they lie day and night, and their dung will fo enrich the land, that it will bring a good fward upon it, and will graze many years afterwards. Our old hufbandmen had an ill opinion of this dung, as fuppofing it bred weeds, but it will probably not obtain much credit at prefent. In fome places they wafh with hogs dung for want of foap: which anfwers tolerably well, if the linen hangs long enough in the air to become thoroughly fweet.

* Syst. Husb. p. 171.

† Art. Husb. vol. i. p. 115.

The wild boar was formerly a native of our country, as appears from the laws of Hoel dda, who permitted his grand huntfman to chace that animal from the middle of November to the beginning of December. William the Conqueror punifhed with the lofs of their eyes any that were convicted of killing the wild boar, the ftag, or the roebuck; and Fitz-Stephen tells us, that the vaft foreft that in his time grew on the north fide of London, was the retreat of ftags, fallow-deer, wild boars, and bulls. Charles I. turned out wild boars in the New Foreft, Hampfhire; but they were deftroyed in the civil wars.

On the continent the wild boar is hunted with dogs, or killed by furprife during the night, when the moon fhines. As he runs flowly, leaves a ftrong odour behind him, and defends himfelf againft the dogs, and often wounds them dangeroufly, fine hunting dogs are unneceffary, and would have their nofe fpoiled, and acquire a habit of moving flowly by hunting him. Maftiffs, with very little training, are fufficient. The oldeft, which are known by the tract of their feet, fhould only be attacked: A young boar of three years old is difficult to hunt down; becaufe he runs very far without ftopping. But the older boars do not run far, allow

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the dogs to run near, and often ftop to repel them. During the day, he commonly remains in his foil, which is in the moft fequeftrated part of the woods. He comes out in the night in queft of food. In fummer, when the grain is ripe, it is eafy to furprife him among the cultivated fields, which he frequents every night. As foon as he is flain, the hunters cut off his tefticles, the odour of which is fo ftrong, that in a few hours it would infect the whole flefh. The fnout of an old boar is the only part that is efteemed; but every part of the caftrated and young boar, not exceeding one year fed, makes delicate eating. The pork of the domeftic boar is ftill worfe than that of the wild boar; and it can only be rendered fit for eating by caftration and fattening. The ancients caftrated the young boars which they could carry off from their mothers, and returned them to the woods, where they grew fat, and their pork was much better than that of domeftic hogs. There are feveral varieties of the common hog.

2. The *ethiopicus*, or Ethiopian hog, with fmall tufks in the lower jaw, very large ones in the upper, in old boars bending towards the forehead in form of a femicircle: no fore teeth: nofe broad, depreffed, and almoft of a horny hardnefs: head very large and broad: beneath each eye a hollow, formed of loofe fkin, very foft and wrinkled; under thefe a great lobe or wattle, lying almoft horizontal, broad, flat, and rounded at the end, placed fo as to intercept the view of any thing below from the animal. Between thefe and the mouth on each fide, there is a hard callous protuberance. The mouth is fmall: fkin dufky: briftles difpofed in fafciculi, of about five each; longeft between the ears and on the beginning of the back, thinly difperfed on the reft of the back. Ears large and fharp pointed, infide lined with long whitifh hairs: tail flender and flat, not reaching lower than the thighs, and is covered with hairs difpofed in fafciculi. Body longer, and legs fhorter, than in the common fwine: its whole length 4 feet 0 inches; height before, 2 feet 2 inches: but in a wild ftate, it grows to an enormous fize.—Thefe animals inhabit the hotteft parts of Africa, from Senegal to Congo, alfo the ifland of Madagafcar. We know little of their nature; but they are reprefented as very fierce and fwift, and that they will not breed with the domeftic fow.

3. The *tajaffu*, pecary, or Mexican hog, with four cutting teeth above, and fix below: two tufks in each jaw; thofe in the upper jaw pointing down, and little apparent when the mouth is fhut; the others hid: length from nofe to the end of the rump about three feet: head not fo taper as in common fwine: ears fhort and erect: body covered with briftles, ftronger than thofe of the European kind, and more like thofe of a hedge-hog; they are dufky, furrounded with rings of white; thofe on the top of the neck and back are near five inches long, grow fhorter on the fides: the belly almoft naked; from the fhoulders to the breaft is a band of white: no tail: on the lower part of the back is a gland, open at the top, difcharging a fetid ichorous liquor; this has been by miftake called a *navel*.—Inhabits the hotteft parts of South America, and fome of the Antilles: lives in the forefts on the mountains: not fond of mire or marfhy places: lefs fat than the common hog. Thefe animals go in great droves. They are very fierce, and will fight ftoutly with the beafts of prey: the jaguar, or American leopard, is their mortal enemy; often the body of that animal is found with feveral of thefe hogs flain in combat. Dogs will fcarce attack this animal: if wounded, it will turn on the hunters. They feed on fruits and roots; alfo on toads and all manner of ferpents, which they hold with their fore-feet, and fkin with great dexterity. The flefh is reckoned very good food; but all writers agree that the dorfal gland muft be cut out as foon as the animal is killed, or the flefh will become fo infected as not to be eatable. The Indian name of this fpecies is *paquiras*, from whence feems to be derived that of *pecary*. There are more varieties of this fpecies, the *tajaffu minor* and the *patera*.

4. The *babyruffa*, or Indian hog, with four cutting teeth in the upper, fix in the lower jaw; ten grinders to each jaw; in the lower jaw two tufks pointing towards the eyes, and ftanding near eight inches out of their fockets; from two fockets on the outfide of the upper jaw two other teeth, twelve inches long, bending like horns, their ends almoft touching the forehead: ears fmall, erect, fharp-pointed: along the back are fome weak briftles; on the reft of the body only a fort of wool, fuch as is on the lambs: the tail long, ends in a tuft, and is often twifted: the body plump and fquare. Inhabits Buero, a fmall ifle near Amboina: it is alfo found in Celebes, but neither on the continent of Afia or Africa; what M. de Buffon takes for it is the Ethiopian boar. They are fometimes kept tame in the Indian ifles: live in herds: have a very quick fcent: feed on herbs and leaves of trees; never ravage gardens like other fwine: their flefh well tafted. When purfued and driven to extremities, they rufh into the fea, fwim very well, and even dive, and pafs thus from ifle to ifle. In the forefts they often reft their heads, by hooking their upper tufks on fome bough. The tufks, from their form, are ufelefs in fight.

SUSA, the ancient royal refidence of the kings of Perfia, built by Darius Hyftafpis, according to Pliny; though he probably only reftored it, being a very ancient city, founded by Tithonus father of Memnon. It was in compafs 120 ftadia, of an oblong quadrangular form, with a citadel called *Memnoneum*. In fcripture it is called *Sufan*, the royal citadel, from the great number of lilies growing in that diftrict (Athenæus); fituate on the river Ulai, or Eulæus (Daniel): and the Spaniards call at this day a lily *afufena* (Pinedo). Sufa was the winter, as Ecbatana was the fummer, refidence of the kings of Perfia, (Xenophon, Strabo, Plutarch). Here the kings kept their treafure, (Herodotus.) Now called *Tufter*.

SUSPENSION, in Scots law. See LAW, n° clxxxv. 5, 6, and 7.

SUSSEX, a county of England, deriving its name from its fituation in refpect of the other Saxons, and called *Suffex*, *i. e.* the country of the South Saxons, has Hampfhire on the weft, the Britifh channel on the fouth, Surry on the north, and Kent on the eaft. Its length is 65 miles, its breadth 30, and its circumference 170. It is divided into 6 rapes, and thefe into 65 hundreds, in which are 342 parifhes, of which 123 are vicarages, one city, 16 market-towns, 1,140,000 acres, and about 120,000 fouls. It has few good ports, though it lies along the channel for 65 miles, which is its greateft length, the coaft being encumbered in many places with rocks; and where it is more open, fuch quantities of fand are thrown upon it by the fouth-weft winds, and the harbours fo choaked up, that they will not admit veffels of any great draught or burden. The county is well watered by the rivers Arun, Adar, Oufe, Rother, Lavant, Cuckmeer, Afhburn, and Aften, by which it is well fupplied with fifh, as well as from the fea. Hence different places of the county are famed for different forts of fifh, as the Arun for mullets, which enter it from the fea in fummer in fhoals, and by feeding upon a particular kind of herb become extremely delicious: Chichefter for lobfters, Selfey for cockles, Amberley for trout, Pulborough for eels, Rye for herrings, and the county in ge-

Suffex, Sutherland

general for carp. It is remarkable, that all the rivers above-mentioned rise and fall into the sea within the county.

The air, as well as the soil, is various in different parts of the county. Upon the coast the air is aguish, upon the hills and downs pleasant and wholesome; but somewhat moist and foggy in the valleys, the soil being deep and rich, and the vegetation in summer very vigorous. The downs in some places are very fertile in corn and grass; in others they feed great flocks of sheep, whose flesh and wool are very fine; but of the latter no inconsiderable quantity is clandestinely exported to France. In the Weald and the valleys the roads are very deep, especially in winter. In the north quarter are many woods, and some forests in other places; whence the king's yards are supplied with the largest and best timber in England, besides what is made into charcoal and consumed in the iron-works; for on the east side is plenty of iron ore, with furnaces, forges, and mills for manufacturing it. The gunpowder of this county is said to excel that of any other. Those delicious birds called *wheatears* are bred in this shire; they are no bigger than a lark, but almost an entire lump of fat. That part now called the *Wild* or *Weald* of Sussex, was anciently a mere desert for hogs and deer, of great extent, taking in a part of Kent and Surry; and was called *Anderida Silva*, *Coed Andred*, and *Andradswald*, from Anderida an adjoining city. This county is in the home circuit and diocese of Chichester, giving title of earl to the family of Yelverton, and sends 28 members to parliament, viz, two for the county, two for the city of Chichester, and two for each of the following towns, Horsham, Lewes, Bramber, East-Grinstead, Midhurst, Shoreham, Staining, Arundel, Hastings, Rye, Winchelsea, and Seaford; of which the four last are cinque-ports.

SUTHERLAND, one of the most northerly counties of Scotland. Including Strathnavern, it borders on Caithness to the north and north-east, is bounded by the ocean on the north, the country of Assynt on the west, Ross on the south, and by the German sea on the east and south east. It stretches about 70 miles in length, and 40 in breadth; is generally hilly, tho' in many parts arable; well watered with small rivers and streams replete with fish, and exhibiting about 60 lakes, the habitation of various fish, swans, ducks, geese, &c. One of the largest of these is Lochshin, extending 18 miles in length. Some of them are interspersed with small verdant islands, which in summer yield a very agreeable prospect. On the coast are many commodious harbours, and all the bays swarm with fish; nay, the sea in this place produces some valuable pearls. Sutherland affords iron-stone, free-stone, lime-stone, and slate, in abundance. Here are also quarries of marble, and mines of coal, though the people use turf and peat for fuel. Lead ore, impregnated with silver, and even some gold, hath been found in this province, together with crystals and pebbles.

The air is so temperate, and the soil so good, that saffron has here been brought to perfection. Many parts of the country are remarkably fruitful in corn, and the pasturage is excellent everywhere. Besides three great forests, there are many smaller woods in Sutherland, abounding with deer and other game. On the hills are fed numerous flocks of sheep and black cattle; small, yet sweet and juicy. There is one bird peculiar to this shire, called *knag*, which resembles a parrot, and digs its nest with its beak in the trunks of oaks. The northern part, called *Strathnavern*, and separated from the rest by a ridge of mountains, is bounded on the north by the Deucaledonian sea, on the west by the channel called the *Minch*, on the east by Caithness, and on the south by Assynt. The length of it, from east to west, amounts to 34 miles; but the breadth from north to south does not exceed 12 in some places. It is very hilly; and the mountains are so high, that the snow remains on the tops of them till midsummer. It is watered by Navern, from whence it derives its name: as this district gives a title to the eldest son of the earl of Sutherland. Here are several woods, frequented by deer and other game, which the people take great delight in hunting. Iron-mines have been worked in some places, but to no great advantage. Strathnavern has many fresh water lakes or lochs; the chief of which are Loch Navern and Loch Lyel: there are several islands on the northern coast; and in various parts of the country we see monuments of victories obtained over the Danes or other foreign invaders. Sutherland boasts of some towns, and a great many villages. The people are numerous, hardy, bold, and enterprising; courteous to strangers; cheerful, open, frugal, and industrious. They, as well as their neighbours of Caithness, speak the language, and wear the garb, used in the Lowlands of Scotland. They carry on a considerable salmon-fishery. They drive a traffic with their black cattle, sheep, and horses, at the neighbouring fairs; but export their corn, barley, salt, coal, salmon, salted beef, butter, cheese, wool-skins, hides, and tallow. Here are provisions of all sorts in plenty; and so cheap through all this country, that a gentleman may keep house and live much more sumptuously for 200 l. a year than he can live for three times the money in the south of England.

SUTLER, in war, one who follows the army, and furnishes the troops with provision. Sutlers pitch their tents, or build their huts, in the rear of each regiment, and about head-quarters.

SUTRIUM (anc. geog.), a famous city, and an ancient colony of the Romans, the key of Etruria; founded about seven years after the taking of Rome by the Gauls (Velleius). Now *Sutri* in St Peter's patrimony, on the river Pozzolo; surrounded on every side with rocks, 24 miles to the north west of Rome.

SUTTON (Samuel), was born at Alfretton in Derbyshire, and going into the army served under the duke of Marlborough in Queen Anne's wars with great credit. He afterwards came to London, commenced brewer, and kept a coffee-house in Aldersgate street, which was well frequented by the learned men of that time, by whom Mr Sutton was much respected, as a man of strong natural parts and uncultivated genius. About the year 1740 he schemed a very simple and natural method for extracting the foul air from the wells of ships, by pipes communicating with the fire-places of the coppers; which operated as long as any fire was kept burning for the ship's use. He took out a patent in 1744, to secure the profits of his invention; and died about the year 1752.

Sutton's Air-pipes. See *Air-Pipes*.

SUTURE, in anatomy, a kind of articulation peculiar to the cranium or skull. See ANATOMY, Part I. Sect. ii. *passim*.

SUTURE, in surgery, a method of uniting the lips of wounds together. See SURGERY.

SWABBER, an inferior officer on board ships of war, whose employment it is to see that the decks are kept clean and neat.

SWABIA. See SUABIA.

SWALLOW, in natural history, is classed under the genus of HIRUNDO, under which article the different species have been already described. Concerning this bird, one curious question, however, still remains to be discussed, What becomes of it in the winter? Upon this subject there are three opinions. Some say that it migrates to a warmer climate; wir[...]

Su[...] Swa[...] Question, Wh[...] be[...] con[...] of [...] low n

Swallow.

mate; ſome, that it retires to hollow trees and caverns, where it lies in a torpid ſtate; and others have affirmed, that it lies in the ſame ſtate in the bottom of lakes and under the ice. The firſt opinion is ſupported by Marſigli, Ray, Willoughby, Cateſby, Reaumur, Adanſon, Buffon, &c. The firſt and ſecond opinion are both adopted by Pennant and White. The third is ſanctioned by Schæffer, Hevelius, Derham, Klein, Ellis, Linnæus, Kalm: and the ſecond and third have been ſtrongly defended by the honourable Daines Barrington.

Though we cannot help giving a preference to that opinion which appears the moſt probable, yet we do not think that any one of them is eſtabliſhed upon ſuch evidence as ſo curious a ſubject requires, and as the advanced ſtate of natural hiſtory would lead us to expect. We ſhall therefore ſtate the arguments upon which each opinion is founded as fairly and diſtinctly as we can, and as often as poſſible in the very words of their reſpective advocates. By doing ſo, we ſhall place the whole ſubject before the eyes of our readers, who will thus have an opportunity of examining it attentively, and of making ſuch obſervations and experiments as may lead to the truth.

Thoſe who aſſert that the ſwallow migrates to a warmer country in winter, argue in this manner: That many birds migrate, is a fact fully proved by the obſervations of natural hiſtorians (ſee MIGRATION). Is it not more probable, therefore, that ſwallows, which diſappear regularly every ſeaſon, retire to ſome other country, than that they lie in a ſtate of torpor in caverns or lakes? But this opinion does not reſt on probability, it is founded on facts.

We often ſee them collected in great flocks on churches, rocks, and trees, about the time when they annually diſappear. The direction of their flight has been obſerved to be ſouthward. Mr White, the ingenious hiſtorian of Selborne, travelling near the coaſt of the Britiſh Channel one morning early, ſaw a flock of ſwallows take their departure. At the beginning of his journey he was environed with a thick fog; but on a large wild heath the miſt began to break, and diſcovered to him numberleſs ſwallows, cluſtered on the ſtanding buſhes, as if they had rooſted there: as ſoon as the ſun burſt out, they were inſtantly on wing, and with an eaſy and placid flight proceeded towards the ſea. After this he ſaw no more flocks, only now and then a ſtraggler.

Mr Laſkey of Exeter obſerved attentively the direction which a flock of ſwallows took in the autumn of 1793. On the 22d of Sept. about ſeven o'clock in the morning, the wind being eaſterly, accompanied with a cold drizzling rain, Mr Laſkey's houſe was entirely covered with houſe-ſwallows. At intervals large flocks arrived and joined the main body, and at their arrival an unuſual chirping commenced. The appearance of the whole company was ſo lethargic, that he found it an eaſy matter to catch a conſiderable number of them, which he kept in a room all that day. By heating the room they all revived: he opened four of them, and found their ſtomachs quite full. The main body occupied the houſe top all day, except for two hours. About half an hour after nine on the morning of the 23d, there was a great commotion, with very loud chirping, and within a few minutes after, the whole multitude took their flight, in a direct ſouth-eaſt direction, having aſcended to a great height in the atmoſphere. He let go the birds which he had caught, at certain intervals till four o'clock, and they all flew toward the ſame quarter.

Not only has the direction of their flight been obſerved, but they have alſo been found on their paſſage at a great diſtance from land. Mr Adanſon informs us, that about 50 leagues from the coaſt of Senegal four ſwallows ſettled upon the ſhip on the 6th of October; that theſe birds were taken; and that he knew them to be European ſwallows, which, he conjectures, were returning to the coaſt of Africa. Sir Charles Wager's authority may alſo be appealed to: "Returning home (ſays he) in the ſpring of the year, as I came into ſoundings in our channel, a great flock of ſwallows came and ſettled on all my rigging; every rope was covered, they hung on one another like a ſwarm of bees; the decks and carving were filled with them. They ſeemed almoſt famiſhed and ſpent, and were only feathers and bones; but, being recruited with a night's reſt, took their flight in the morning." This vaſt fatigue proves that their journey muſt have been very great, conſidering the amazing ſwiftneſs of theſe birds: in all probability they had croſſed the Atlantic ocean, and were returning from the ſhores of Senegal, or other parts of Africa; ſo that this account from that moſt able and honeſt ſeaman, confirms the later information of Mr Adanſon.

Phil. Tranſactions, vol. ii.

Mr Kalm, who is an advocate for the opinion that ſwallows lie immerſed in lakes during the winter, acknowledges, that in croſſing the Atlantic from Europe a ſwallow lighted on the ſhip on the 2d September, when it had paſſed only two thirds of the ocean. Since, therefore, ſwallows have been ſeen aſſembled in great flocks in autumn flying off in company towards ſouthern climes, ſince they have been found both in their paſſage from Europe and returning again, can there be any doubt of their annual migration? —For Mr Barrington's objections to this opinion, ſee MIGRATION, p. 5.

Kalm's Voyage, vol. i. p. 24.

3
Second opinion, that ſome lie in caverns in a torpid ſtate.

The ſecond notion (ſays Mr Pennant) has great antiquity on its ſide. Ariſtotle and Pliny give it as their belief, that ſwallows do not remove very far from their ſummer habitation, but winter in the hollows of rocks, and during that time loſe their feathers. The former part of their opinion has been adopted by ſeveral ingenious men; and of late ſeveral proofs have been brought of ſome ſpecies, at leaſt, having been diſcovered in a torpid ſtate. Mr Collinſon favoured us with the evidence of three gentlemen, eye-witneſſes to numbers of ſand martins being drawn out of a cliff on the Rhine, in the month of March 1762. And the honourable Daines Barrington communicated to us the following fact, on the authority of the late Lord Belhaven, That numbers of ſwallows have been found in old dry walls and in ſandhills near his Lordſhip's ſeat in Eaſt Lothian; not once only, but from year to year; and that when they were expoſed to the warmth of a fire, they revived. We have alſo heard of the ſame annual diſcoveries near Morpeth in Northumberland, but cannot ſpeak of them with the ſame aſſurance as the two former: neither in the two laſt inſtances are we certain of the particular ſpecies.

Pennant's Britiſh Zoology, vol. ii. p. 2..

"Other witneſſes crowd on us to prove the reſidence of thoſe birds in a torpid ſtate during the ſevere ſeaſon. Firſt, In the chalky cliffs of Suſſex; as was ſeen on the fall of a great fragment ſome years ago. Secondly, In a decayed hollow tree that was cut down, near Dolgelli, in Merionethſhire. Thirdly, In a cliff near Whitby, Yorkſhire; where, on digging out a fox, whole buſhels of ſwallows were found in a torpid condition. And, laſtly, The reverend Mr Conway of Sychton, Flintſhire, was ſo obliging as to communicate the following fact: A few years ago, on looking down an old lead-mine in that county, he obſerved numbers of ſwallows clinging to the timbers of the ſhaft, ſeemingly aſleep; and on flinging ſome gravel on them, they juſt moved, but never attempted to fly or change their place: this was between All Saints and Chriſtmas.

"Theſe

Swallow.

"These are doubtless the lurking places of the later hatches, or of those young birds which are incapable of distant migrations. There they continue insensible and rigid; but like flies may sometimes be reanimated by an unseasonable hot day in the midst of winter: for very near Christmas a few appeared on the moulding of a window of Merton college, Oxford, in a remarkably warm nook, which prematurely set their blood in motion, having the same effect as laying them before a fire at the same time of year. Others have been known to make this premature appearance; but as soon as the cold natural to the season returns, they withdraw again to their former retreats.

"The above are circumstances we cannot but assent to, though seemingly contradictory to the common course of nature in regard to other birds. We must, therefore, divide our belief relating to these two so different opinions; and conclude, that one part of the swallow tribe migrate, and that others have their winter-quarters near home. If it should be demanded, why swallows alone are found in a torpid state, and not the other many species of soft billed birds, which likewise disappear about the same time? reasons might be assigned:"

4 Third opinion, that some lie immersed in water.

The third opinion we shall state and support in the words of Mr Kalm. "Natural history (says he), as all other histories, depends not always upon the intrinsic degree of probability, but upon facts founded on the testimony of people of noted veracity.—Swallows are seldom seen sinking down into the water; swallows have not such organs as frogs or lizards, which are torpid during winter; *ergo*, swallows live not, and cannot live, under water.—This way of arguing, I believe, would carry us, in a great many cases, too far: for though it is not clear to every one, it may however be true; and lizards and frogs are animals of a class widely different from that of birds, and must therefore of course have a different structure; hence it is they are classed separately. The bear and the marmot are in winter in a torpid state, and have, however, not such organs as lizards and frogs; and nobody doubts of their being, during some time, in the most rigid climates, in a torpid state: for the Alpine nations hunt the marmots frequently by digging their holes up; and find them so torpid, that they cut their throats, without their reviving or giving the least sign of life during the operation; but when the torpid marmot is brought into a warm room, and placed before the fire, it revives from its lethargy. The question must therefore be decided by facts; nor are these wanting here. Dr Wallerius, the celebrated Swedish chemist, informs us, That he has seen, more than once, swallows assembling on a reed, till they were all immersed and went to the bottom; this being preceded by a dirge of a quarter of an hour's length. He attests likewise, that he had seen a swallow caught during winter out of a lake with a net, drawn, as is common in northern countries, under the ice; this bird was brought into a warm room, revived, fluttered about, and soon after died.

"Mr Klein applied to many farmers-general of the king of Prussia's domains, who had great lakes in their districts, the fishery in them being a part of the revenue. In winter the fishery thereon is the most considerable under the ice, with nets spreading more than 200 or 300 fathoms, and they are often wound by screws and engines on account of their weight. All the people that were questioned made affidavits upon oath before the magistrates. First, The mother of the countess Lehndorf said, that she had seen a bundle of swallows brought from the Frische-Haff (a lake communicating with the Baltic at Pillaw), which, when brought into a moderately warm room, revived and fluttered about. Secondly, Count Schleben gave an instrument on stamped paper, importing, that by fishing on the lake belonging to his estate of Gerdauen in winter, he saw several swallows caught in the net, one of which he took up in his hand, brought it into a warm room, where it lay about an hour, when it began to stir, and half an hour after, it flew about in the room. Thirdly, Farmer-general (Amtman) Witkouski made affidavit, that, in the year 1740, three swallows were brought up with the net in the great pond at Didlacken; in the year 1741 he got two swallows from another part of the pond, and took them home (they being all caught in his presence); after an hour's space they revived all in a warm room, fluttered about, and died in three hours after. Fourthly, Amtman Benke says, that having had the estate of Kleskow in farm, he had seen nine swallows brought up in the net from under the ice, all which he took into a warm room, where he distinctly observed how they gradually revived; but a few hours after they all died. Another time his people got likewise some swallows in a net, but he ordered them to be again thrown into the water. Fifthly, Andrew Rutta, a master fisherman at Oletsko, made affidavit, in 1747, that 22 years ago, two swallows were taken up by him in a net, under the ice, and, being brought into a warm room, they flew about. Sixthly, Jacob Kosulo, a master fisherman at Stradauen, made affidavit, that, in 1736, he brought up in winter, in a net, from under the ice of the lake at Raski, a seemingly dead swallow, which revived in half an hour's time in a warm room; and he saw, in a quarter of an hour after, the bird grow weaker, and soon after dying. Seventhly, I can reckon myself (says our author) among the eye-witnesses of this paradox of natural history. In the year 1735, being a little boy, I saw several swallows brought in winter by the fishermen from the river Vistula to my father's house; where two of them were brought into a warm room, revived, and flew about. I saw them several times settling on the warm stove (which the northern nations have in their rooms); and I recollect well, that the same forenoon they died, and I had them, when dead, in my hand. In the year 1754, after the death of my uncle Godefroy Wolf, captain in the Polish regiment of foot-guards, being myself one of his heirs, I administered for my co-heirs several estates called the *Starosty of Dischau*, in Polish Prussia, which my late uncle farmed under the king. In January, the lake of Lybshaw, belonging to these estates, being covered with ice, I ordered the fishermen to fish therein, and in my presence several swallows were taken, which the fishermen threw in again; but one I took up to myself, brought it home, which was five miles from thence, and it revived, but died about an hour after its reviving.

"These are facts attested by people of the highest quality, by some in public offices, and by others who, though of a low rank, however, made their affidavits upon oath. It is impossible to suppose indiscriminately that they were prompted, by views of interest, to assert as a fact a thing which had no truth in it. It is therefore highly probable, or rather incontestably true, that swallows retire in the northern countries, during winter, into the water, and stay there in a torpid state till the return of warmth revives them again in spring. The question therefore, I believe, ought for the future to be thus stated: The swallows in Spain, Italy, France, and perhaps some from England, remove to warmer climates; some English ones, and some in Germany and other mild countries, retire into clefts and holes in rocks, and remain there in a torpid state. In the colder northern countries the swallows immerse in the sea, in lakes, and rivers; and remain in a torpid state, under ice, during winter. There are still some objections to this latter asser-

assertion, which we must remove. It is said, Why do not rapacious fish, and aquatic quadrupeds and birds, devour these swallows? The answer is obvious, swallows choose only such places in the water for their winter-retreat as are near reeds and rushes; so that sinking down there between them and their roots, they are by them secured against the rapaciousness of their enemies. But others object, Why are not these birds caught in such fresh waters as are continually harassed by nets? I believe the same answer which has been made to the first objection will serve for this likewise. Fishermen take care to keep off with their nets from places filled with reeds and rushes, for fear of entangling and tearing their net; and thus the situation of swallows under water, is the reason that they are seldom disturbed in their silent winter-retreats. What confirms this opinion still more is, that swallows were never caught in Prussia according to the above-mentioned affidavits, but with those parts of the net which passed near to the reeds and rushes; and sometimes the swallows were yet fastened with their feet to a reed, when they were drawn up by the net. As to the argument taken from their being so long under water without corruption, I believe there is a real difference between animals suffocated in water and animals being torpid therein. We have examples of things being a long time under water; to which we may add the intense cold of these northern regions, which preserves them. Who would have thought that snails and polypes might be dissected, and could reproduce the parts severed from their bodies, if it was not a fact? Natural history ought to be studied as a collection of facts, not as the history of our guesses or opinions. Nature varies in an infinite manner; and Providence has diversified the instinct of animals and their economy, and adapted it to the various seasons and climates."

With Mr Kalm's concluding observations we heartily concur. Natural history ought to be studied as a collection of facts; and it was from this very notion that we have stated the above mentioned opinions so fully, and brought together the facts which the best advocates for each opinion have judged most proper for supporting them. We are sensible of the great improbability of the third opinion, and know that many arguments have been used to prove its absurdity: such as these, The swallow is lighter than water, and therefore cannot sink: if it could at all, it could not [illegible] under water during its torpid state, which is very improbable; there is no instance of land animals living so long under water without respiration. Many other arguments of the same sort have been advanced, and certainly afford a [illegible] way of deciding the question; but unless they were sufficient to prove the immersion of swallows a physical impossibility, they are of no force when opposed to the evidence of testimony, if there be no cause to suspect the witnesses of inaccuracy or design. The true way to refute such an opinion is by accurate observation and experiment. We have not heard of any accurate inquiries being made by philosophers in those northern countries where swallows are said to pass the winter under water. The count de Buffon, indeed, shut up some swallows in an ice-house by way of experiment, which died in a few days; but as he does not tell us what precautions he took to make the experiment succeed, it is not intitled to any attention.

Mr John Hunter made a very judicious experiment on the banks of the Thames, which is described by a correspondent in the Gentleman's Magazine, who asserts that he had it from Mr Hunter himself.

One year in the month of September, he prepared a room, with every accommodation and convenience which he could contrive, to serve as a dormitory for swallows, if they were disposed to sleep in winter. He placed in the centre a large tub of water with twigs and reeds, &c which reached to the bottom. In the corners of the room he contrived artificial caverns and holes, into which they might retire; and he laid on the floor, or suspended in the air, different lengths of old wooden pipes, which had formerly been employed in conveying water through the streets, &c.

6 Mr Hunter's experiment ingenious.

When the receptacle was rendered as complete as possible, he then engaged some watermen to take by night a large quantity of the swallows that hang upon the reeds in the Thames about the time of their departure. They brought him, in a hamper, a considerable number; and had so nicely hit the time of their capture, that on the very day following there were none to be seen.

He put the swallows into the room so prepared, where they continued to fly about, and occasionally perch on the twigs, &c. But not one ever retired into the water, the caverns, holes, or wooden pipes, or shewed the least disposition to grow torpid, &c. In this situation he let them remain till they all died but one. This, appearing to retain some vigour, was set at liberty; when it mounted out of sight, and flew away. All the birds lay dead scattered about the room; but not one was found asleep or torpid, or had, if the correspondent remembers, so much as crept into any of the receptacles he had so provided.

7 But not decisive with respect to northern countries.

This experiment was ingenious, and certainly does render the doctrine of immersion much more improbable; but it is not decisive; for it may still be urged by the advocates for that doctrine, as Mr Kaim has done, that it may only be in the colder countries where swallows retire into the water. We formerly said that none of the three opinions are supported by such evidence as to satisfy the mind completely. Opinions which respect events which happen every year ought to be confirmed by a great number of observations, and not by a few instances divested of almost all their concomitant circumstances. Can no better proofs be brought to prove the migration of swallows than those of Adanson and Sir Charles Wager, or the circumstances mentioned by Mr White and Mr Laskey respecting their disappearing? We ought not merely to know that some swallows have taken a southerly flight in autumn, that some have been found at a great distance from land in the spring, or in harvest; but we ought to know to what countries they actually retire. Before we can rest satisfied, too, that it is a general fact that swallows remain in a torpid state during winter, either in caverns or in the bottom of lakes, &c. we must have more proofs; we must know what species of swallows they are said to be, in what countries this event takes place, and several other circumstances of the same kind.

8 [illegible]

We cannot help being of opinion that much remains to be done in order properly to ascertain what becomes of the swallows of Europe during winter. It would be necessary, in the first place, to know accurately what are the countries in which swallows are found. 2. Do they remain visible there the whole year? or, if they disappear, at what season does this happen, and when do they appear again? 3. Do they ever appear while a strong north wind blows, or do they only come in great numbers with a south wind? We will endeavour to answer some of these questions in part; but must regret, that all the information on this subject which we have been able to cull from the best writers in natural history is very scanty; and we merely give it by way of specimen, hoping that future observations will soon render it more complete.

9 [illegible] important [illegible]

There are five species which visit Britain during the summer months; the common or chimney swallow, the martin, sand martin, swift, and goat-sucker. The chimney swallow frequents almost every part of the old continent, being known (says Dr Latham) from Norway to the Cape

Swallow.

of Good Hope on the one side, and from Kamtschatka to India and Japan on the other. It is also found in all parts of North America, and in several of the West Indian islands. In Europe it disappears during the winter months. It appears generally a little after the vernal equinox; but rather earlier in the southern, and later in the northern latitudes. It adheres to the usual seasons with much regularity; for though the months of February and March should be uncommonly mild, and April and May remarkably cold, it never deviates from its ordinary time. In the cold spring of 1740 some appeared in France before the insects on which they feed had become numerous enough to support them, and great numbers died *. In the mild and even warm spring of 1774 they appeared no earlier than usual. They remain in some warm countries the whole year. Kolben assures us that this is the case at the Cape of Good Hope; but that they are more numerous in winter. Some birds of this species live, during winter, even in Europe; for example, on the coast of Genoa, where they spend the night in the open country on the orange shrubs.

* Buffon's Natural History of Birds, vol vi. p. 527.

2. The *martins* are also widely diffused through the old continent; but the countries where they reside or visit have not been marked by naturalists with much attention. 3. The *sand martins* are found in every part of Europe, and frequently spend the winter in Malta ‡. Two birds of this species were seen in Perigord in France, on the 27th December 1775, when there was a southerly wind, attended with a little rain ‖. 4. The *swift* visits the whole continent of Europe; has also been observed at the Cape of Good Hope, and in Carolina in North America. 5. The *goat-suckers* are not very common birds, yet are widely scattered. They are found in every country between Sweden and Africa: they are found also in India. In April the south-west wind brings them to Malta, and in autumn they repass in great numbers.

‡ Ibid. 527.

‖ Ibid. 484.

Mr Markwick of Catsfield, near Battle in Sussex, has drawn up an accurate table, expressing the day of the month on which the birds, commonly called *migratory*, appeared in spring, and disappeared in autumn, for 16 years, from 1768 to 1783 inclusive. The observations were made at Catsfield. From this table we shall extract the dates for five years, and add the very few observations which we have been able to collect respecting the time when the swallow appears and disappears in other countries.

Transactions of the Linnean Society, vol. i.

	First seen.	Last seen.
1779.		
Chim. Swal.	Ap. 14.	Oct. 25.
Martins	14.	15.
Sand Mart.	May 7.	
Swift	9.	
1780.		
Chim. Swal.		Nov. 3.
Martins	Ap. 29.	3.
Sand Mart.	8.	Sep. 8.
Swift	May 6.	8.
1781.		
Chim. Swal.	Ap. 8.	Oct. 15.
Martins	May 12.	Sep. 7.

	First seen.	Last seen.
1781.		
Sand Mart.	Ap. 16.	Sep. 1.
Swift	May 12.	1.
1782.		
Chim. Swal.	Ap. 22.	Sep. 1.
Martins	26	Nov. 2.
Sand Mart.	May 15.	Aug. 28.
Swift	18.	28.
1783.		
Chim. Swal.	Ap. 15.	Nov. 6.
Martins	May 1.	6.
Sand Mart.	July 25.	Sep. 1.
Swift	May 13.	Nov. 6.

	Chim. Swal.	Swifts.	Martins.	S. Mart.
	Appear about			
In Burgundy *			Ap. 9.	Ap. 12.
In Selborne, Hampshire †	Ap. 4.	Ap. 24.	Ap. 30.	
In South Zeal, Devonshire ‡	25.	May 1.	May 15.	
In Blackburn, Lancashire ‡	26.	Ap. 23.		
In Upland, Sweden §			May 9.	

* Buffon, ibid.
† White's Natural History of Selborne.
§ Buffon, ibid.

Were tables of the same kind made in every different country, particularly within the torrid zone, it would be easy to determine the question which we have been considering. To many, perhaps, it may not appear a matter of such importance as to be worth the labour. We acknowledge it to be rather a curious than an important inquiry; yet it is one which must be highly gratifying to every mind that can admire the wisdom of the Great Architect of nature. The instinct of the swallow is indeed wonderful: it appears among us just at the time when insects become numerous; and it continues with us during the hot weather, in order to prevent them from multiplying too much. It disappears when these insects are no longer troublesome. It is never found in solitude; it is the friend of man, and always takes up its residence with us, that it may protect our houses and our streets from being annoyed with swarms of flies.

Swallow-Wort, in botany. See Asclepias.

Swammerdam.

SWAMMERDAM (John), a celebrated and learned natural philosopher, was the son of John James Swammerdam, an apothecary and famous naturalist of Amsterdam, and was born in 1637. His father intended him for the church, and with this view had him instructed in Latin and Greek; but he, thinking himself unequal to so important a task, prevailed with his father to consent to his applying himself to physic. As he was kept at home till he should be properly qualified to engage in that study, he was frequently employed in cleaning his father's curiosities, and putting every thing in its proper place. This inspired our author with an early taste for natural history; so that, not content with the survey of the curiosities his father had purchased, he soon began to make a collection of his own, which he compared with the accounts given of them by the best writers. When grown up, he regularly attended to his anatomical and medical studies; yet spent part of the day and the night in discovering, catching, and examining the flying insects proper to those times, not only in the province of Holland, but in those of Guelderland and Utrecht.—Thus initiated in natural history, he went to the university of Leyden in 1651; and in 1663 was admitted a candidate of physic in that university. His attention being now engaged by anatomy, he began to consider how the parts of the body, prepared by dissection, could be preserved, and kept in constant order for anatomical demonstration; and herein he succeeded, as he had done before in his nice contrivances for dissecting and managing the minutest insects. Our author afterwards made a journey into France, where he spent some time at Saumur, and where he became acquainted with several learned men. In 1667 he returned to Leyden, and took his degree of Doctor of Physic. The next year the grand duke of Tuscany being in Holland in order to see the curiosities of the country, came to view those of our author and his father; and on this occasion Swammerdam made some anatomical dissections of insects in the presence of that prince, who was struck with admiration at our author's great skill in managing them, especially at his proving that the future butterfly lay with all its parts neatly folded up in a caterpillar, by actually removing the integuments that covered the former, and extricating and exhibiting all its parts, however minute, with incredible ingenuity, by means of instruments of inconceivable fineness. On this occasion the duke offered our author 12,000 florins for his share of the collection, on condition of his removing them himself into Tuscany, and coming to live at the court of Florence; but Swammerdam, who hated a court-life, declined his highness's proposal. In 1663, he published a General History of Insects. About this time, his father began to take offence at his inconsiderately neglecting the practice of physic, which might have supported him in affluence; and would neither supply him with money nor clothes. This reduced him to some difficulties. In 1675 he published his History of the Ephemeras; and his father dying the same year, left him a fortune sufficient for his support:

Swan ‖ Sweden. poſt: but he did not long ſurvive him, for he died in 1682. Gaubius gave a tranſlation of all his works from the original Dutch into Latin, from which they were tranſlated into Engliſh, in folio, in 1758. The celebrated Boerhaave wrote his life.

SWAN, in ornithology. See ANAS.

SWANPAN, or Chineſe ABACUS: an inſtrument for performing arithmetical operations, deſcribed by Du Halde in his Hiſtory of China.

It is compoſed of a ſmall board, croſſed with 10 or 12 parallel rods or wires, each ſtrung with ivory balls, which are ſo divided by a partition in the middle, that two are on one ſide of it, and five on the other. The two in the upper part ſtand each for five units, and each of the five in the lower part for one. "In joining and ſeparating theſe balls, they reckon much as we do with counters; but, according t. Mag. 748. to our author, more expeditiouſly than Europeans do even with figures." This is hardly credible; but if all the Chineſe weights and meaſures be decimally divided, as by his very lame deſcription of the *ſwanpan* they would appear to be, it is eaſy to conceive how computation may be made by this inſtrument very expeditiouſly. The inſtrument, too, may be ſo contrived as to ſuit any diviſion of weights and meaſures, and in that form be uſeful to the blind; but as we have elſewhere given deſcriptions of ſuperior inſtruments, for their accommodation (ſee BLIND) it is needleſs to offer in this place any improvement of the *ſwanpan*.

SWANEMOTE, SWAINMOTE, or SWEINMOTE. See *Foreſt-Courts*.

SWEARING. See OATH.

SWEAT, a ſenſible moiſture iſſuing from the pores of the ſkins of living animals.

The exceſs of it dries and weakens the body, deprives the humours of their watery parts. and induces the blood to an inflammatory and atrabiliary diſpoſition. A ſudden ſuppreſſion of it will equally hurt as well as a ſuppreſſion of perſpiration.

SWEATING SICKNESS, a diſorder which appeared in England about the year 1481, and was by foreigners called the *Engliſh ſweat*. It returned again in 1485; then in 1506; afterwards in 1517. It appeared again in 1528, or 1529, at which time alone it ſpread itſelf to the Netherlands and angin's atiſe on t, &c. Germany: a circumſtance which ſhows the impropriety of calling it *the Engliſh ſweat*, in Latin *ſudor Anglicanus*; beſides, Sennertus takes notice, that it ſpread as far as Denmark, Norway, and France. It raged again in 1548. And the laſt return of it in London was in 1551, when it was ſo violent as in one day to take off 120 of the inhabitants of Weſtminſter. Some were ſeized abroad, and cut off in the road, others at home. Some when awake, others when faſt aſleep. Some died in a moment, and others in one, two, three, four, or more hours after they began to ſweat.

SWEDEN, one of the moſt northerly kingdoms of Europe, lying between Lat. 55. 20. and 69. 30. north, and between 12° and 32° eaſt from London. On the ſouth it is bounded by the Baltic, on the north by Daniſh Lapland, on the eaſt by Muſcovy, and on the weſt by the mountains of 1 of Norway, being 800 miles in length and 350 in breadth.

ly hiy unain. The early hiſtory of Sweden is no leſs involved in fables than that of moſt other nations. Some hiſtorians have pretended to give regular catalogues of the princes who reigned in Sweden in very early times; but they differ ſo much among themſelves, that no credit can be given to them. However, all agree that ancient Scandinavia was firſt governed by judges elected for a certain time by the voice of the people. Among theſe temporary princes the country was divided, until, in the year of the world 2054, according to ſome, or 1951, according to others, Eric, or, if we Swedes believe Puffendorf, Suenon was raiſed to the ſupreme power, with the prerogatives of all the temporary magiſtrates united in his perſon for life, or until his conduct ſhould merit depoſition.

From this very early period till the year 1366 of the Chriſtian era, the hiſtories of Sweden preſent us with nothing but what is common to all nations in their early periods, viz. the endleſs combats and maſſacres of barbarians, tending to no other purpoſe than the effuſion of blood. At 2
the time juſt mentioned, however, Albert of Mecklenburg, Albert of having concluded a peace between Sweden and Denmark, Mecklenwhich two kingdoms had been at violent war for ſome burg detime before, was proclaimed king of Sweden. The peace clared king in 1350. was of ſhort duration, being broken in 1368; on which Albert entered into an offenſive and defenſive league with the earl of Holſtein, the Jutland nobility, the dukes of Selſwick, Mecklenburg, and the Hanſe-towns, againſt the kings 3
of Denmark and Norway. Albert proved very ſucceſsful War with againſt Waldemar king of Denmark at that time, driving Denmark him entirely out of his dominions; but he himſelf was de- and Norfeated by the king of Norway, who laid ſiege to his capi- way. tal. Soon after this, a new treaty of peace was concluded, by which Albert was allowed to enjoy the crown of Sweden in peace. However, having formed a deſign of rendering himſelf abſolute, he fell under the diſpleaſure of his ſubjects, and Margaret of Norway was proclaimed queen of Sweden by the malecontents. A war immediately enſued, 4
in which Albert was defeated and taken priſoner; but as Is defeated the princes of Mecklenburg, the earls of Holſtein, and the and taken Hanſe towns, entered into a league in his favour, the war priſoner by was ſo far from being extinguiſhed by this event, that it ra- Margaret ged with more fury than ever. of Norway.

At length, in 1394, the contending parties came to an 5
accommodation. Albert was ſet at liberty, on condition Set at liberthat he ſhould in three years ſurrender to Margaret all pre- ty. tenſions to the city of Stockholm; and the Hanſe-towns engaged to pay the ſum of 60,000 marks of ſilver in caſe of Albert's breach of faith. Not long after this, Eric the ſon of Albert died; and he, having no other child, did not think it worth his while to contend for the kingdom of Sweden: he therefore acquieſced in the pretenſions of Margaret, and paſſed the remainder of his days at Mecklenburg. 6

Margaret died in 1415, and was ſucceeded by Eric of Margaret Pomerania. This prince's reign was cruel and oppreſſive is ſucceeded to the laſt degree. The people were ruined by taxes; and by Eric a the Danes being every where preferred to the offices of cruel tyrant. power, committed the greateſt cruelties. The conſequence 7
of this was a revolt; and Charles Canutſon, grand mare- A general ſchal of Sweden and governor of Finland, having joined the revolt takes malecontents, was declared commander in chief of their ar- place, and Eric is demy. Eric was now formally depoſed, and commenced pi- poſed rate: Canutſon was choſen regent: but beginning to oppreſs the people, and aſpiring openly at the crown, the Swedes and Danes revolted; in conſequence of which a revolution took place, and Chriſtopher duke of Bavaria, nephew to Eric, was choſen king of Denmark, Sweden, and Norway, in 1442.

On the acceſſion of the new prince, complaints againſt Canutſon were brought from all quarters: but, through the intereſt of his friends, he eſcaped the puniſhment due to him; and in 1448, Chriſtopher having died after a tyrannical reign of ſomewhat more than five years, he was raiſed to the throne at which he had ſo long aſpired. However, the kingdoms of Denmark and Norway refuſed to own allegiance to him; upon which a war immediately commenced.

Sweden.

8
The three kingdoms united under Christian king of Denmark, and proves a tyrant and is driven out.

In 1464 peace was concluded, and Denmark for the present freed from the Swedish yoke. Neither did Canutson long enjoy even the crown of Sweden itself. Having quarrelled with the archbishop of Upsal, the latter formed such a strong party that the king could not resist him. Christian king of Denmark was called to the throne of Sweden; and in 1457 once more united the three kingdoms. He enjoyed his dignity but a short time; for having begun to oppress his subjects in an arbitrary manner, he was obliged to retire to Denmark in 1463. Katil bishop of Lincoping, who had driven out the king, took upon himself the office of regent. Next year Christian returned with a powerful army; but was defeated. The people then thought proper to recal Canutson: but he, on his first accession, having offended the warlike Bishop Katil, was by him defeated, and obliged to renounce his right to the crown. After this the kingdom was rent into factions; between whom the most cruel civil wars took place, until the year 1467, when Canutson was again recalled, and enjoyed the kingdom, though not without difficulty and opposition, till his death, which happened in 1470.

The confusion in which the Swedish affairs had been so long involved did not cease on the death of Canutson. Christian again invaded Sweden; but was defeated by Steen Sture, nephew to the late king. After this the kingdom seems to have remained in peace till the year 1487, when the Russians invaded Carelia, committing everywhere the greatest ravages. These were soon driven out: but in 1497, a rupture happening betwixt Sture and the senate, an offer was made of the Swedish crown to John king of Denmark. This prince readily accepted the offer, and was crowned accordingly; but no sooner was he seated on the throne than he became odious to the Swedes, from his partiality to the Danes. In a short time he set out for Denmark, leaving his queen, with a strong garrison, in the citadel of Stockholm. He was no sooner gone than the capital was invested: and though the queen made a noble defence, she was at last obliged to capitulate, on condition of being allowed to pass into Denmark. All the garrison were made prisoners of war, and the queen herself was confined in a monastery till the following year.

9
John king of Denmark obtains the Swedish crown, but is driven out.

The Swedish affairs continued to be involved in the same dreadful confusion as we have already related, until the year 1520, when a great revolution was effected by Gustavus Ericson, a nobleman of the first rank, who restored the kingdom to its liberty, and laid the foundation of its future grandeur. The occasion of this great revolution was as follows: In 1518, Christian king of Denmark invaded Sweden, with a design to subdue the whole country; but being defeated with great loss by young Steen Sture, the regent at that time, he set sail for Denmark. But meeting with contrary winds, he made several descents on the Swedish coast, which he ravaged with all the fury of an incensed barbarian. The inhabitants, however, bravely defended themselves, and Christian was reduced to the utmost distress; one half of his forces having perished with hunger, and the other being in the most imminent danger by the approach of a rigorous winter. He then thought of a stratagem, which had almost proved fatal to the regent; for having invited him to a conference, at which he designed either to assassinate or take him prisoner, Sture was about to comply, had not the senate, who suspected the plot, interposed and prevented him. Christian then offered to go in person to Stockholm in order to confer with Sture, upon condition that six hostages should be sent in his room. This was accordingly done; but the wind happening then to prove favourable, he set sail for Denmark with the hostages, of whom Gustavus Ericson was one. Next year he returned; and having drawn Sture into an ambush, the regent received a wound of which he died some time after. The kingdom being thus left without a head, matters soon came to the most desperate crisis. The army disbanded itself; and the senate, instead of taking proper measures to oppose the enemy, spent their time in idle debates. Christian in the mean time advanced into the heart of the kingdom, destroying every thing with fire and sword; but on his arrival at Stragnez, he granted a suspension of arms, to give the people time to deliberate on their situation, and to reflect that they might easily get rid of their troubles by electing him king. This they accordingly did; and Christian proved one of the most bloody tyrants that ever sat on the throne of any kingdom. Immediately after his coronation, he gave grand entertainments for three days; during which time he projected the diabolical design of extirpating at once all the Swedish nobility, and thus for ever preventing the people from revolting, by depriving them of their proper leaders. As the tyrant had signed articles, by which he promised indemnity to all who had borne arms against him, it became necessary to invent some cause of offence against those whom he intended to destroy. To accomplish his purpose, Gustavus Trolle, formerly archbishop of Upsal, but who had been degraded from that dignity, in an oration before his majesty lamented the demolition of Stecka, his place of residence, and the losses sustained by the see of Upsal, amounting to near a million of money. He then proceeded in a bitter accusation against the widow and the son-in-law of Sture the late regent, comprehending in the same accusation about 15 of the principal nobility, the whole senate, and the burghers of Stockholm. The consequence of this was, that above 60 of the principal nobility and people of first rank in Sweden were hanged up as traitors. Innumerable other cruelties were committed; part of which are owned by the Danish historians, and minutely related by those of Sweden. At last he departed for Denmark, ordering gibbets to be erected, and causing the peasants to be hanged on them for the slightest offences, all the way as he passed along; and it is related of him, that at Jencoping he caused two boys, one of seven and the other of nine years of age, to be whipped to death.

10
Christian king of Denmark invades Sweden, but is defeated and driven out.

11
He treacherously carries off hostages, of whom Gustavus Ericson is one.

12
Is chosen king, and proves a most bloody tyrant.

13
Massacre of the nobility, and causes gibbets to be erected as he passed along.

This monstrous cruelty, instead of securing him on the throne, exasperated the whole nation against him. It has already been mentioned, that Gustavus Ericson, or, as he is commonly called, *Gustavus Vasa*, was among the number of the hostages whom Christian had perfidiously carried to Denmark in 1519. Large promises had been made in order to reconcile him to Christian, and threats had been used for the same purpose, but all in vain. Secret orders were given to strangle him in prison; but the officer to whom the assassination was committed remonstrated to the king about the consequences of it, and prevailed on him to change the sentence of death into close confinement in the castle of Copenhagen. Some of the hostages perished in consequence of the rigorous treatment they met with; but Gustavus withstood all hardships. At last one Banner, a Danish nobleman, prevailed on the king to put him into his hands, in order to try whether or not he could prevail upon him to change his sentiments. The king, however, told Banner, that he must pay 6000 crowns in case the prisoner should make his escape. Banner generously assented; and having brought the noble prisoner to his fortress of Calo in Jutland, soon allowed him all the liberty he could desire, and otherwise heaped favours upon him. All this, however, could not extinguish his remembrance of the cruelties of Christian, and the desire he had of being serviceable to his country. He therefore determined to make his escape; and the liberty he enjoyed soon put him in a capacity of effecting

14
Adventures of Gustavus Vasa or Ericson.

15
He escapes from Denmark.

effecting it. Having one day mounted his horſe, under pretence of hunting as uſual in the foreſt, when he got at a proper diſtance, he changed his dreſs to the habit of a peaſant; and quitting his horſe, he travelled for two days on foot through by paths, and over mountains almoſt impaſſable, arriving on the third at Flenſburgh. Here no one was admitted without a paſſport; and Guſtavus dreaded preſenting himſelf to the governor or the officer upon guard, for fear of being diſcovered. Happily for him, it chanced to be on that ſeaſon of the year when the merchants of Lower Saxony drove a conſiderable trade in cattle, which they purchaſe in Jutland. Guſtavus hired himſelf to one of theſe merchants; and under favour of his diſguiſe eſcaped out of the Daniſh territories, and arrived at Lubec.

16 ...es at ...c.

Banner was no ſooner acquainted with his eſcape, than he ſet out after him with the utmoſt diligence, found him at Lubec, and reproached him with great warmth as ungrateful and treacherous; but he was ſoon appeaſed by the arguments urged by Guſtavus, and eſpecially by the promiſe he made of indemnifying him in the loſs of his ranſom. Upon this Banner returned, giving out that he could not find his priſoner. Chriſtian was enraged at his eſcape, apprehending that he might reverſe all his deſigns in Sweden; and gave orders to Otho his general to make the ſtricteſt ſearch, and leave no means untried to arreſt him. Guſtavus applied to the regency for a ſhip to convey him to Sweden, where he hoped he ſhould be able to form a party againſt the Danes. He likewiſe endeavoured to draw the regency of Lubec into his meaſures; and reaſoned with ſo much zeal and ability, that Nicholas Gemins, firſt conſul, was entirely gained; but the regency could never be prevailed on to declare for a party without friends, arms, money, or credit. However, before his departure, the conſul gave him aſſurances, that if he could raiſe a force ſufficient to make head againſt the enemy in the field, he might depend on the ſervices of the republic, and that the regency would immediately declare for him. Guſtavus deſired to be landed at Stockholm; but the captain of the ſhip, either having ſecret orders to the contrary, or buſineſs elſewhere, ſteered a different courſe, and put him on ſhore near Calmar; a city hitherto garriſoned by the troops of Chriſtina widow of the regent. In truth, the governor held this place for his own purpoſes, and only waited to make the beſt terms he could with the Danes. When Guſtavus arrived, he made himſelf known to him and the principal officers of the garriſon, who were moſtly Germans, and his fellow-ſoldiers in the late adminiſtrator's army. He flattered himſelf that his birth, his merit, and connections, would immediately procure him the command. But the mercenary band, ſeeing him without troops and without attendants, regarded him as a deſperate perſon devoted to deſtruction, refuſed to embrace his propoſals, and even threatened to kill or betray him, if he did not inſtantly quit the city.

17 ...n; ts in t... the ...cy conve... ...ſice.

18 ...rives ...mar, ...meets ...n un... ...rable ...tion.

Diſappointed in his expectations, Guſtavus departed with great expedition; and his arrival being now publicly known, he was again forced to have recourſe to his peaſant's diſguiſe to conceal him from the Daniſh emiſſaries diſperſed over the country to ſearch for him. In a waggon loaded with hay he paſſed through every quarter of the Daniſh army, and at laſt repaired to an old family caſtle in Sudermania. From hence he wrote to his friends, notifying his return to Sweden, and beſeeching them to aſſemble all their forces in order to break through the enemy's army into Stockholm, at that time beſieged; but they, too, refuſed to embark in ſo hazardous and deſperate an attempt.

19 ...friends ...ſe to ...him.

Guſtavus next applied himſelf to the peaſants: but they anſwered, that they enjoyed ſalt and herrings under the government of the king of Denmark; and that any attempts to bring about a revolution would be attended with certain ruin, without the proſpect of bettering their condition; for peaſants they were, and peaſants they ſhould remain, whoever was king. At length, after ſeveral vain attempts to throw himſelf into Stockholm, after that city was ſurrendered to the king, after the horrid maſſacre of the ſenate, and after running a thouſand dangers, and undergoing hardſhips and fatigues hardly to be ſupported by human nature, he formed the reſolution of trying the courage and affection of the Dalecarlians. While he was in the deepeſt obſcurity, and plunged in almoſt unſurmountable adverſity, he never relinquiſhed his deſigns nor his hopes. The news of the maſſacre had, however, very near ſunk him into deſpondency, as thereby he loſt all his friends, relations, and connections, and indeed almoſt every proſpect of ſafety to himſelf or deliverance to his country. It was this that inſpired the thought of going to Dalecarlia, where he might live with more ſecurity in the high mountains and thick woods of that country, if he ſhould fail in the attempt of exciting the inhabitants to revolt.

20 Applies in vain to the peaſants.

Attended by a peaſant, to whom he was known, he travelled in diſguiſe through Sudermania, Nericia, and Weſtermania, and, after a laborious and painful journey, arrived in the mountains of Dalecarlia. Scarce had he finiſhed his journey, when he found himſelf deſerted by his companion and guide, who carried off with him all the money he provided for his ſubſiſtence. Thus forlorn, deſtitute, half ſtarved, he entered among the miners, and wrought like a ſlave under ground, without relinquiſhing his hopes of one day aſcending the throne of Sweden. His whole proſpect for the preſent was to live concealed, and gain a maintenance, until fortune ſhould effect ſomething in his favour: nor was it long before this happened. A woman in the mines perceived, under the habit of a peaſant, that the collar of his ſhirt was embroidered. This circumſtance excited curioſity; and the graces of his perſon and converſation, which had ſomething in them to attract the notice of the meaneſt of the vulgar, afforded room for ſuſpicion that he was ſome perſon of quality in diſguiſe, forced by the tyranny of the government to ſeek ſhelter in theſe remote parts. The ſtory came to the ears of a neighbouring gentleman, who immediately went to the mines to offer his protection to the unfortunate ſtranger; and was aſtoniſhed on recognizing the features of Guſtavus, whoſe acquaintance he had been at the univerſity of Upſal. Touched with compaſſion at the deplorable ſituation of ſo diſtinguiſhed a nobleman, he could ſcarce refrain from tears; but however had preſence of mind enough not to make the diſcovery. At night he ſent for Guſtavus, made him an offer of his houſe, and gave him the ſtrongeſt aſſurances of his friendſhip and protection. He told him, he would meet with better accommodations, and as much ſecurity as in the mines; and that, ſhould he chance to be diſcovered, he would, with all his friends and vaſſals, take arms in his defence.

21 Arrives in Dalecarlia, is robbed by his guide and engaged to work in the mines

22 Is diſcovered and relieved.

This offer was embraced by Guſtavus with joy, and he remained for ſome time at his friend's houſe; but finding it impoſſible to induce him to take part in his deſigns, he quitted him, and fled to one Peterſon, a gentleman whom he had formerly known in the ſervice. By him he was received with all the appearance of kindneſs; and, on the very firſt propoſal made by Guſtavus, offered to raiſe his vaſſals. He even named the lords and peaſants whom he pretended to have engaged in his ſervice: but in a very few days after, he went ſecretly to a Daniſh officer, and gave him information of what had paſſed. The officer immedi-

ately cauſed the houſe to be ſurrounded with ſoldiers, in ſuch a manner that it ſeemed impoſſible for Guſtavus to

23 Has a very narrow eſcape from the Danes.

make his eſcape. In the interval, however, he eſcaped, being warned by Peterſon's wife of the treachery of her huſband, and by her direction fled to the houſe of a clergyman, her friend. By him Guſtavus was received with all the reſpect due to his own birth and merit; and leſt the domeſtic who conducted him ſhould follow the treacherous example of his maſter, he removed him to the church, and conducted him to a ſmall cloſet, of which he kept the key. Having lived for ſome time in this manner, Guſtavus began to conſult with his friend concerning the moſt proper method of putting their ſchemes in execution. The prieſt adviſed him to apply directly to the peaſants themſelves; told him that it would be proper to ſpread a report, that the Danes were to enter Dalecarlia in order to eſtabliſh new taxes by force of arms; and as the annual feaſt of all the neighbouring villages was in a few days to be held, he could not have a more favourable opportunity: at the ſame time he promiſed to engage the principal perſons of the dioceſe in his intereſt.

24 His cauſe eſpouſed by the peaſants of Dalecarlia.

Agreeable to this advice Guſtavus ſet out for Mora, where the feaſt was to be held. He found the peaſants already informed of his deſigns, and impatient to ſee him. Being already prepoſſeſſed in his favour, they were ſoon excited to an enthuſiaſm in his cauſe, and inſtantly reſolved to throw off the Daniſh yoke. In this deſign they were more confirmed by their ſuperſtition; ſome of their old men having obſerved that the wind had blown from the north while Guſtavus was ſpeaking, which among them was reckoned an infallible omen of ſucceſs. Guſtavus did not give their ardour time to cool, but inſtantly led them againſt the governor's caſtle; which he took by aſſault, and put the garriſon to the ſword. This inconſiderable enterpriſe was attended with the moſt happy conſequences. Great numbers of the peaſants flocked to his ſtandard; ſome of the gentry openly eſpouſed his cauſe, and others ſupplied him with money. Chriſtian was ſoon acquainted with what had paſſed; but deſpiſing ſuch an inconſiderable enemy, he ſent only a ſlender detachment under the command of one Soren Norby, to aſſiſt his adherents in Dalecarlia.

25 The Danes defeated.

Guſtavus advanced with 5000 men, and defeated a body of Danes commanded by one Meleen; but he was ſtrenuouſly oppoſed by the archbiſhop of Upſal, who raiſed numerous forces for king Chriſtian. The fortune of Guſtavus, however, ſtill prevailed, and the archbiſhop was defeated with great loſs. Guſtavus then laid ſiege to Stockholm; but his force being too inconſiderable for ſuch an undertaking, he was forced to abandon it with loſs.

This check did not prove in any conſiderable degree detrimental to the affairs of Guſtavus; the peaſants from all parts of the kingdom flocked to his camp, and he was joined

26 Horrid cruelty of King Chriſtian.

by a reinforcement from Lubec. Chriſtian, unable to ſuppreſs the revolt, wreaked his vengeance on the mother and ſiſters of Guſtavus, whom he put to death with the moſt excruciating torments. Several other Swediſh ladies he cauſed to be thrown into the ſea, after having impoſed on them the inhuman taſk of making the ſacks into which they were to be incloſed. His barbarities ſerved only to make his enemies more reſolute. Guſtavus having aſſembled the ſtates at Wadſtena, he was unanimouſly choſen regent, the diet taking an oath of fidelity to him, and promiſing to aſſiſt him to the utmoſt. Having thus obtained the ſanction of legal authority, he purſued his advantages againſt the Danes. A body of troops appointed to throw ſuccours into Stockholm were totally cut in pieces; and the regent ſending

27 Succeſs of Guſtavus.

ſome troops into Finland, ſtruck the Danes there with ſuch terror, that the archbiſhop of Upſal, together with Slaheg and Baldenacker the Daniſh governors, fled to Denmark. Chriſtian received them but very coldly, apprehending that their flight might be prejudicial to his affairs; and in a ſhort time the two governors were put to death, that the king might have an opportunity of charging them with being guilty of the cruelties which they had committed by his order. He then ſent expreſs orders to all his governors and officers in Finland and Sweden to maſſacre the Swediſh gentry without diſtinction. The Swedes made repriſals by maſſacring all the Danes they could find; ſo that the whole country was filled with bloodſhed and ſlaughter.

In the mean time Guſtavus had laid ſiege to the towns of Calmar, Abo, and Stockholm; but Norby found means to oblige him to raiſe all of them with great loſs. Guſtavus, in revenge, laid ſiege to the capital a third time, and petitioned the regency of Lubec for a ſquadron of ſhips and other ſuccours for carrying on the ſiege. This was complied with, but on very hard conditions, viz. that Guſtavus ſhould oblige himſelf, in the name of the ſtates, to pay 60,000 merks of ſilver as the expence of the armament; that, until the kingdom ſhould be in a condition to pay that ſum, the Lubec merchants trading to Sweden ſhould be exempted from all duties on imports or exports; that all other nations ſhould be prohibited from trading with Sweden, and that ſuch traffic ſhould be deemed illicit; that Guſtavus ſhould neither conclude a peace, nor even agree to a truce, with Denmark, without the concurrence of the regency of Lubec; and that in caſe the republic ſhould be attacked by Chriſtian, he ſhould enter Denmark at the head of 20,000 men. Upon theſe hard terms did Guſtavus obtain aſſiſtance from the regency of Lubec; nor did his dear-bought allies prove very faithful. They did not indeed go over to the enemy; but in a ſea-fight, where the Danes were entirely in the power of their enemies, they ſuffered them to eſcape, when their whole force might have been entirely deſtroyed. This treachery had well nigh ruined the affairs of Guſtavus; for Norby was now making preparations effectually to relieve Stockholm; in which he would probably have ſucceeded: but at this critical period news arrived that the Danes had unanimouſly revolted, and driven Chriſtian from the throne; and that the king had retired into Germany, in hopes of being reſtored by the arms of his brother-in law the emperor. On hearing this news, Norby retired with his whole fleet to the iſland of Gothland, leaving but a ſlender garriſon in Calmar. Guſtavus did not fail to improve this opportunity to his own advantage, and quickly made himſelf maſter of Calmar. Mean time Stockholm continued cloſely inveſted; but Guſtavus thought proper to protract the ſiege until he ſhould get himſelf elected king. Having for this purpoſe called a general diet, the firſt ſtep was to fill up the vacancy in the ſenate occaſioned by the maſſacres of Chriſtian. Guſtavus had the addreſs to get ſuch nominated as were in his intereſt; and of conſequence the aſſembly was no ſooner met, than a ſpeech was made, containing the higheſt encomiums on Guſtavus, ſetting forth in the ſtrongeſt light the many 28 He is elected king of Sweden.

eminent ſervices he had done for his country, and concluding that the ſtates would ſhow themſelves equally ungrateful and blind to their own intereſt if they did not immediately elect him king. This propoſal was acceded to by ſuch tumultuous acclamations that it was impoſſible to collect the votes; ſo that Guſtavus himſelf acknowledged, that their affection exceeded his merit, and was more agreeable to him than the effects of their gratitude. He was urged to have the ceremony of his coronation immediately performed: but the king having ſome deſigns on the clergy, did not think proper to comply with their requeſt, as he would have been obliged to take an oath to preſerve them in

in their rights and privileges.—Indeed he had not been long seated on the throne before he incurred the displeasure of that body; for having large arrears due to the army, with several other incumbrances, Gustavus found it necessary to raise large contributions on the clergy. On this he was accused of avarice and heresy before the pope's nuncio. Gustavus took the proper methods for defending himself against these accusations; and in a short time after showed a great partiality for the doctrines of Luther, which by this time had been preached and received by many people in Sweden. This embroiled him more than ever with the ecclesiastics; and it soon appeared, that either Gustavus must resign his throne, or the clergy some part of the power they had assumed. Matters were driven to extremities by the king's allowing the scriptures to be translated into the Swedish language. In 1526, the king, finding them entering into a combination against the reformists, went to Upsal, and publicly declared his resolution of reducing the number of oppressive and idle monks and priests, who, under pretence of religion, fattened on the spoils of the industrious people. At last, taking advantage of the war between the pope and Charles V. of Spain, he declared himself to be of the reformed religion, and established it throughout his dominions; and at the same time, to humble the arrogance of the ecclesiastics, he gave the senators the precedency of them, and in many other respects degraded them from the dignities they formerly enjoyed. For some time the states hesitated at supporting the king in his work of reformation; insomuch, that at last he threatened to resign the kingdom, which, he said, was doomed to perpetual slavery either to its temporal or spiritual tyrants. On this the states came into his measures, and retrenched the priviliges of the ecclesiastics in the manner he proposed. Several disturbances, however, ensued. An impostor, who pretended to be of the family of Sture the former regent, having claimed the throne, the Dalecarlians revolted in his favour; but on the approach of a powerful army sent by Gustavus, they submitted to his terms. Soon after, Lutheran professors were established in every diocese; upon which a new rebellion ensued. At the head of this was Thure Johanson, who had married the king's sister. Several of the nobility joined him; and the king of Denmark also acceded to their cause, thinking, by means of these disturbances, to reunite the three kingdoms of Sweden, Denmark, and Norway, as they had formerly been. But Gustavus prevailed, and the rebels were obliged to take refuge in Denmark. A fresh accident, however, had like to have embroiled matters worse than before. The subsidy granted to the regency of Lubec was still due; and for the payment of it the states granted to the king all the useless bells of the churches and monasteries. The people were shocked at the sacrilege; and the Dalecarlians again betook themselves to arms. Intimidated, however, by the courage and vigorous conduct of the king, they again submitted, and were taken into favour. But tranquillity was not yet restored. Christian having established a powerful interest in Norway, once more made an attempt to recover his kingdoms, and was joined by the Dalecarlians; but being defeated by the Swedish forces, he was forced to return to Norway, where, being obliged to capitulate with the Danish generals, he was kept prisoner all his life.

In 1542, Gustavus having happily extricated himself out of all his troubles, prevailed on the states to make the crown hereditary in his family; after which he applied himself to the encouragement of learning and commerce. A treaty was set on foot for a marriage between his eldest son Eric and Elizabeth queen of England. The prince's brother, duke John, went over to England, and resided for some time at the court of London with great splendour. He returned, full of expectations of success; but bringing with him no sort of proofs in writing, his father soon perceived that he had been the dupe of Elizabeth's superior policy. However, at last he allowed Prince Eric to go in person to England; but before he could embark, the death of Gustavus made him lay aside all thoughts of the voyage and marriage.

35 Gustavus dies, and is succeeded by Eric a weak and imprudent prince.

Gustavus Vasa died in 1560, and was succeeded by his son Eric XIV. The new king was a man possessed of all the exterior ornaments which give an air of dignity to the person; but he had neither the prudence nor the penetration of his father. He created the first nobility that were ever known in Sweden; which he had no sooner done than he quarrelled with them, by passing some acts which they thought derogatory to their honour and dignity. The whole course of his reign was disturbed by wars with Denmark, and disputes with his own subjects. In the former he was unfortunate, and towards the latter he behavd with the greatest cruelty. At last, by the torments of his own conscience, it is said, he run mad. He afterwards recovered his senses, but was thereupon dethroned by his brothers; of whom Duke John, who had been hitherto kept prisoner by Eric, succeeded him in the kingdom.

36 Eric deposed, and succeeded by his brother John.

This revolution took place in the year 1568, but with no great advantage to Sweden. Disputes about religion between the king and his brothers, and wars with Muscovy, threw matters into the utmost confusion. At last prince Sigismund, the king's son, was chosen king of Poland, which proved the source of much trouble to the kingdom. He was elected on the following conditions, viz. That there should be a perpetual peace between the states of Poland and Sweden; that, on the death of his father, prince Sigismund should succeed to the throne of Sweden; that, on urgent occasions, he might, with the consent of the states, return to Sweden; that he should maintain, at his own expence, a fleet for the service of Poland; that he should cancel a debt which had been long due from the crown of Poland to Sweden; that, with the consent of the states, he should build five fortresses on the frontiers of Poland; that he should have liberty to introduce foreign soldiers into the kingdom, provided he maintained them at his own expence; that he should not make use of Swedish counsellors in Poland; that he should have his body guard entirely of Poles and Lithuanians; and that he should annex to Poland that part of Livonia now subject to Sweden. In 1590 king John died; and as Sigismund was at a distance, every thing fell into the utmost confusion: the treasury was plundered, and the wardrobe quite spoiled, before even duke Charles could come to Stockholm to take the administration into his hands until king Sisgismund should return. This, however, was far from being the greatest disaster which befel the nation at this time. It was known that the king had embraced the Popish religion, and it was with good reason suspected that he would attempt to restore it upon his arrival in Sweden. Sigismund also was obliged, on leaving Poland, to promise that he would stay no longer in Sweden than was necessary to regulate his affairs. These circumstances served to alienate the minds of the Swedes from their sovereign even before they saw him; and the universal dissatisfaction was increased, by seeing him attended, on his arrival in Sweden in 1593, by Malaspina the pope's nuncio, to whom he made a present of 30,000 ducats to defray the expences of his journey to Sweden.

37 Prince Sigismund chosen king of Poland.

38 ... cceeds to the crown of Sweden.

What the people had foreseen was too well verified: the king refused to confirm the Protestants in their religious privileges, and showed such partiality on all occasions to the Papists, that a party was formed against him; at the head

39 A party formed against Sigismund.

Sweden.

of which was duke Charles his uncle. Remonſtrances, accompanied with threats, took place on both ſides; and at a private interview between the king and Charles, the diſpute would have ended in blows, had they not been parted by ſome of the nobility. This, however, made ſuch an impreſſion upon Sigiſmund, that he was apparently reconciled to his brother, and promiſed to comply with the inclinations of the people in every reſpect, though without any inclination to perform what he had promiſed. The agreement, indeed, was ſcarce made, before Sigiſmund conceived the horrid

40 Forms a deſign of murdering his uncle.

deſign of murdering his uncle at the Italian comedy acted the night after his coronation. The duke, however, having notice of the plot, found means to avoid it. This enraged the king ſo much, that he reſolved to accompliſh his deſigns by force; and therefore commanded a Poliſh army to march towards the frontiers of Sweden, where they committed all the ravages that could be expected from an enraged and cruel enemy. Complaints were made by the Proteſtant clergy to the ſenate: but no other reply was made them, than that they ſhould abſtain from theſe bitter invectives and reproaches, which had provoked the Catholics, until the king's departure; at which time they would be at more liberty.

In 1595 Sigiſmund ſet ſail for Dantzic, leaving the adminiſtration in the hands of duke Charles. The conſequence of this was, that the diſſenſions which had already taken place being continually increaſed by the obſtinacy of

41 Sigiſmund depoſed, and is ſucceeded by Charles IX.

the king, duke Charles aſſumed the ſovereign power; and in 1604 Sigiſmund was formally depoſed, and his uncle Charles IX. raiſed to the throne. He proved a wiſe and brave prince, reſtoring the tranquillity of the kingdom, and carrying on a war with vigour againſt Poland and Denmark. He died in 1611, leaving the kingdom to his ſon, the celebrated Guſtavus Adolphus.

42 State of Sweden on the acceſſion of Guſtavus Adolphus.

Though Charles IX. by his wiſe and vigorous conduct had in a great meaſure retrieved the affairs of Sweden, they were ſtill in a very diſagreeable ſituation. The finances of the kingdom were entirely drained by a ſeries of wars and revolutions; powerful armies were preparing in Denmark, Poland, and Ruſſia, while the Swediſh troops were not only inferior in number to their enemies, but the government was deſtitute of reſources for their payment.

43 He is allowed to take the adminiſtration while yet a minor.

Though the Swediſh law required that the prince ſhould have attained his 18th year before he was of age, yet ſuch ſtriking marks of the great qualities of Guſtavus appeared, that he was allowed by the ſtates to take upon him the adminiſtration even before this early period. His firſt act was to reſume all the crown-grants, that he might be the better able to carry on the wars in which he was unavoidably engaged; and to fill all places, both civil and military, with perſons of merit. At the head of domeſtic and foreign affairs was placed chancellor Oxenſtiern, a perſon every way equal to the important truſt, and the chooſing of whom impreſſed mankind with the higheſt opinion of the young monarch's penetration and capacity.

Soon after his acceſſion, Guſtavus received an embaſſy from James I. of Britain, exhorting him to make peace with his neighbours. This was ſeconded by another from Holland. But as the king perceived that the Daniſh monarch intended to take every opportunity of cruſhing him, he reſolved to act with ſuch vigour, as might convince him

44 He invades Denmark, and obliges the king to conclude a peace.

that he was not eaſily to be overcome. Accordingly he broke into Denmark with three different armies at once; and though the enemy's ſuperiority at ſea gave them great advantages, and the number of the king's enemies diſtracted his attention, he carried on the war with ſuch ſpirit, that in 1613 a peace was concluded upon good terms. This war being finiſhed, the king applied himſelf to civil polity, and made ſome reformations in the laws of Sweden. In 1615, hoſtilities were commenced againſt Ruſſia, on account of the refuſal of that court to reſtore ſome money which had been formerly lent them. The king entered Ingria, took Kexholm by ſtorm, and was laying ſiege to Pleſcow, when, by the mediation of James I. peace was concluded, on condition of the Ruſſians repaying the money, and yielding to Sweden ſome part of their territory. In this and the former war, notwithſtanding the ſhortneſs of their duration, Guſtavus learned the rudiments of the military art for which he ſoon became ſo famous. He is ſaid, indeed, to have catched every opportunity of improvement with a quickneſs of underſtanding ſeemingly more than human. In one campaign, he not only learned, but improved, all the military maxims of La Gardie, a celebrated general, brought the Swediſh army in general to a more ſteady and regular diſcipline than had formerly been exerciſed, and formed and ſeaſoned an invincible body of Finlanders, who had afterwards a very conſiderable ſhare in the victories of the Swedes.

4[5] Ruſſia invaded with ſucce[ſs].

4[6] Extraordinary military genius of the king.

Peace was no ſooner concluded with Ruſſia, than Guſtavus was crowned with great ſolemnity at Upſal. Soon after this, Guſtavus ordered his general La Gardie to acquaint the Poliſh commander Codekowitz, that as the truce between the two kingdoms, which had been concluded for two years, was now expired, he deſired to be certainly informed whether he was to expect peace or war from his maſter. In the mean time, having borrowed money of the Dutch for the redemption of a town from Denmark, he had an interview on the frontiers with Chriſtian the king of that country. At this interview, the two monarchs conceived the utmoſt eſteem and friendſhip for each other; and Guſtavus obtained a promiſe, that Chriſtian would not aſſiſt Sigiſmund in any deſigns he might have againſt Sweden. In the mean time, receiving no ſatisfactory anſwer from Poland, Guſtavus began to prepare for war. Sigiſmund entered into a negotiation, and made ſome pretended conceſſions, with a view to ſeize Guſtavus by treachery; but the latter having intimation of his deſign, the whole negotiation was changed into reproaches and threats on the part of Guſtavus.

Has friendly interview with the king of Denmark, and prepares for war with Poland.

Immediately after this, Guſtavus made a tour in diſguiſe through Germany, and married Eleonora the daughter of the elector of Brandenburg. He then reſolved to enter heartily into a war with Poland; and with this view ſet ſail for Riga with a great fleet, which carried 20,000 men. The place was well fortified, and defended by a body of veterans enthuſiaſtically attached to Sigiſmund. A dreadful bombardment enſued; the ſtreets were raked by the cannon, and the houſes laid in aſhes by the bombs; the moat was filled up, one of the half moons taken by ſtorm, and the ſtrong fortreſs of Dunamund was reduced. The cannon having now effected a breach in another part of the walls, Guſtavus reſolved to make a general aſſault. For this purpoſe a flying bridge over the moat was contrived by his majeſty; for though the ditch was filled with faſcines and rubbiſh, it ſtill contained too much water to admit the paſſage of a large body of men. The ſoldiers, however, crowded on to the attack with ſo much impetuoſity, that the bridge gave way, and the attempt proved unſucceſsful. Next day the Swedes were repulſed in attempting to ſtorm another half-moon; and the king was obliged to proceed more ſlowly. By the middle of September, at which time the town had been inveſted for ſix weeks, two bridges were thrown over the river together with a ſtrong boom, while the Swedes had formed their mines under the ditch. The garriſon being now reduced to extremity, were obliged to capitulate;

Marries Eleonora daughter of the elector of Brandenburg.

Riga beſieged and taken.

capitulate; and Guſtavus treated the inhabitants with great clemency.

After the reduction of Riga, the Swediſh monarch entered Courland, where he reduced Mittau; but ceded it again on the concluſion of a truce for one year. Sigiſmund, however, no ſooner had time to recover himſelf, than he began to form new enterpriſes againſt the Swedes in Pruſſia; but Guſtavus ſetting ſail with his whole fleet for Dantzic, where the king of Poland then reſided, ſo broke his meaſures, that he was obliged to prolong the truce for another year. Sigiſmund, however, was not yet appriſed of the danger he was in, and refuſed to liſten to any terms of accommodation: upon which Guſtavus entering Livonia, defeated the Poliſh general, and took Derpt, Hockenhauſen, and ſeveral other places of leſs importance; after which, entering Lithuania, he took the city of Birſen.

Notwithſtanding this ſucceſs, Guſtavus propoſed peace on the ſame equitable terms as before; but Sigiſmund was ſtill infatuated with the hopes that, by means of the emperor of Germany, he ſhould be able to conquer Sweden. Guſtavus finding him inflexible, reſolved to puſh his good fortune. His generals Horn and Thurn defeated the Poles in Semigallia. Guſtavus himſelf with 150 ſhips ſet ſail for Pruſſia, where he landed at Pillaw. This place was immediately delivered up to him; as were alſo Braunſberck, Frawenberg, Elbing, Marienberg, Mew, Dirſchau, Stum, Chriſtburg, &c. Sigiſmund, alarmed at the great ſucceſſes of Guſtavus, ſent a body of forces to oppoſe him, and to prevent Dantzic from falling into his hands. In this he was attended with as bad ſucceſs as before. His troops were defeated before Marienberg, Mew, and Dirſchau; and in May 1627, Guſtavus arrived with freſh forces before Dantzic, which he would probably have carried, had he not been wounded in the belly by a cannon-ſhot. The Poles in the mean time recovered Mew; and the States of Holland ſent ambaſſadors to mediate a peace between the two crowns. Sigiſmund, however, depending upon the aſſiſtance of the emperor of Germany and king of Spain, determined to hearken to no terms, and reſolved to make a winter-campaign; but Guſtavus was ſo well intrenched, and all his forts were ſo ſtrongly garriſoned, that the utmoſt efforts of the Poles were to no purpoſe (A). The city of Dantzic in the mean time made ſuch a deſperate reſiſtance as greatly irritated Guſtavus. In a ſea-engagement the Swediſh fleet defeated that of the enemy; after which Guſtavus, having blocked up the harbour with his fleet, puſhed his advances on the land-ſide with incredible vigour. He made a ſurpriſing march over a moraſs 15 miles broad, aſſiſted by bridges of a peculiar conſtruction, over which he carried a ſpecies of light cannon invented by himſelf. By this unexpected manœuvre he got the command of the city in ſuch a manner, that the garriſon were on the point of ſurrendering, when, by a ſudden ſwell of the Viſtula, the Swediſh works were ruined, and the king was obliged to raiſe the ſiege. In other reſpects, however, the affairs of Guſtavus went on with their uſual good fortune. His general Wrangel defeated the Poles before Brodnitz, of whom 3000 were killed, and 1000 taken priſoners, with five pieces of cannon and 2000 waggons loaden with proviſions. At Stum the king gained another and more conſiderable victory in perſon.

Sweden.

55 The Poles and Germans defeated with great ſlaughter in two engagements.

The emperor had ſent 5000 foot and 2000 horſe under Arnheim, who joined the main army commanded by the Poliſh general Conieccſpolſki, in order to attack the Swediſh army encamped at Quidzin. The enemy were ſo much ſuperior in number, that the friends of Guſtavus repreſented to him the imminent danger of attacking them. But the king being determined, the engagement began. The Swediſh cavalry charged with ſuch impetuoſity, contrary to their ſovereign's expreſs order, that they were almoſt ſurrounded by the enemy; but Guſtavus, coming up to their aſſiſtance, puſhed the enemy's infantry with ſo much vigour, that they gave way, and retreated to a bridge they had thrown over the Werder. But here they were diſappointed; for the Swedes had already taken poſſeſſion of the bridge. On this a new action enſued more bloody than the former, in which the king was expoſed to great danger, and thrice narrowly eſcaped being taken priſoner; but at laſt the Poles were totally defeated, with the loſs of a great many men, 22 pair of colours, five ſtands, and ſeveral other military trophies. The ſlaughter of the German auxiliaries was ſo great, that Arnheim ſcarce carried off one half of the troops he brought into the field. This defeat did not hinder the Poliſh general from attempting the ſiege of Stum; but here again he was attended by his uſual bad fortune. The garriſon ſallied out, and he was defeated with the loſs of 4000 men. The blame of this miſfortune was laid upon Arnheim; who was recalled, and ſucceeded by Henry of Saxe Lawenburg and Philip count Mansfeldt. The change of general officers, however, produced no good conſequences to the Poles; a famine and plague raged in their camp, ſo that they were at laſt obliged to conſent to a truce for ſix years, to expire in the month of June 1635. The conditions were, that Guſtavus ſhould reſtore to Sigiſmund the towns of Brodnitz, Stum, and Dirſchau; that Marienberg ſhould remain ſequeſtrated in the hands of the elector of Brandenburg, to be reſtored again to Sweden in caſe a peace was not concluded at the end of the ſix years. Guſtavus, on his ſide, kept the port and citadel of Memel, the harbour of Pillau, the town of Elbing, Braunſberg, and all that he had conquered in Livonia.

56 They are again defeated, and obliged to conſent to a truce of ſix years.

Guſtavus having thus brought the war with Poland to an honourable concluſion, began to think of reſenting the conduct of the emperor in aſſiſting his enemies and oppreſſing the Proteſtant ſtates. Before embarking in ſuch an important undertaking, it was neceſſary that he ſhould conſult the diet. In this the propriety of engaging in a war with Germany was warmly debated; but, after much altercation, Guſtavus in a very noble ſpeech determined the matter, and ſet forth in ſuch ſtrong terms the virtuous motives by which he was actuated, that the whole aſſembly wept, and every thing was granted which he could require.

57 Guſtavus reſolves on war with the emperor.

It was not difficult for Guſtavus to begin his expedition. His troops amounted to 60,000 men, hardened by a ſucceſſion of ſevere campaigns in Ruſſia, Finland, Livonia, and Pruſſia. His fleet exceeded 70 ſail, carrying from 20 to 40 guns, and manned with 6000 mariners. Embarking

his

(A) In this campaign the practice of duelling became ſo prevalent in the Swediſh army, as to engage the king's attention, and to oblige him to ſuppreſs it by very rigorous edicts. Soon after theſe were paſſed, a quarrel aroſe between two general officers, who aſked his majeſty's permiſſion to decide their difference by the laws of honour. The king conſented, but wiſhed to be a ſpectator of their courage. He went to the place appointed, attended by a body of guards, and having ordered the executioner to be called, "Now gentlemen, ſaid he to the officers, fight until one dies;" adding to the excutioner, "Do you immediately cut off the head of the other." On this the quarrel was dropped, and no more challenges were heard of in the camp.

Reduces Wolgast, Stetin, &c. his troops, he landed at Usedom on the 24th of June 1630, the Imperialists having evacuated all the fortresses they possessed there; and the isle of Rugen had been before reduced by general Lesly, in order to secure a retreat if fortune should prove unfavourable. Passing the frith, Gustavus stormed Wolgast and another strong fortress in the neighbourhood, leaving general Kannier with a garrison for the defence of these conquests. He then proceeded to Stetin; which was no sooner invested than it consented to receive a Swedish garrison, and the king persuaded the duke of Pomerania to enter into an alliance with him. In consequence of this the Swedish troops were received into several towns of Pomerania; and the most bitter enmity took place between the Imperialists and Pomeranians, each refusing the other quarter.

These successes of Gustavus struck the empire with consternation; for being already overwhelmed with civil dissensions, they were in no condition to resist so impetuous an
59 Count Tilly chosen general by the emperor.
enemy. At this time also the Imperialists were without a general, the command of the army being disputed by a number of candidates of very unequal merit; but at last count Tilly was fixed upon as the most proper person, and invested with the dignity of Veldt Mareschal. In the mean time the king being reinforced by a considerable body of troops in Finland and Livonia under the conduct of Gustavus Horn, defeated the Imperialists before Griffenhagen; taking the place soon after by assault. By this and some other conquests he opened a passage into Lusatia and Silesia; but in the mean time count Tilly cut off 2000 Swedes
60 Cuts off 2000 Swedes.
at New Brandenburg, owing to the obstinacy of their commander Kniphausen, who had orders to evacuate the place and join the main army. This advantage, however, was soon overbalanced by the conquest of Franckfort on the
61 Franckfort and Landsberg taken by Gustavus.
Oder, which Gustavus took by assault, making the whole garrison prisoners. Thus he commanded the rivers Elbe and Oder on both sides, and had a fair passage not only to the countries already mentioned, but also to Saxony and the hereditary dominions of the house of Austria. Soon after this, Gustavus laid siege to Landsberg, which he took by assault; though the number of soldiers he had with him was so inconsiderable, that he had thoughts of sending to the main army for a reinforcement before the prisoners should march out, being apprehensive that they might give him battle in the open field, though they could not defend themselves behind walls.

About this time the Protestant princes held a diet at Leipsic; to which Gustavus sent deputies, and conducted his negotiations with such address, as tended greatly to promote his interests. Immediately after this he reduced
62 He reduces Pomerania, and restores the dukes of Mecklenburg.
Gripswald, and with it all Pomerania. Then marching to Gustrow, he restored the dukes of Mecklenburg to their dominions. Here the Imperialists had tyrannized in such a manner that Gustavus was received as the deliverer of the people; and the ceremony of the duke's inauguration was in a short time performed with great solemnity.

All this time count Tilly was employed in the siege of Magdeburg; but now, being alarmed at the repeated successes of the Swedes, he left Pappenheim with part of the army before that city, while he marched with the rest into Thuringia, to attack the landgrave of Hesse-Cassel and the
63 Magdeburg taken by the Imperialists, and the inhabitants cruelly used.
elector of Saxony. After a most obstinate defence, Magdeburg fell into the hands of Pappenheim, when he committed all imaginable cruelties. Gustavus formed a plan of recovering the city; but was obliged to abandon it, by Pappenheim's throwing himself into the place with his whole army, and by the progress which Tilly was making in Thuringia. Relinquishing this enterprise, therefore, he ordered Bannier to attack Havelburg; which was done with such resolution, that the place was forced in a few hours, and all the garrison made prisoners. Werben was next obliged to submit after an obstinate conflict, in which many fell on both sides.—These successes obliged count Tilly to attempt in person to check the progress of the Swedes. He detached the vanguard of his army, composed of the flower of the Imperial cavalry, within a few miles of the Swedish camp. An action ensued, in which Bernstein the Imperial general was defeated and killed, with 1500 of his men. Gustavus, after this advantage, placed himself in a situation so much superior to his enemies, that count Tilly was fired with indignation, and marched up to the Swedish lines to give him battle. Gustavus kept within his works, and Tilly attacked his camp, though almost impregnably fortified, keeping up a most terrible fire from a battery of 32 pieces of cannon; which, however, produced no other effect, than obliging the Swedish monarch to draw up his army behind the walls of Werben. Tilly had placed his chief hopes in being able to nail up the enemy's cannon, or set fire to their camp in divers quarters; after which he proposed making his grand attack. With this view he bribed some prisoners; but they betrayed him, and told his design to Gustavus. The king ordered fires to be lighted in different parts of his camp, and his soldiers to imitate the noise of a tumultuous disorderly rabble. This had the desired effect. The count led his army to the breach made by the cannon; where he was received with such a volley of grape shot as cut off the first line, and put the whole body in disorder, so that they could never be brought back to the charge. In this confusion the Imperial army was attacked by Banditzen, and, after an obstinate conflict, obliged to quit the field.

64 Havelburg and Werben taken. The vanguard of the Imperial cavalry defeated by the Swedes.

65 Count Tilly defeated by Gustavus.

Soon after this action the queen arrived at the camp with a reinforcement of 8000 men; at the same time a treaty was concluded with Charles I. of England, by which that monarch allowed the marquis of Hamilton to raise 6000 men for the service of Gustavus. These auxiliaries were to be conducted to the main army by a body of 4000 Swedes; and were in every thing to obey the king while he was personally present, but in his absence were to be subject to the orders of the marquis. With these troops the king had resolved to make a diversion in Bremen: but the marquis finding it impossible for him to effect a junction with the Swedish army, resolved, without debarking his troops, to steer his course for the Oder, and land at Usedom. Gustavus was very much displeased at finding his project thus disconcerted; however, making the best of the present circumstances, he commanded the British troops to act on the Oder instead of the Weser. The number of this little army was magnified exceedingly by report, insomuch that count Tilly had some thoughts of marching against them with his whole force; but on the departure of the marquis for Silesia, he reinforced the army in that country with a large detachment, which was thought to contribute not a little to the defeat he soon after received.

66 A body of British soldiers in the assistance of the Swedes.

Ever since the late action Gustavus had kept within his intrenchments, where his army was well provided with every thing. Tilly made several attempts to surprise or draw him to an engagement; but finding all his endeavours fruitless, he marched into Saxony, and laid siege to Leipsic. This precipitate measure proved highly advantageous to the Swedish monarch; as thus the elector, who had been wavering in his resolutions, was now obliged to have recourse to the Swedes, in order to preserve himself from utter destruction. A treaty offensive and defensive was immediately concluded with Gustavus: and the elector willingly promised every thing that was required of him; and among the rest, that not only the prince his son, but he himself, should

ſhould reſide in the Swediſh camp, and engage his life and fortune in the common cauſe. Tilly, in the mean time, carried fire and ſword into the unhappy electorate. At the head of an army of 44,000 veterans, he ſummoned the city of Leipſic to ſurrender; denouncing the ſame vengeance againſt it as had been executed on Magdeburg, in caſe of a refuſal. By this the governor was ſo much intimidated, that he inſtantly ſubmitted; and alſo ſurrendered the caſtle of Paſſenberg, which was in a condition to have ſtood out till the arrival of the Swediſh army. The elector, enraged at the loſs of theſe valuable places, ordered his army to join the Swedes with all expedition, and preſſed the king ſo warmly to engage, that at laſt he yielded to his deſire.

67 ...ny ra-...d by ...t Tilly, takes ...ſic.

68 ...le of ...ſic.

On the 7th of September 1631, Guſtavus led out his army in the moſt beautiful order, the Swedes forming one column on the right, and the Saxons another on the left; each amounting to 15,000 men. Tilly drew up his men in one vaſt column, poſſibly with a view of ſurrounding the flanks of the king's army; but every officer of experience in his army, from the excellency of the Swediſh diſpoſition, prognoſticated the event of the engagement. Guſtavus led on the troops againſt that wing of the Imperialiſts commanded by Pappenheim, whom he drove back to ſuch a diſtance, that he gained a point of the wind; by which the ſmoke fell upon their enemies and conſiderably embarraſſed them, at the ſame time that the Swedes were got without the reach of a battery which played furiouſly on their flank. General Bannier in the mean time cut in pieces the troops of Holſtein, and mortally wounded the duke who commanded them. Pappenheim led on his troops ſeven times to the charge, in hopes of regaining his former ſituation; but was as often repulſed by the Swedes. Tilly all this while engaged with the Saxons; but having at laſt driven them off the field, the whole ſtrength of the Imperial army was turned upon the Swediſh left wing commanded by General Horn. The Swedes ſuſtained the attack with the greateſt firmneſs, until the king detached general Teuffel with the centre to aſſiſt them. The Imperialiſts then were no longer able to ſtand their ground; but gave way everywhere except in the centre, which was compoſed of 18 regiments of veterans accuſtomed to victory, and deemed invincible. They made incredible efforts to maintain the reputation they had acquired; and, though ſwept off in great numbers by the Swediſh artillery, never ſhrunk or fell into confuſion. Four regiments, after their officers had been killed, formed themſelves, and retired to the ſkirt of a wood; where they were all to a man cut in pieces, without demanding quarter. Tilly retired at the head of 600 men, and eſcaped by the coming on of the night. Seven thouſand Imperialiſts lay dead on the field of battle; 4000 were taken priſoners; a fine train of artillery was loſt, with upwards of 100 ſtandards, enſigns, and other military trophies.—On this occaſion it was that the Scots regiment in the Swediſh ſervice firſt practiſed the method of firing in platoons; to which ſome aſcribe the aſtoniſhment and confuſion that appeared in the Imperial army. It is thought, however, that the Swediſh monarch diſplayed greater abilities in gaining this victory than improving it afterwards; for had he marched immediately to Vienna, before his enemies had time to recover their conſternation, it is ſuppoſed that the emperor would have been obliged to abandon his capital, and leave his hereditary dominions to the mercy of the conqueror. But Guſtavus apprehended that Tilly might fall upon the Saxons while he was ravaging the Auſtrian hereditary dominions; which would have deprived him not only of an ally, but of the free quarters which the elector had promiſed to his troops in caſe of a retreat. For this and ſome other reaſons he determined to penetrate into Franconia, where he reduced ſeveral places, particularly the fortreſs of Workburg. Tilly having collected his ſcattered troops, which formed an army ſtill ſuperior in number to that of Guſtavus, marched to the relief of this place; but came too late. He then directed his march towards Rottenberg, where four regiments were cut in pieces by a Swediſh detachment. After this the king reduced Hanau, Franckfort on the Maine, and Mentz; deſtroying a body of Spaniards, who had thrown themſelves in his way to obſtruct his paſſage.

69 ...Impe-...ts de-...d with ...t ...hter.

70 ...duct of ...avus ...ured.

71 The Swedes ... and cut off four regi-...

The court of Vienna was now thrown into the utmoſt confuſion; and ſent everywhere begging aſſiſtance, and ſoliciting the Catholic princes to arm in defence of their religion. The emperor was moſt embarraſſed in finding out a general capable of oppoſing Guſtavus in the field; for the late misfortunes of count Tilly had entirely ſunk his reputation. Walleſtein, an old experienced officer, was made choice of; but as he had formerly been diſgraced, it was apprehended that he would not accept of the command of which he had once been deprived. This objection, however, was got over; and Walleſtein not only accepted of the command, but, at his own expence, augmented the army to 40,000 men.

72 Walleſtein choſen general by the emperor.

73 A great number of towns taken by the Swedes.

During the whole winter the Swediſh army kept the field; and before the approach of ſummer had reduced Crantznach, Bobenhauſen, Kirchberg, Magdeburg, Gozlar, Northeim, Gottingen, and Dunderſtadt; while the landgrave William made great progreſs in Weſtphalia. Guſtavus Horn was repulſed before Bamberg; but ſoon had his revenge, by entirely deſtroying two regiments of Imperialiſts. To prevent the troops from being affected by the loſs before Bamberg, the king reſolved to give battle to Tilly, who was marching into Bavaria to prevent the Swedes from gaining a footing in that electorate. He purſued the Imperial general through a vaſt tract of country, defeated his rear-guard, and, having reduced a variety of towns and fortreſſes on the Danube, penetrated as far as Ulm. Advancing to the river Leck, count Tilly poſted himſelf in a wood on the oppoſite ſide, to diſpute his paſſage. Guſtavus endeavoured to diſlodge him by a regular fire from 70 pieces of cannon. The ſlaughter was dreadful; and Tilly himſelf, being wounded by a cannon-ball in the knee, died a few days before he was to have been ſuperſeded by Walleſtein. The following night the Imperial army evacuated the poſt; part retiring to Ingoldſtadt, and others to Newburg. Guſtavus immediately croſſed the river, and ſeized the towns of Rain and Newburg, which the enemy had abandoned. Augſburg next ſubmitted; and from the inhabitants of this place Guſtavus exacted an oath of fidelity, not only to himſelf but to the crown of Sweden. This meaſure gave the greateſt offence to many of the Germanic body, and made them imagine that the king of Sweden had other views than the defence of the Proteſtant cauſe.

74 Count Tilly defeated and killed.

From Augſburg the Swedes advanced towards Ratiſbon; but were diſappointed in their deſign of getting poſſeſſion of that city, by reaſon of the Bavarians having thrown a very numerous garriſon into the place.—In the mean time, ambaſſadors arrived from Denmark, offering the mediation of that crown for obtaining a laſting peace between the contending parties. Guſtavus, however, replied, that no ſuch peace could take place till the Catholic princes thought proper to grant the Proteſtants full and ample ſecurity for their enjoyment of future tranquillity. But the ambaſſadors had no inſtructions to propoſe any thing farther, and thus the negotiation vaniſhed. Guſtavus now, reſolving to retort upon themſelves the cruelties which the Bavarians had inflicted on the Proteſtants, laid the towns of Morzbourg, Frietengen, and Landſhut, in aſhes. The inhabitants of Munich ſaved themſelves by ſubmiſſion; but as the peaſants in that neigh-

75 Three towns laid in aſhes by the Swedes.

Sweden. neighbourhood had collected themſelves into bodies in order to murder the ſtragglers from the Swediſh army. Guſtavus burnt their houſes, and defeated the forces of the elector, who had been joined by a conſiderable body of militia.

While Guſtavus was thus employed, Wallſtein had aſſembled a vaſt army. He was ſtrongly ſolicited by the elector of Bavaria to come to his aſſiſtance; but, in revenge of the elector's having formerly obtained the command for count Tilly in preference to himſelf, he drew off towards Bohemia to encounter the Saxons. Arnheim, who commanded the

76 Saxon forces in that place, was the enemy of Guſtavus, who

The Saxons [illegible] Wallſtein. had formerly rallied him for his cowardice. He therefore permitted Walleſtein to gain an eaſy victory, in hopes that his maſter, the elector of Saxony, a prince entirely devoted to his pleaſures, might be induced to relinquiſh the friendſhip of ſuch a reſtleſs and warlike ally as Guſtavus; and indeed he uſed all the eloquence of which he was maſter to detach him from the Swediſh cauſe. Several advantages, in the mean time, were gained by the Imperialiſts. Pappenheim defeated the archbiſhop of Bremen's cavalry at Werden; and three Swediſh regiments were cut off near Kadingen. Pappenheim, however, was forced to retire, and withdraw his forces from Stade; of which the Swedes took poſſeſſion. Walleſtein and the elector of Bavaria, who had now joined their forces, threatened Guſtavus with greatly ſuperior numbers. At laſt, however, the king, being reinforced with 15,000 men, no longer declined the engagement; but Walleſtein was too wiſe to truſt the fate

77 of the empire to a ſingle engagement againſt ſuch an enemy

Guſtavus attacks his camp, and is repulſed with loſs. as the king of Sweden. Guſtavus attacked his camp, but was repulſed with the loſs of 2000 men; which cauſed a general murmuring and diſcontent againſt his raſhneſs. Several other misfortunes happened to the Swedes; and at laſt, after various manœuvres, Walleſtein bent his courſe towards Miſnia, in order to oblige the elector of Saxony to declare againſt the Swedes, and to draw them out of Bavaria. Guſtavus, notwithſtanding the inconſtancy of Auguſtus, immediately ſet out to aſſiſt him. With incredible diligence he marched to Miſnia, where the Imperialiſts were aſſembling their whole ſtrength. Hearing that the enemy were encamped at Weſſenfells, and that Pappenheim had been detached with a ſtrong corps, Guſtavus reſolved to engage

78

Battle of Lutzen. them before they could effect a junction. With this view he marched to Lutzen, where he attacked Walleſtein with incredible fury. The Swediſh infantry broke the Imperialiſts in ſpite of their utmoſt efforts, and took all their artillery. The cavalry not being able to paſs the river ſo expeditiouſly as the king thought neceſſary, he led the way, attended only by the regiment of Smaaland and the duke of Saxe-Lauwenburg. Here, after charging impetuouſly, he

79 was killed, as Puffendorff alleges, by the treachery of the

Guſtavus killed. duke; who, being corrupted by the emperor, ſhot him in the back during the heat of the action. The news of his death was in an inſtant ſpread over both armies. The courage of the Imperialiſts revived, and they now made themſelves ſure of victory. But the Swedes, eager to revenge the death of their beloved monarch, charged with ſuch fury that nothing could reſiſt them. The Imperialiſts

80 were defeated a ſecond time, juſt as Pappenheim, with his

The Imperialiſts defeated. freſh corps, came up to their aſſiſtance. On this the battle was renewed, but the Swedes were ſtill irreſiſtible. Pappenheim was mortally wounded, and his army finally routed, with the loſs of 9000 killed in the field and in the purſuit.

81

Chriſtina, a minor, [illegible] Sweden. The victory of Lutzen proved more unfortunate to Sweden than the greateſt defeat. The crown devolved upon Chriſtina, an infant of ſix years old; the nation was involved in an expenſive foreign war, without any perſon equal to the arduous taſk of commanding the armies, or regulating domeſtic affairs, as Guſtavus had done. However, Chriſtina the daughter of Guſtavus was immediately proclaimed queen. The regency devolved on the grand bailiff, the mariſchal, the high-admiral, the chancellor, and the treaſurer of the crown. Oxenſtiern was inveſted with the chief management of affairs, and conducted himſelf with the greateſt prudence. He was greatly embarraſſed indeed by the diviſions among the Proteſtant princes, which became more violent after the death of Guſtavus; but, in ſpite of all difficulties, he went on purſuing the intereſt of his country, and planning the means of retaining the Swediſh con- 82

queſts. Matters went on pretty ſucceſsfully till the year The Swedes

1634, when, through the raſhneſs of the Swediſh ſoldiers, receive

they were defeated at Nordlingen, with the loſs of 6000 great overthrow at

men killed on the ſpot, a number of priſoners, and 130 ſtan- Nordlingen.

dards, with other military trophies, taken by the enemy. Oxenſtiern's conſtancy was ſhaken by this dreadful blow; but he applied himſelf diligently to repair the loſs, by recruiting the army, and rendering the allies faithful. The latter proved the moſt difficult taſk. The death of Guſtavus, and the defeat at Nordlingen, had thrown them into deſpair; and every one was deſirous of making the beſt 83

terms he could with the emperor. The Saxons not only The Saxons

renounced their alliance with Sweden, but openly commen- declare

ced war againſt it; and though the regency would gladly againſt Sweden.

have conſented to an honourable peace, the enemy were now too much fluſhed with ſucceſs to grant it. Oxenſtiern had no other reſource than an alliance with France, and the bravery of his generals. In 1635, he went in perſon to the court of Louis, and concluded a treaty; which, however, 84

anſwered no purpoſe, as it was never obſerved. The ene- Succeſs of

my, in the mean time, puſhed their good fortune. They the Imperi-

ſurpriſed Philipſburg, where the French had laid up vaſt aliſts.

magazines; and reduced Spires, Augſburg, Treves, Wurtſburg, Cobourg, and ſome other places. To complete the misfortunes of Sweden, it was expected that the Poles would immediately invade Pruſſia. To prevent this, La Gardie was diſpatched thither with a powerful army; but as it was impoſſible to reſiſt ſo many enemies at once, the chancellor purchaſed the friendſhip of Poland for 26 years by ceding that duchy to the republic. Thus he got rid of a power- 85

ful enemy; and the Swediſh affairs began to revive by a The Saxons

victory which general Bannier gained over the Saxons, in defeated by

conſequence of which they were driven beyond the Elbe. general Bannier.

Early in the ſpring of 1636, the Saxons made ſome motions as if they intended to cut off Bannier's communication with Pomerania. This he prevented by a ſtratagem; defeated a body of the enemy; and obliged the Saxons to retire. Soon after this he drove them out of their winter-quarters with conſiderable loſs; at which time alſo a conſiderable body of Imperialiſts who came to their aſſiſtance 86

were diſperſed. In Weſtphalia general Kniphauſen beat The Impe-

the Imperialiſts with the loſs of 1500 men, but he himſelf rialiſts de-

was killed in the purſuit, and his army obliged to repaſs the feated

Weſer. Some advantages were alſo gained in the neigh- Kniphauſen

bourhood of Minden by General Leſly, who had aſſembled 87

a conſiderable army. In Alſace, Bernard duke of Saxe- And the

Weymar defeated count Gallas the Imperial general, and duke of

diſperſed his army. But when every thing ſeemed thus ſuc- Saxe Weymar.

ceſsful for the Swedes, the city of Magdeburg, contrary to the expectation of every body, ſurrendered for want of powder, which the garriſon had wantonly conſumed. The Saxons alſo made ſome conqueſts on the Elbe, which obliged Bannier to recal general Leſly from Weſtphalia to march againſt them. The Saxons fixed on a moſt convenient ſituation, whence they hoped to deſtroy the Swediſh army without coming to a battle. But Bannier, reſolving to hazard every

every thing rather than suffer his army to be wasted by famine, advanced towards Perleberg, a place closely blocked up by the enemy. Here he drove from an advantageous post four regiments of Saxon cuirassiers, having killed or taken prisoners 400 men; after which he soon forced them to
88 a general engagement. The numbers were very unequal, Bannier's army amounting to 9000 horse and 7000 foot, and the Saxons to 15,000 horse and 13 battalions of foot. The battle began with great fury; the right wing of the Swedes was almost oppressed by numbers before the left could come to their assistance. They were ten times driven back, and as often returned to the charge. At last they made such a desperate effort, that the enemy were entirely broken and defeated. Five thousand were killed on the spot, 3000 wounded, and as many taken prisoners, together with 150 colours and standards, and several pieces of cannon.

Thus ended the campaign of 1636, in a manner highly honourable to the Swedes. Some fruitless negotiations were set on foot during the winter; but these coming to nothing, Bannier quitted his winter-quarters very early in
89 the season; and falling upon eight regiments of Saxons cantoned at Eulenburg, pursued them to Torgau, where he obliged them to surrender at discretion. Another party of Saxons was defeated in the neighbourhood of Leipsic; after which he proposed investing that city. But in this project he was disappointed by the Imperialists penetrating into
90 Thuringia. He then called in all his detachments, with a view to prevent them from crossing a river named *Sala*; but in this also he was disappointed. However, he had the good fortune to defeat 2000 Imperialists near Pegau, and to destroy several detachments that attempted to obstruct his march. Yet, notwithstanding all these successes, Bannier found his situation every day more straitened, from the continual increase of the enemy's forces; which obliged him at last to retreat into Pomerania, out of which he soon drove count Gallas.

The affairs of the Swedes were now once more reduced to the brink of ruin, through the unguarded conduct of general Wrangel, who had also an army in Pomerania. After Bannier had driven count Gallas out of the province as above mentioned, Wrangel, imagining himself perfectly secure, cantoned his troops, and extended his quarters, the bet-
91 ter to accommodate his army. But Gallas, being informed of this proceeding, suddenly returned, ravaged all Upper Pomerania, and reduced the towns of Usedom, Demmin, and Wollin; after which, leaving garrisons in the fortresses, he returned to his winter-quarters in Saxony.

This unfortunate campaign counterbalanced all the advantages of the former. Wrangel was so struck with the suddenness of the blow, that he could take no measures for
92 opposition. Some of the Swedish allies again fell off, and took up arms against them. In 1638, the Swedish affairs again began to revive in this quarter, through the excellent conduct of Bannier, who defeated count Gallas with the loss of 3000 men killed and taken prisoners. Pursuing his good fortune, he so harassed the count, that he obliged him in great haste to repass the Elbe, and take shelter in the hereditary dominions of Austria. Great as Bannier's exploits
93 had been, however, they were eclipsed by those of duke Bernard. That general had so increased his army in the Protestant cantons of Switzerland, and in Franche Comte, that he found himself in a condition to act without the assistance of the French, who indeed were but treacherous allies. Advancing to the Rhine, he seized on Seckingen and Lassuburg, and laid siege to Rheinfield. The Imperialists, in conjunction with the troops of Bavaria, advanced to the relief of the place. An engagement ensued, in which the victory was disputed: the enemy threw succours into the city, and the duke withdrew his army. Within a month he gave them battle a second time; and so completely defeated them, that only one Imperial officer above the rank of a captain escaped being killed or taken prisoner. He then renewed the siege of Rheinfield; which he reduced, as well as several other important places. Advancing to Brisac, he blocked it up with a design of forcing the garrison to surrender by famine. General Gotz, with 12,000 men, attempted to throw in 1000 waggons of provisions; but he was defeated, with the loss of all his men except 2500. Duke Charles of Lorrain, with 4000 men, joined the remains of Gotz's army, in order to relieve the town; but being surprised by Bernard, his whole army was cut in pieces. A third attempt was made by Gotz, but it proved as unsuccessful as the former; and the place being reduced to great straits, was obliged to capitulate.

In January 1639, the two victorious generals Bernard and Bannier prepared to attack the enemy on their own ground. Bannier made an irruption into the territories of Anhalt and Halberstadt. Leaving his infantry behind, he pushed on with his cavalry, and surprised Salis, grand-master 94
of the Imperial artillery. After a bloody conflict, the Bannier de-
Swedes gained a complete victory, seven regiments of the feats the
enemy being cut in pieces. Next entering Saxony, he de- enemy in several en-
feated four regiments of the enemy, obliging a much larger gagements.
body to take shelter under the cannon of Dresden. Hearing that the Saxons were encamped near Chemnitz, where they waited to be joined by the Imperialists, he resolved to attack them before this junction could be effected. The same good fortune still attended his arms, and the Saxons were almost all killed or taken. Bannier next entering into Bohemia, laid the country under contribution; after which, returning cross the Elbe, he fell on general Hofskirk, who was encamped near Brandeiz with 10 regiments of horse and several battalions of foot. Him he defeated with the loss of 2000 men. The remains of the Imperial forces were pursued to the walls of Prague, and the generals Hofskirk and Montecuculi were taken prisoners. Yet, notwithstanding these constant successes, the enemies of Bannier multiplied daily. He had expected an insurrection in his favour in Silesia or Bohemia; but no such event took place. The Protestant princes, overawed by the enemy, did not send him the necessary assistance. Undismayed, however, by difficulties or danger, Bannier performed wonders. He defeated a body of Imperialists at Glatz; three times he drove the Saxons from their camp at Firn; and yet was forced to evacuate the place, because he could not spare a garrison. His army being destitute of the means of recruiting, was considerably diminished in number; yet with it he reduced a number of towns, and obtained a variety of other important advantages, when on a sudden all his hopes were blast- 95
ed by the death of the duke of Saxe-Weymar; poisoned, Death of
as was supposed, by the French, who were desirous of get- the duke of Saxe-
ting the town of Brisac into their hands, from which the Weymar.
duke prevented them.

The difficulties to which Bannier was now reduced pro- 96
ved extreme. The French monarch took upon him to dis- Treachery
pose of the army and conquests of Bernard as he thought of the
proper. Brisac, and other places of importance, he kept to French.
himself; after getting possession of which, the French endeavoured, as much as possible, to ruin the army. In the mean time, the Imperial army under Piccolomini, in the Netherlands, was prodigiously augmented; and the archduke Leopold-William, in quality of generalissimo, was assembling his whole strength to crush the Swedes at once. Bannier, however, did not despair. George duke of Lunenburg having conceived some disgust at the emperor, Bannier hoped to

Sweden. to gain him over: he therefore approached nearer to his country; by which also he drew towards the armies of Weymar and Hesse. In his way he cut in pieces a body of 3000 Croats. General Konigsmark routed the Imperialists at Gera; a second time at Scholen; and a third time entirely defeated them near Leipsic. Bannier was very pressing on the allies to join him; and at last, in 1640, he was joined by the Weymar army under the dukes of Longueville and Gubrien, a body of Hessians led by general Melander, and the troops of Lunenburgh commanded by general Klitzing. The army now amounted to 22 battalions of infantry and 22,000 horse; so that they were much more than a match for their enemies, had they been under the sole direction of Bannier. But unanimity was wanting; every one would be supreme in the command; and Bannier, the best general of them all, had the least influence. Instead of those masterly and decisive strokes by which the Swedes had hitherto distinguished themselves, the armies continued looking at one another, each suffering the rigours of famine. At last Bannier, resolving to expose his troops no longer, set out for Thuringia, through Franconia, to seize an advantageous post on the Maine; but as he advanced to the Sala, he found the Imperialists entrenched on the other side. Finding it impossible to force a passage, he took the road through Hesse, where his troops suffered greatly by famine. Here he proposed to fight the enemy; but the Landgrave and duke of Lunenburg refused their consent. Upon this he threatened to leave them to the mercy of the confederates, and thus obliged them to be somewhat more pliant. None of those brilliant successes, however, now attended the operations of the Protestant allies: the campaigns of 1640 and 1641 were spent in useless marches and countermarches; serving only to bring the army into the greatest dangers, from which they were as constantly relieved by the active and intrepid Bannier. At last this brave general, worn out with perpetual fatigues, died of a fever in the year 1641, leaving the Swedish army in a worse situation than ever.

97 Imperialists defeated by Konigsmark.

98 Death of Bannier.

The Imperialists were too well acquainted with the abilities of Bannier, not to take advantage of the opportunity offered by his death. A Swedish detachment was cut in pieces at Quidlenberg. The Swedish army, accustomed only to be obedient to Bannier, became mutinous, and Piccolomini resolved to fall upon them with his whole force. But the four generals, Wrangel, Konigsmark, Wittemberg, and Pful, having convinced the soldiers of the necessity of defending themselves, made such excellent dispositions, that the Imperialists durst not attack them. Piccolomini then detached part of his army to attack the Hessians in their quarters; but Wrangel and Konigsmark threw themselves in their way, and defeated them with the loss of 2000 men. This victory, however, did not retrieve the Swedish affairs. Dissensions and mutiny began again to take place in the army to such a degree as threatened its dissolution. In 1642 general Torenston was sent from Sweden, with a large sum of money and a strong reinforcement, to take upon him the supreme command. This general was inferior in abilities to none of his predecessors, and designed without loss of time to come to an engagement; but the Weymar army separating from him, put an end to that design, and obliged him to remain for a considerable time inactive. He was also confined to his chamber for some time by a dangerous gout; and thus a report of his death being spread, the Imperialists were encouraged to begin a long march through roads scarce passable, in hopes of surprising the Swedish army without a general. Torstenson having intelligence of this, seized an advantageous post, which could not be forced; and thus obliged the enemy to retreat, after having suffered as much by their fatiguing march as if they had fought a bloody battle. Then joining general Stalhanch, who had been driven by the Imperialists out of Silesia, he reduced the town of Great Glogau, with a number of other important places; after which he laid siege to Schweidnitz. The duke of Saxe-Lawenburgh, at the head of all his cavalry, endeavoured to throw in succours; but was defeated with the loss of 3000 men. He himself was taken prisoner, and died of chagrin a few days after. In consequence of this defeat Schweidnitz surrendered at discretion; and Torstenson having sent a detachment to invest the city of Neisse, proceeded with the rest to drive the enemy entirely out of Silesia. This he effectually performed; obliging them to retire over barren mountains, almost famished for want of provisions, and harassed by his light troops; so that this lately formidable army was almost entirely ruined. With his victorious troops the Swedish general then poured into Moravia; where, in five days, he reduced the strong town of Olmutz (which not long ago sustained a siege of as many weeks by the late king of Prussia). Litta and Newstadt shared the same fate; after which, the Swedes, returning suddenly to Silesia, made themselves masters of Oppelein and Brieg, and laid siege to Breslau. Here the garrison made such an obstinate defence, that the Imperialists had time to assemble under the conduct of the archduke Leopold, and come to their relief. As Torstenson was greatly inferior in number, he raised the siege; but appeared so formidable in his retreat, that the enemy durst neither attack him, nor attempt to prevent his encamping in a very advantageous situation. The Imperialists took this opportunity of laying siege to Glogau; but after having lost a great number of men, they were forced to abandon the enterprise on the junction of Wrangel with Torstenson; by which means the Swedes were once more in a condition to face their enemies in the field.

99 A Swedish detachment cut in pieces.

100 The Imperialists defeated.

101 General Torstenson takes the command of the Swedish army.

102 Reduces several towns.

103 Drives the Imperialists out of Silesia, and takes Olmutz, &c.

Torstenson now projected an irruption into Bohemia, and putting his army into winter-quarters in that country; but in this he was prevented by the vigilance of the enemy: however, he reduced the city of Zittau, where, for the first time, a cartel for prisoners was established; by which means the Swedish army was considerably augmented. Thus disappointed in his designs on Bohemia, Torstenson directed his course to Leipsic, which he intended to invest. The Imperial generals assembled their whole force, and set out to relieve that important place. The two armies soon came in sight of each other; and a furious cannonading was the prelude to a general engagement. A single bullet had almost proved fatal to the Swedish cause. It carried away the furniture of Torstenson's horse, killed the count Palatine's horse, pierced general Rabenau through the body, took off the head of a celebrated counsellor named *Crabbe*, and carried away the leg of a private soldier. The Swedes, as soon as the armies came up, behaved with their wonted resolution, and after an obstinate conflict obtained a complete victory; 5000 of the enemy being killed on the spot, 3000 wounded, and as many taken prisoners. This victory was followed by the immediate surrender of Leipsic; and in all probability the Swedes would have finally triumphed over all their enemies, had not a rupture with Denmark ensued. Torstenson and Horn behaved with their usual valour in Holstein and Schonen, while general Konigsmark distinguished himself in Germany; but the ruin of the Weymar army, which was totally defeated with the loss of one half its number at Dettingen by the Bavarians, proved a dreadful blow, from which the Swedes could scarce recover themselves. Indeed, notwithstanding the valour and success of the Swedes, their affairs in Germany must have gone to wreck in the campaigns of 1643 and 1644, had not the French

104 Entirely defeats them at Leipsic.

105 War with Denmark.

106 The Swedes defeated at Dettingen.

French under Condé and Turenne made a moſt powerful diverſion, and performed ſuch exploits as immortalized the names of theſe two generals.

In 1645, the war againſt Denmark was puſhed with ſuch vigour, that a peace, very honourable and advantageous for Sweden, was concluded; and thus Torſtenſon was again at liberty to act againſt the Imperialiſts. He now took meaſures for carrying the war into the heart of the Auſtrian dominions. Hatfield aſſembled a conſiderable army to oppoſe the Swedes; and the emperor came in perſon to Prague to animate his troops. The two armies came in ſight at Jancowitz, and both prepared for an engagement. The valour of the Swedes once more prevailed; and they totally defeated their enemies. Four thouſand of the Imperialiſts were killed on the ſpot, among whom were general Hatfield and a great number of officers; and near 5000 were taken priſoners. No great advantages, however, were derived from this victory. Some towns indeed were reduced; but at laſt Torſtenſon was obliged to retire into Moravia, where he put his army into winter-quarters; and in the beginning of the year 1646 reſigned the command to Wrangel.

The new general conducted the Swediſh affairs with great ability and ſucceſs; till at laſt the Imperialiſts, finding themſelves finally unable to drive the Swedes out of Germany, concluded a peace with them in 1648. This was the memorable treaty of Weſtphalia, by which the Germanic conſtitution was ſettled upon its ancient principles, and thoſe implacable diſputes which had ſo long torn the empire were ended; the duchies of Bremen and Verden, all the Upper and part of Lower Pomerania, the city of Wiſmar and the iſle of Rugen, were aſſigned to Sweden, and a gratification of five millions of crowns was given to the army.

Sweden now enjoyed ſome years of repoſe. Charles Guſtavus, count Palatine, having gained the favour of Chriſtina, was appointed generaliſſimo of the forces, and heir-apparent to the crown. A marriage was propoſed between them; but the queen would never liſten to this or any other propoſal of the kind. In 1650, the ceremony of the queen's coronation was performed; but in four years thereafter, ſhe reſigned the crown in favour of Guſtavus. (See the article Christina).

The new king found himſelf involved in conſiderable difficulties on his acceſſion to the throne. The treaſury was quite exhauſted; great part of the revenue was appointed for the ſupport of Chriſtina's houſehold; the people were oppreſſed with taxes; and the nation having been diſarmed for ſeveral years, began to loſe its reputation among foreigners. To remedy theſe evils, Charles propoſed to reſume all the crown-lands which had been alienated by grants to favourites during the late reign; to repeal a duty which had been laid upon ſalt; to put the kingdom in a poſture of defence; and to enter upon a war with ſome neighbouring ſtate. Under a pretence, therefore, that Caſimir king of Poland had queſtioned his title to the throne, he began to make preparations for invading that kingdom. Several embaſſies were ſent from Poland to Stockholm; but ſome point of ceremony always diſappointed them of an audience of the king; ſo that they were obliged to return without their errand. As ſoon as matters were in readineſs, General Wittemberg made an irruption into Poland from the ſide of Pomerania. The Poles oppoſed him with an army of 15,000 men; but inſtead of fighting, they began to negotiate, and in a ſhort time entirely diſperſed themſelves. Charles himſelf ſoon followed with a powerful army, and purſued his march without obſtruction, all the cities throwing open their gates to him as he approached, and offering to ſupply him with neceſſaries. As he advanced to Cracow, Caſimir reſolved to make one effort to ſave his capital. His army amounted only to 10,000 men; and theſe were unfortunately ſuch as had never ſtood fire. After a feeble reſiſtance, they fled with precipitation, having loſt 1000 men killed and taken priſoners. A few days after this Charles defeated the Poles a ſecond time, about eight leagues from Cracow; upon which Caſimir fled with his family to Oppelen in Sileſia. The capital was then inveſted; and though defended with the utmoſt valour by Stephen Czarneſki, was in a ſhort time obliged to capitulate. Thus in leſs than three months Charles apparently became maſter of Poland; but it ſoon became evident that the Poles had no intention of abandoning their former ſovereign.

Sweden.

114 The Poles defeated, and the kingdom reduced.

In 1656 a war took place with the elector of Brandenburg. While Charles was employed in the conqueſt of Poland, that prince had invaded the Royal and Ducal Pruſſia, and reduced the moſt conſiderable towns with little oppoſition. The king of Sweden took umbrage at his progreſs; and having marched againſt him, defeated his forces in ſeveral ſlight encounters, and obliged him to own that he was a vaſſal of Sweden. Theſe rapid conqueſts alarmed all Europe; and the different powers ſought for means of driving the Swedes out of Poland, which they had ſo unexpectedly and unjuſtly ſeized. The Poles were no ſooner aſſured that they ſhould be aſſiſted, than they everywhere revolted and maſſacred the Swedes. Caſimir returned from Sileſia; and thoſe very troops and generals who had before ſubmitted to Charles without oppoſition, now ranged themſelves under the banners of his antagoniſt. Charles immediately marched from Pruſſia to chaſtiſe the inſolence of the Poles, and totally defeated a body of 12,000 men under the command of Czarneſki. This did not hinder all the Poles incorporated with his troops to deſert; which conſiderably reduced his army; and the campaign being performed in the depth of winter, he was at laſt obliged to retreat to Pruſſia. In his march he was haraſſed by the Poles; and a body of 4000 Swedes was ſurpriſed and defeated by them at Warka. This loſs, however, was ſoon after recompenſed by a complete victory gained by Adolphus the king's brother and General Wrangel over Czarneſki. In the mean time the king was taking meaſures for laying ſiege to Dantzic; but was prevented by the Dutch, who threatened to oppoſe him, unleſs a proper regard was paid to their intereſt. Charles accordingly granted them advantageous terms; and afterwards gained over the elector of Brandenburg, by ceding to him the ſovereignty of Pruſſia, that he might be at liberty to turn his whole ſtrength againſt Poland.

115 War with the elector of Brandenburg.

116 The Poles revolt.

117 Charles gains a victory, but is obliged to retire.

118 Concludes a treaty with the Dutch and the elector of Brandenburg.

By the treaty juſt concluded with the elector, the latter was to aſſiſt Charles in his war with Poland; but the elector had ſo procraſtinated matters, that the Poles, having obtained aſſiſtance from the Tartars, had reduced the city of Warſaw. The two princes, however, now marched in concert againſt their enemies, who were encamped in a ſtrong ſituation in the neighbourhood of the city above-mentioned, their camp being fronted by the Viſtula. The Poles were driven from their entrenchments with prodigious ſlaughter, and a vaſt number taken priſoners. The Poles and Tartars then laboured to break the alliance; with which view they entered Ducal Pruſſia, and defeated the electoral army, taking prince Radzivil and other perſons of diſtinction priſoners. The Swedes ſoon had their revenge. General Steinbock attacked the ſame Poliſh army at Philippowa, and overthrew it with ſuch ſlaughter as obliged the Poles for that ſeaſon to quit the field. A more formidable enemy than the Poles now began to make their appearance. The Ruſſians invaded the provinces of Carelia, Ingermania, and Livonia;

119 The Poles and Tartars defeated with great ſlaughter.

Sweden.

120
The ſufferings of the Swediſh dominions.

Livonia; while the elector of Brandenburg began to waver in his fidelity. To preſerve this only ally at ſuch a critical juncture, Charles was obliged to give him more advantageous terms than thoſe already mentioned; while the Ruſſians were repulſed in the provinces of Carelia and Ingermania. But in Livonia they had better ſucceſs, two important fortreſſes falling into their hands; after which they laid ſiege to Riga. For ſeven months they battered the walls of this city, without once venturing to paſs the ditch or ſtorm the practicable breaches. The beſieged, under the command of Magnus de la Gardie and Simon Helmfield, defended themſelves with the greateſt intrepidity; cutting off many thouſands of the enemy in the ſallies they made. At laſt they attacked the Ruſſian camp, drove them out of it with great ſlaughter, and obliged them to raiſe the ſiege with precipitation.

121
Are defeated before Riga.

Charles, notwithſtanding the number of his enemies, was now become ſo formidable by the valour and diſcipline of his troops, that whole armies often fled on the very news of his approach. At laſt, in 1657, the Poles, finding they could not reſiſt him in the field, contented themſelves with haraſſing the Swedes on their march, and cutting off the foragers and convoys. This proved much more deſtructive to the Swedes than their former method; ſo that Charles was obliged to enter into an alliance with Ragotſki prince of Tranſylvania, by aſſigning him certain provinces in his neighbourhood, in order to furniſh himſelf with irregular troops, who might fight the Poles in their own way. This, however, proved of no real advantage; for the confederates, after ſpending a whole campaign in Lithuania, were obliged to return without accompliſhing more than the reduction of a ſingle fortreſs; upon which Charles returned with the Swediſh army to Pruſſia.

122
Charles enters into an alliance with Ragotſki prince of Tranſylvania.

Leopold, the young king of Hungary, having beheld for a long time the Swedes with a jealous eye, now reſolved to declare for Poland. The more effectually to curb the ambition of the Swediſh monarch, he ſolicited the king of Denmark to come to a rupture with him. This was inſtantly complied with, and the Danes invaded Bremen. Charles haſtened to oppoſe this new enemy; which gave ſuch offence to Ragotſki, that he neglected to take the proper meaſures for his own defence in the abſence of the Swedes, and ſuffered his army to be deſtroyed by the Poles and Tartars. At the ſame time the Turks invaded Tranſylvania, under pretence that Ragotſki, being a vaſſal of the Grand Signior, had no right to invade Poland without his leave. Ragotſki oppoſed them in the field; where he was defeated and killed, leaving Charles deſtitute of the only ally on whom he could have depended.

123
Leopold king of Hungary declares againſt Sweden.

124
Ragotſki's army deſtroyed by the Poles and Tartars.

125
He is defeated and killed by the Turks.

The king, however, not diſmayed by this misfortune, traverſed Pomerania and the duchy of Mecklenburg; after which he fell upon Holſtein, while general Wrangel with another corps entered the duchy of Bremen. The latter executed his meaſures with the utmoſt vigour and intrepidity. In 15 days he retook all the towns which the enemy had reduced; defeated and drove the Daniſh army out of the country, killing 3000 of their beſt ſoldiers. In Holſtein the king reduced ſeveral fortreſſes, laid Itzehoe in aſhes, defeated a body of Danes, and laid ſiege to Frederic-Udda, into which the Danes had thrown a ſtrong garriſon. The conduct of this ſiege he left to Wrangel, he himſelf retiring to Wiſmar in order to obſerve the ſituation of affairs in Poland; but no ſooner was he gone than Wrangel attacked the place with ſuch fury, that he became maſter of it in two hours. In the province of Halland the Swedes were defeated; but the enemy derived no advantage from their victory: at ſea the fleets met, and maintained a hot engagement for two days, without any conſiderable advantage on either ſide. In Poland matters went on much worſe. The houſe of Auſtria had now declared for Caſimir; a German army entered Poland, and reduced Cracow, though not without great loſs to themſelves. Czarneſki entered Pomerania, where he butchered the unhappy peaſants without mercy; but on the approach of Charles he fled as uſual, having gained nothing by his expedition but the character of a cruel barbarian.

126
Bravery and ſucceſs of general Wrangel.

The king of Sweden was now ſurrounded by enemies. The elector of Brandenburg had declared againſt him; and he had beſides to engage the armies of Auſtria, Poland, Ruſſia, and Denmark, in the field. In this dangerous ſituation he reſolved to attack Denmark, in ſuch a manner as ſhould oblige that power to come to a ſpeedy accommodation. His deſigns were forwarded by a very early froſt, which enabled him to tranſport his troops without the expence and trouble of ſhipping. Having paſſed over on the ice to the iſland of Funen, he cut in pieces a body of 4000 Daniſh ſoldiers and 500 peaſants. The whole iſland was reduced in a few days; after which he paſſed to Langland, then to Laaland, after that to Falſtre, and laſtly to Zealand. The Danes were terrified at this unexpected invaſion, and were giving themſelves up to deſpair, when Charles offered to conclude a peace upon equitable terms. The king of Denmark very gladly conſented; but with a deſign to renew the war as ſoon as he thought it could be done with ſafety. By this treaty, called the *treaty of Roſchild*, concluded on the 12th of March 1658, the provinces of Schonen, Halland, and Bleking, Lyſter, and Huwen, the iſle of Borkholm, the bailliages of Bahus and Drontheim in Norway, were yielded to Sweden, and a free paſſage thro' the Sound was granted to the Swediſh ſhips.

No ſooner was Charles retired, than the king of Denmark began to act againſt him in an underhand manner; on which, reſolving to anticipate him in his deſigns, he appeared unexpectedly with a fleet before Copenhagen. Had he given the aſſault immediately, before the inhabitants had time to recover from their ſurpriſe, it would probably have ſurrendered at once; but, by landing at the diſtance of 17 miles, he gave them time to prepare for their defence: the ſiege proved extremely tedious, and at laſt the place was relieved by a Dutch fleet. On this Charles converted the ſiege into a blockade, which continued till the end of the war. Wrangel reduced the ſtrong fortreſs of Cronenburg; and the Swediſh forces were ſo judiciouſly poſted, that all Denmark was in a manner blocked up; when, in 1660, king Charles died of an epidemical fever: and thus an end was put, for that time, to all the ambitious deſigns of Sweden.

The new king Charles XI. was a minor at the time of his father's death; and as the kingdom was involved in a dangerous war with ſo many enemies, the regency determined to conclude a peace, if it could be obtained on reaſonable terms. A treaty was accordingly concluded at Oliva; by which Caſimir renounced his pretenſions to the crown of Poland, and that republic gave up all pretenſions to Livonia. Bornholm and Drontheim were ceded to Denmark; and an equivalent in Schonen remained with Sweden. During the minority of the king, nothing remarkable occurs in the hiſtory of Sweden. In 1672 he entered into alliance with Louis XIV. which two years after involved him in a war with the elector of Brandenburg. At firſt the Swedes carried all before them; and general Wrangel having fallen ſick, they continued their conqueſts under another named *Mardenfeldt*. Almoſt all the towns in Brandenburg were reduced, when the elector arrived with an army to the relief of his diſtreſſed ſubjects. He retook ſeveral towns, defeated Mardenfeldt in a general engagement, and ſoon after forced them to abandon all their conqueſts. In conjunction

 with

Sweden.

with the Danes, he then invaded the Swedish dominions: many places of importance were reduced; and, in 1676, Sweden received a most destructive blow by the defeat of her fleet in an engagement with the combined fleets of Denmark and Holland. Soon after this the king took the government into his own hands, and in some degree restored the fortune of Sweden; but though matters went on in a more prosperous way where the king commanded in person, the same losses and disgrace attended the Swedish arms in every other quarter. In Pomerania, count Konigsmark lost every place of importance excepting Stralsund, Stetin, and Gripswald. In 1678, the Swedish fleet was defeated in two engagements. At Landscroon a most obstinate battle was fought from ten in the morning till six at night; when both parties were obliged, by their fatigue, to retire to their respective camps. At Oldeval in Norway, the Swedes were defeated; and the Danes laid desolate the islands of Oeland, Smaaland, Unno, and Kuno; while the electoral troops and Imperialists reduced count Konigsmark to the utmost distress in the neighbourhood of Stralsund.

In this deplorable situation of affairs count Konigsmark found an opportunity of attacking his enemies to such advantage, that he obtained a complete victory; after which he ravaged the duchy of Mecklenburg. Yet notwithstanding this success, he could not prevent the elector from reducing Stralsund; after which he was obliged to evacuate Pomerania; and, to complete his distress, the fleet which transported the Swedish army from Pomerania was wrecked on the coast of Bornholm; by which accident 2000 persons were drowned, and the remainder plundered and taken prisoners by the Danes, though they had been furnished with passports from king Frederic.

In this unprosperous situation of affairs a peace was concluded at St Germain's between France and her enemies, by which the Swedes and Danes were left to decide their quarrel by themselves. Denmark was by no means a match for Sweden, even in the distressed situation to which she was reduced: for which reason a treaty was instantly concluded, on terms much more favourable to Sweden than could have been expected; and the peace was confirmed by a marriage between Charles and Ulrica Eleonora, daughter to the king of Denmark. From this time the Swedish monarch applied himself to the reformation of the state; and by artfully managing the disputes between the nobility and peasants, he obtained a decree of the states empowering him to alter the constitution as he pleased. Being thus invested with absolute power, he proceeded to take some very extraordinary measures. In 1685 it was projected to liquidate the public debts by raising the nominal value of money, without adding any thing to its intrinsic value. This was put in execution the following year, by which the creditors of the government lost upwards of nine millions of crowns. This, with some other arbitrary steps taken about the same time, disgusted all the nobility, merchants, and crown-creditors. In Livonia they were highly resented; and remonstrances were repeatedly sent by the hands of deputies, who had orders to insist upon their privileges confirmed by many acts of the king's predecessors. The deputies could obtain nothing, so that the diet was assembled. On their report the body of nobility resolved to draw up a stronger remonstrance than any of the former, to be presented to the king by captain Patkul one of the deputies, who had already distinguished himself by his boldness and attachment to liberty. His public spirit, however, produced no other effect than to procure his own destruction. An accusation was drawn up against all the remonstrants, but especially Patkul. He was sentenced to lose his right hand, then to be deprived of his life, honours, and estates; to have the latter confiscated to the crown, and his papers burnt by the hands of the common executioner. The accusation was declared unjust by the university at Leipsic: but notwithstanding this, Patkul was obliged to fly his country, to avoid the execution of his rigorous sentence; which, however, fell upon him with redoubled fury in the subsequent reign, of which an account is given under the article PATKUL.

141 Charles XI. dies, and is succeeded by his son Charles XII.

On the 15th of April 1697, died Charles XI. leaving his crown to his son, the celebrated Charles XII. at that time a minor. On his accession he found himself under the tuition of his grandmother Eleonora, who had governed the kingdom during the minority of the late king. Though Charles was at that time only 15 years of age, he instantly showed a desire of taking the government into his own hands. His counsellors, count Piper and Axel Sparre, signified his desire to the queen-regent. They were by her referred to the states; and there all were unanimous: so that the queen, finding that opposition would be vain, resigned her power with a good grace; and Charles was invested with absolute authority in three days after he had expressed his desire of reigning alone. He was scarce seated on the throne when a powerful combination was formed against him. King Augustus of Poland formed designs on Livonia; the king of Denmark revived the disputes he had with the duke of Holstein, as a prelude to a war with Sweden; and Peter the Great of Muscovy began to form designs upon Ingria, formerly a province of Russia. In 1699 the king of Denmark marched an army into Holstein. Charles sent a considerable body of troops to the duke's assistance; but before their arrival the Danes had ravaged the country, taken the castle of Gottorp, and laid close siege to Tonningen. Here the king of Denmark commanded in person; and was assisted by the troops of Saxony, Brandenburg, Wolfenbuttle, and Hesse-Cassel. England and Holland, as guarantees of the last treaty with Denmark, in concert with Sweden, joined Charles against this confederacy, and sent fleets to the Baltic. They proposed a termination of the war upon equitable terms; but these were haughtily refused by the Danish monarch, who despised the youth and inexperience of Charles, and relied too much upon the alliance he had formed with Saxony, Brandenburg, Poland, and Russia. The town of Tonningen, however, resisted all his efforts; and when he ordered the place to be stormed, he had the mortification to see his troops driven headlong from the walls by a handful of Swedes under general Bannier.

142 He takes the government into his own hands at the age of 15.

143 A powerful combination formed against him.

144 Holstein ravaged by the Danes.

145 They are repulsed at Tonningen.

146 Charles sets out from Stockholm, and defeats the fleet of the allies.

In the year 1700, Charles, having entrusted the affairs of the nation with a council chosen out of the senate, set out on the 8th May from his capital, to which he never afterwards returned. He embarked at Carlscroon, and defeated the fleet of the allies. Having made a descent on the island of Zealand, he defeated a body of cavalry that opposed his march, and then proceeded to invest Copenhagen by sea and land. The king of Denmark then saw the necessity there was either of having his capital destroyed, or of doing justice to the duke of Holstein. He chose the latter; and a treaty was concluded in eleven days, upon much the same terms as formerly. Charles, being thus at liberty to turn his arms against the other princes who had conspired his destruction, resolved to lead his army against Augustus king of Poland; but on his way he received intelligence that the czar of Muscovy had laid siege to Narva with 100,000 men. On this he immediately embarked at Carlscroon, though it was then the depth of winter, and the Baltic scarce navigable; and soon landed at Pernaw in Livonia with part of his forces, the rest being ordered to Reval. His army did not exceed 20,000 men; but they were the best soldiers in Europe, while the Russians were only an undisciplined multitude.

147 Obliges the Danes to make peace.

148 Marches against the Russians.

Sweden.

multitude. The czar, however, had thrown every possible obstruction in the way of his antagonist. Thirty thousand men were posted in a defile on the road, to oppose his passage; and this corps was sustained by a body of 20,000 others, posted some leagues nearer Narva. The czar himself had set out to hasten the march of a reinforcement of 40,000 men, with whom he intended to attack the Swedes

149
Defeats two Russian armies and attacks the Czar's camp.

in flank and rear. But the celerity and valour of the Swedes baffled every endeavour. With 4000 foot and an equal number of horse the king set out, leaving the rest of the army to follow him at their leisure. With these he attacked and defeated the Russian armies one after another, pushing his way to the czar's camp, which he gave immediate orders for attacking. This camp was fortified by lines of circumvallation and contravallation, by redoubts, by 100 pieces of brass cannon placed in front; and was defended by an army of 80,000 men: yet so violent was the attack of the Swedes, that in three hours the entrenchments were carried; the king with 4000 men that composed the wing he commanded in person, pursued a flying army of of 50,000 to the river Narva. The bridge broke down by the weight of the fugitives, and the river was instantly covered with their bodies. Great numbers returned in despair to their camp, where they defended themselves for a while;

150
The camp forced, and the Russians defeated with great slaughter.

but at last the generals Gallowin and Frederowitz, who commanded them, surrendered. Thirty thousand were killed in the intrenchments and in the pursuit, or drowned in the river; 20,000 surrendered at discretion, and were dismissed unarmed; while the rest were totally dispersed. An hundred and fifty pieces of fine cannon, 28 mortars, 151 pair of colours, 20 standards, and all the baggage of the enemy, were taken. Among the prisoners were the duke de Croy, the prince of Georgia, and seven other generals.

151
Generosity of Charles.

Charles behaved with the greatest generosity to the conquered. Being informed that the tradesmen of Narva had refused credit to the officers whom he detained prisoners, he sent 1000 ducats to the duke of Croy, and to every other officer a proportionable sum.

Peter was advancing with 40,000 men to surround the Swedes, when he received intelligence of the dreadful defeat at Narva. He was greatly chagrined; but, comforting himself with the hopes that the Swedes would in time teach the Russians to beat them, he returned to his own dominions, where he applied himself with the utmost diligence to the raising of another army. He evacuated all the provinces which he had invaded, and for a time abandoned all his great projects, thus leaving Charles at liberty to prosecute the war against Poland.

152
Treaty between the Czar and king of Poland.

As Augustus had expected an attack, he endeavoured to draw the czar into a closer alliance with him. The two monarchs had an interview at Birsen, where it was agreed that Augustus should lend the czar 50,000 German soldiers, to be paid by Muscovy; that the czar should send an equal number of his troops to be trained up to the art of war in Poland; and that he should pay the king three millions of rix-dollars in the space of two years. Of this treaty Charles had notice, and by means of his minister count Piper entirely frustrated the scheme.

153
Charles marches against the Saxons.

In 1701, as early as the season permitted, Charles, having received a reinforcement from Sweden, took the field, and appeared suddenly on the banks of the Duna, along which the Saxon army was posted to receive him. The king of Poland at that time being sick, the army was commanded by Ferdinand duke of Courland, marischal Stenau, and general Paykel, all officers of valour and experience. They had fortified certain islands in the mouth of the river, and taken every other precaution against an attack; the soldiers were hardy, well disciplined, and nearly equal to the Swedes in number; yet Charles, having passed the river in boats with high sides, to screen the men from the fire of the enemy, attacked them with such fury, that they were entirely defeated, with the loss of 2500 killed on the spot, and 1500 taken prisoners. All the Saxon baggage, 36 pieces of cannon, five pair of colours, and six standards, fell into the hands of the Swedes.

This victory was followed by the surrender of all the towns and fortresses in the duchy of Courland. The king then passed into Lithuania, where every town opened its gates to him. At Birsen, an army of 20,000 Russians retired with the utmost precipitation on the news of his approach. Here Charles, perceiving that the kingdom of Poland was greatly disaffected to Augustus, began to project the scheme of dethroning him by means of his own subjects. This scheme he executed with more policy than he ever showed on any other occasion. The manner of putting it in execution was concerted between Radziewischi, cardinal primate of Poland, and count Piper. Intrigues and cabals were held at the house of the treacherous ecclesiastic, while he was publishing circular letters to keep the people in their duty to the king. The diet being filled with Swedish partisans, became tumultuous, and broke up in confusion. The affairs of the kingdom then fell into the hands of the senate; but here the Swedish party was as strong as in the diet. It was agreed that they should send an embassy to Charles; that the pospolite should mount, and be ready against all events; but the chief regulations respected the king's authority, which it was determined at any rate to retrench. Augustus, resolving rather to receive laws from the victorious Charles than from his own subjects, sent an embassy to him, committing the management of the whole to the countess of Konigsmark, a native of Sweden, and a lady famous for her wit and beauty. But the king refused to see her; on which she returned, chagrined and disappointed, to Warsaw. The ambassadors of the senate instantly obtained an audience; and were assured by Charles, that he took arms against the Saxons in defence of the liberties of the Poles, whom he should always regard as his best friends. Conferences were appointed to be held at Kinschin; but Charles soon after altered his mind, and told the ambassadors he would hold them at Warsaw.

Augustus, in the mean time, finding his scheme of peace frustrated, had recourse to the senate; but met with such a rough answer from them, that he determined once more to apply to Charles. To him therefore he sent his chamberlain; but a passport being forgot, the ambassador was arrested. Charles continued his march to Warsaw, which surrendered on the first summons; but the citadel held out for some days. Augustus, finding at last that no dependence was to be had on the Poles, determined to trust his fortune wholly to the Saxon army and the nobility of the palatinate of Cracow, who offered to support him to the utmost of their power. The Saxon army was now advanced to the frontiers, and Augustus immediately put himself at the head of it. Being joined by the nobility of Cracow, he found his forces to amount to 30,000 men, all brave and well-disciplined. With these he marched in quest of his enemy; who did not decline the combat, though he had with him only 12,000 men. Though the Saxons were strongly posted, having their front covered by a morass, besides being fortified with pallisadoes and chevaux de frise, they were attacked with irresistible impetuosity, and entirely defeated, with the loss of 4000 killed, 2000 made prisoners, and all their baggage and cannon. This victory was followed by the loss of Cracow: after which Charles set out in pursuit of the flying army, with a design of preventing them from reassembling; but his horse falling under him, he had the misfortune

fortune to break his thigh, by which he was confined six weeks; and thus Augustus obtained some respite. The interval he made the best use of. Having convoked a diet first at Marienburg, and then at Lublin, from them he obtained the following resolutions; that an army of 50,000 men should be raised by the republic for the service of the prince; that six weeks should be allowed the Swedes to determine whether they were for war or peace; and that the same time should be granted to the turbulent and discontented nobles of Poland to make their concessions. To counteract the effects of these resolutions, Charles assembled another diet at Warsaw; and while the two assemblies disputed concerning their rights and privileges, he recovered of his wound, received a strong reinforcement from Pomerania, and utterly defeated and dispersed the remains of the Saxon army.

The ill fortune of Augustus continued still to persecute him. In 1704 he was formally deposed by the diet, and the crown conferred by Charles on Stanislaus Lecsinsky palatine of Posnania. Augustus, however, did not yet tamely give up his kingdom. His adherents daily skirmished with the Swedes; and Augustus himself, being reinforced by 9000 Russians, retook Warsaw, and was very near surprising the new king, who lived in perfect security in the city while Charles fought in his cause. Count Horn, with 1500 Swedes, vigorously defended the citadel; but at last, finding it no longer tenable, he was obliged to surrender at discretion. The reduction of Warsaw was among the last advantages gained by Augustus in the course of this war. His troops were now composed of Saxon recruits and undisciplined Poles, who had no attachment to his person, and were ready on all occasions to forsake him. Charles and Stanislaus advanced with the victorious army; the Saxons fled before them, and the towns for several miles round sent their submissions. The Poles and Saxons were under the command of Schullemberg, a most sagacious and experienced general, who used every expedient to check the progress of the Swedes, by seizing on the advantageous posts, sacrificing small parties to the safety of the whole, and to mislead the enemy, &c. However, with all his conduct and caution, he found himself outwitted, and Charles in the neighbourhood of his camp ready to fall upon him, while he thought him at 50 leagues distance. The Swedish monarch attacked him with a superior army, but entirely composed of horse. Schullemberg had posted his men in such a manner as rendered it impossible to surround them. His first rank being armed with pikes and fusees, presented a kind of rampart of bayonets; the second line stooping over the first who kneeled, fired over their heads, while the third rank, who stood upon their feet, kept up an incessant fire, by which the Swedish horse were exceedingly galled and put in disorder. Charles lost the opportunity of cutting off the whole Saxon army, by omitting to order his men to dismount. This was almost the first time that infantry had been regularly opposed to cavalry, and the superiority of the former was evident. After the engagement had continued about three hours, the Saxons retreated in good order; which no enemy had ever done before in any engagement with Charles. The Swedes pursued their enemies towards the Oder, and forced them to retreat through thick woods, almost impervious even to infantry. The Swedish horse, however, pushed their way, and at last inclosed Schullemberg between a wood and the river, where Charles had no doubt of obliging him to surrender at discretion, or die sword-in-hand, as having neither boats nor bridges; but the genius of Schullemberg supplied every defect. In the night he ordered planks and floats of trees to be fastened together; upon which he carried over his troops, while the Swedes were employed in dislodging 300 men, which he had placed in a wind-mill, for the purpose of defending his flank and keeping the enemy in play. Charles spoke of this retreat with admiration, and said he had been conquered by Schullemberg.

No material advantage, however, resulted from this to king Augustus; who was again obliged to leave Poland, and fortify the capital of his hereditary dominions, which he expected every moment to see invaded. In the mean time, however, the Russians having recovered their spirits, fell upon the Swedes in Livonia with the utmost fury. Narva, Dorpt, and several other towns, were taken, and the inhabitants and garrisons treated with great cruelty. Soon after, an army of 100,000 Russians entered Poland. Sixty thousand Cossacks under Mazeppa entered the country at the same time, and ravaged every thing with the fury of barbarians. Schullemberg, too, perhaps more formidable than either, advanced with 14,000 Saxons and 7000 Russians, disciplined in Germany, and reputed excellent soldiers. Could numbers have determined the event of war, the Swedes must certainly have been at this time overpowered. Instead of this, however, Charles seemed to triumph over his enemies with more ease the more numerous they were. The Russians were defeated so fast, that they were all dispersed before one party had notice of the misfortunes of another. The defeating an army of 40,000 men scarcely obstructed the march of the Swedes, while their affrighted enemies looked upon these actions as the effects of witchcraft, and imagined that the king of Sweden had dealings with infernal spirits. With these apprehensions they fled beyond the Boristhenes, leaving the unhappy Augustus to his ill fate. Schullemberg, with all his skill and experience, succeeded no better. The Swedish general Renschild engaged and defeated him in half an hour, though the Swedes were vastly inferior in number, and their enemies posted in a most advantageous situation. Nothing could be more complete than this victory. Whole regiments of Saxons threw down their arms, and begged their lives in the most suppliant posture. Six thousand were slain in the field, and 7000 taken prisoners. Thirty-six pieces of cannon, 11,000 muskets, 40 pair of colours and standards, with all the Saxon baggage, fell into the hands of the Swedes: and the consequences were still more important; for now a passage was opened into Saxony, and Augustus seemed to be in as great danger of losing his hereditary dominions as he had been of losing Poland. This extraordinary victory, indeed, is said to have been owing to a panic which seized the troops of Schullemberg: however, it was looked upon with admiration, and thought to make the renown of Renschild equal to that of his sovereign. Charles himself was jealous, and could not help exclaiming, "Surely Renschild will not compare himself with me!" But the cruelty of this general sullied his reputation; for six hours after the engagement, he caused 1000 Russians to be massacred in cold blood, to revenge, as he said, the cruelties they had committed in Poland.

Soon after this victory, which was gained on the 12th of February 1706, Charles entered Saxony at the head of 24,000 men. The diet at Ratisbon declared him an enemy to the empire if he crossed the Oder. But to this declaration no regard was paid. Charles pursued his march; while Augustus was reduced to the condition of a vagrant in Poland, where he possessed not a single town besides Cracow. Into this city he threw himself with a few Saxon, Polish, and Russian regiments, and began to erect some fortifications for its defence; but the approach of the Swedish general Meyerfeldt, and the news of the invasion of Saxony, disconcerted all his measures, and threw him into despair. The Russians indeed were his faithful allies; but he dread-ed

168

169 The Russians take ... Poland.

170 ... against ...

171 ... berg entirely defeated by Renschild.

172 Cruelty of the Swedish general.

173 Charles invades Saxony.

Sweden.

ed them almoſt as much as the Swedes: ſo that he was reduced to the neceſſity of writing a letter to Charles with his own hand, begging for peace on whatever terms he thought

174 Auguſtus begs for peace on any terms.

proper to grant. However, as he was then at the mercy of the Ruſſians, this tranſaction was concealed with the greateſt care. His emiſſaries were introduced to the Swediſh court in the night-time; and being preſented to Charles, received the following anſwer: That king Auguſtus ſhould

175 Charles's anſwer.

for ever renounce the crown of Poland, acknowledge Staniſlaus, and promiſe never to reaſcend the throne, ſhould an opportunity offer; that he ſhould releaſe the princes Sobieſki, and all the Swediſh priſoners made in the courſe of the war; ſurrender Patkul, at that time reſident at his court as ambaſſador for the Czar of Muſcovy, and ſtop proceedings againſt all who had paſſed from his into the Swediſh ſervice. Theſe articles Charles wrote with his own hand, and delivered to count Piper, ordering him to finiſh them with the Saxon ambaſſadors.

176 Auguſtus, in conjunction with the Ruſſians, defeats and takes priſoner a whole Swediſh army;

Auguſtus all this time was obliged to continue a ſhow of war, though he had neither ability nor inclination to carry it on. He was joined by prince Menzikoff with 30,000 Ruſſians; which obliged him, contrary to his inclination, to come to an engagement with Meyerfeldt, who commanded 10,000 men, one half of whom were Swedes. As at this time no diſparity of numbers whatever was reckoned an equivalent to the valour of the Swedes, Meyerfeldt did not decline the combat, though the army of the enemy was four times as numerous as his own. With his countrymen he defeated the enemy's firſt line, and was on the point of defeating the ſecond, when Staniſlaus, with the Poles and Lithuanians, gave way. Meyerfeldt then perceived that the battle was loſt; but he fought deſperately, on purpoſe to avoid the diſgrace of a defeat. At laſt, however, he was oppreſſed by numbers, and forced to ſurrender; ſuffering the Swedes, for the firſt time, to be conquered by their enemies. The whole army were taken priſoners excepting major-general Kraſſau; who having repeatedly rallied a body of horſe formed into a brigade, at laſt broke through the enemy, and eſcaped to Poſnania.—Auguſtus had ſcarce ſung *Te Deum* for this victory, when his plenipotentiary returned

177 But is obliged to resign the crown of Poland.

from Saxony with the articles of the treaty above-mentioned. The king heſitated and ſcrupled, but at laſt ſigned them; after which he ſet out for Saxony, glad at any rate to be freed from ſuch an enemy as the king of Sweden, and from ſuch allies as the Ruſſians.

The Czar Peter was no ſooner informed of this extraordinary treaty, and the cruel execution of his plenipotentiary Patkul *, than he ſent letters to every court in Chriſtendom, complaining of this groſs violation of the law of nations.

* See the article *Patkul*.

178 Czar Peter complains to all the ſtates in Europe.

He intreated the emperor, the queen of Britain, and the States-General, to revenge this inſult on humanity. He ſtigmatized the compliance of Auguſtus with the opprobrious name of *puſillanimity*; exhorted them not to guarantee a treaty ſo unjuſt, but to deſpiſe the menaces of the Swediſh bully. So well, however, was the proweſs of the king of Sweden known, that none of the allies thought proper to irritate him, by refuſing to guarantee any treaty he thought proper. At firſt, Peter thought of revenging Patkul's death by maſſacring the Swediſh priſoners at Moſcow; but from this he was ſoon deterred, by remembering that Charles had

179 Invades Poland and ſets the crown on Staniſlaus.

many more Ruſſian priſoners than he had of Swedes. Giving over thoughts of revenging himſelf in this way, therefore, in the year 1707 he entered Poland, at the head of 60,000 men. Advancing to Leopold, he made himſelf maſter of that city, where he aſſembled a diet and ſolemnly depoſed Staniſlaus with the ſame ceremonies which had been uſed with regard to Auguſtus. The country was now reduced to the moſt miſerable ſituation; one party, through fear, adhered to the Swedes; another was gained over, or forced by Peter to take part with him: a violent civil war took place between the two, and great numbers of people were butchered, while cities, towns, and villages, were laid in aſhes by the frantic multitude. The appearance of a Swediſh army under king Staniſlaus and general Lewenhaupt put a ſtop to theſe diſorders, Peter himſelf not caring

180 Retires to Lithuania.

to ſtand before ſuch enemies. He retired, therefore, into Lithuania, giving as the cauſe of his retreat, that the country could not ſupply him with proviſions and forage neceſſary for ſo great an army.

181 Imperious behaviour of Charles.

In the mean time Charles had taken up his reſidence in Saxony, where he gave law to the court of Vienna, and in a manner intimidated all Europe. He declared himſelf the protector of the Proteſtant intereſt in Germany, particularly of the emperor's Proteſtant ſubjects in Sileſia. He de-

182 Submissive behaviour of the emperor to him.

ſired, or rather *commanded*, the emperor to renew and confirm to them all the liberties granted by the treaties of Weſtphalia, but ſince that time reclaimed or eluded at the treaty of Ryſwick. The emperor durſt not refuſe; and upwards of 100 churches were given to the Proteſtants. On this occaſion the emperor is reported to have ſaid, that "had Charles deſired him to become a Lutheran, he did not know whether he could have refuſed." One would indeed have imagined that Charles had ſome thoughts of converting, or at leaſt dethroning, the Pope himſelf; for being incenſed at the conſtant oppoſition of the court of Rome, whoſe weakneſs and intrigues he deſpiſed, he one day told the emperor's miniſter, that "the Swedes had conquered Rome before now, and he might one day demand an inventory of the effects left there by queen Chriſtina." At laſt, ſatiated with the glory of having dethroned one king, ſet up another, and ſtruck all Europe with terror and admiration, Charles began to evacuate Saxony, in purſuit of his great plan, the dethroning Czar Peter, and conquering the vaſt empire of Ruſſia. While the army was on full march

183 Charles viſits king Auguſtus.

in the neighbourhood of Dreſden, he took the extraordinary reſolution of viſiting king Auguſtus with no more than five attendants. Though he had no reaſon to imagine that Auguſtus either did or could entertain any friendſhip for him, he was not uneaſy at the conſequences of thus putting himſelf entirely in his power. He got to the palace door of Auguſtus before it was known that he had entered the city. General Fleming having ſeen him at a diſtance, had only time to run and inform his maſter. What might be done in the preſent caſe immediately occurred to the miniſter; but Charles entered the elector's chamber in his boots before the latter had time to recover from his ſurpriſe. He breakfaſted with him in a friendly manner, and then expreſſed a deſire of viewing the fortifications. While he was walking round them, a Livonian, who had formerly been condemned in Sweden, and ſerved in the troops of Saxony, thought he could never have a more favourable opportunity of obtaining pardon. He therefore begged of king Auguſtus to intercede for him, being fully aſſured that his majeſty could not refuſe ſo ſlight a requeſt to a prince in whoſe power he then was. Auguſtus accordingly made the requeſt; but Charles refuſed it in ſuch a manner, that he did not think proper to aſk it a ſecond time. Having paſſed ſome hours in this extraordinary viſit, he returned to his army, after having embraced and taken leave of the king he had dethroned.

184 Marches againſt the Ruſſians.

The armies of Sweden, in Saxony, Poland, and Finland, now exceeded 70,000 men; a force more than ſufficient to have conquered all the power of Muſcovy, had they met them on equal terms. Peter, who had his army diſperſed in ſmall parties, inſtantly aſſembled it on receiving notice of the king of Sweden's march, was making all poſſible preparations

tions for a vigorous resistance, and was on the point of attacking Stanislaus, when the approach of Charles struck his whole army with terror. In the month of January 1708 he passed the Niemen, and entered the south gate of Grodno just as Peter was quitting the place by the north gate. Charles at this time had advanced to some distance before the army at the head of 600 horse. The Czar having intelligence of his situation, sent back a detachment of 2000 men to attack him: but they were utterly defeated; and this disappointment was followed by the total evacuation of Lithuania. The king pursued his flying enemies in the midst of snow and ice, over mountains, rivers, morasses, and through almost every obstacle that could be surmounted by human power. He had foreseen all difficulties, and determined to surmount them all. As he knew that the country could not furnish provisions sufficient for the subsistence of his army, he had provided a great quantity of biscuit, on which his men chiefly subsisted till they came to the banks of the Berezine, in view of Borislow. Here the Czar was posted, and Charles designed to bring him to a battle; after which he could penetrate with the greater ease into Russia. Peter, however, did not think proper to come to an action; but retreated towards the Boristhenes, whither he was pursued by Charles as soon as he had refreshed his army. The Russians had destroyed the roads and desolated the country; nevertheless the Swedish army advanced with great celerity, and in their way defeated 20,000 of the enemy, though entrenched to the teeth. This victory, considering the circumstances in which it was gained, was one of the most glorious the Swedes ever obtained. The memory of it is preserved by a medal struck in Sweden, with this inscription, *Sylvæ*, *Paludes*, *Aggeres*, *Hostes*, *victi*.

When the Russians had repassed the Boristhenes, which separates Poland from Muscovy, the Czar, finding himself closely pursued by an enemy with whom he was not able to cope, determined at last to propose peace. Proposals were accordingly made; but Charles returned no other answer than that he would treat at Moscow; which being reported to Peter, he coolly replied, "My brother Charles affects to play Alexander, but he will not find in me a Darius." However, he did not think proper to venture an engagement, but continued his retreat; and Charles pursued so close, that he was daily skirmishing with the rear of the enemy. In these actions the Swedes had generally the advantage, though in the main these victories proved detrimental, by weakening the army in a country where it was impossible to recruit. Near Smolensko, the king, with only six regiments, defeated a body of 10,000 horse and 6000 Calmucks. In this engagement he was exposed to the utmost danger, the enemy having separated him from his troops. With one regiment only, he fought with such fury as dispersed the enemy, and drove them before him, at the time they thought themselves sure of taking him prisoner. Two aids-de-camp that fought near him were killed; his horse was killed, as was also an equerry while he presented another. The enemy had broke through the regiment, and got quite up to the king; who is said to have on this occasion killed 12 men with his own hand without receiving a wound.

189

By the 3d of October 1708 Charles was within 100 leagues of Moscow; but the Czar had made the roads impassable, either by laying them under water, digging deep ditches, or covering them with the wood of whole forests. He had also destroyed the villages on every side, and taken away every possibility of subsisting an army. The season was also far advanced; the intense severe weather was approaching; so that the Swedes were threatened with all the miseries of cold and famine, at the same time that they were exposed to the attacks of an enemy greatly superior in number, who, from their knowledge of the country, had already constant opportunities of harassing and attacking them by surprise. For these reasons the king resolved to pass thro' the Ukrain, where Mazeppa, a Polish gentleman, was general and chief of the nation. Mazeppa having been affronted by the Czar, readily entered into a treaty with Charles, whom he promised to assist with 30,000 men, great quantities of provisions and ammunition, and with all his treasures, which were immense. The Swedish army advanced towards the river Disna, where they had to encounter the greatest difficulties; a forest above 40 leagues in extent, filled with rocks, mountains, and marshes. To complete their misfortunes, they were led 30 leagues out of the right way; all the artillery was sunk in bogs and marshes; the provision of the soldiers, which consisted of biscuit, was exhausted; and the whole army spent and emaciated when they arrived at the Disna. Here they expected to have met Mazeppa with his reinforcement; but instead of that, they perceived the opposite banks of the river covered with a hostile army, and the passage itself almost impracticable. Charles, however, was still undaunted; he let his soldiers by ropes down the steep banks; they crossed the river either by swimming or on rafters hastily put together; drove the Russians from their post, and continued their march. Mazeppa soon after appeared, having with him about 6000 broken remains of the army he had promised. The Russians had got intelligence of his designs, defeated and dispersed his adherents, laid his towns in ashes, and taken all the provisions collected for the Swedish army. However, he still hoped to be useful by his intelligence in an unknown country; and the Cossacks, out of revenge, crowded daily to the camp with provisions.

190 Resolves to pass through the Ukrain.

191 Meets with great difficulties

192 Defeats the Russians, and is joined by Mazeppa in great distress.

Greater misfortunes still awaited the Swedes. When Charles entered the Ukrain, he had sent orders to general Lewenhaupt to meet him with 15,000 men, 6000 of whom were Swedes, and a large convoy of provisions. Against this detachment Peter now bent his whole force, and marched against him with an army of 65,000 men. Lewenhaupt had received intelligence that the Russian army consisted only of 24,000; a force to which he thought 6000 Swedes superior, and therefore disdained to entrench himself. A furious contest ensued; in which the Russians were defeated with the loss of 15,000 men. The Swedes continued their march; but, by the treachery of their guide, were led into a marshy country, where the roads were made impassable by deep ditches and trees laid across. Here he was again attacked by the Czar with his whole army. Lewenhaupt had sent a detachment of two battalions to dispute the passage of the enemy over a morass; but finding they were likely to be overpowered, he marched at the head of the whole infantry to their relief. Another desperate battle ensued; when at last the Russians were put in disorder, and on the point of being totally defeated, when the Czar gave orders to the Cossacks and Calmucks to fire upon all the Russians who fled. "Even kill me (said he) if I should be so cowardly as to turn my back." On this the battle was renewed with great vigour; but notwithstanding these positive orders, and the example of the Czar himself, the Russians were a third time put in disorder, after losing 6000 men, when general Baver arrived with a strong reinforcement of fresh Russian troops. The engagement was again renewed, and continued without intermission till night. The Swedes took possession of an advantageous post; but were next morning attacked by the Russians. Lewenhaupt had formed a kind of rampart of his waggons, but was obliged to set fire to them, in order to prevent their falling into the hands of the enemy, and at the same time to cover his retreat by the smoke. The Russians, however, came soon enough

193 Desperate encounters between General Lewenhaupt and the Russians.

194 All the Swedish provisions burnt, and ... Ret...

enough to save 5000 waggons of those provisions destined for the distressed Swedes. A strong detachment was sent to pursue Lewenhaupt; but so terrible did he appear, that the Russians would offer him an honourable capitulation. This was rejected with disdain; and the battle renewed with the same vigour as before. The Swedes, though reduced to 4000, defeated their enemies, and killed some on the spot. After this, Lewenhaupt was suffered to pursue his
195 Lewenhaupt [illegible] march without molestation, but also without cannon or provisions. Prince Menzikoff, indeed, was detached to harass him; but such was the formidable appearance of the Swedes even in their distress, that he was afraid to attack them: so that at last the 4000 arrived safe in the camp of Charles, after having killed upwards of 30,000 of the enemy on their march.

This, we may say, was the last effort of Swedish valour. The difficulties they had now to undergo exceeded what human nature could bear; yet still they hoped, by constancy and courage, to overcome every obstacle. In the se-
196 Extreme [illegible] of the Swedes. verest winter known for a long time even in Russia, they made long marches, clothed like savages in the skins of wild beasts; all the draught-horses perished; thousands of soldiers dropped dead with cold and hunger: so that by the month of February 1709, the whole army was reduced to 18,000 Swedes. Amidst numberless difficulties these penetrated at last to Pultowa, a town on the eastern frontier
197 Charles besieges Pultowa. of the Ukraine, where the Czar had laid up magazines; and of these Charles resolved to get possession. Mazeppa advised the king to invest the place, in consequence of his having correspondence with some of the inhabitants, by whose means he hoped it would be surrendered. However, he was
198 A detachment of Swedes entirely defeated and cut off. deceived; the besieged made an obstinate defence, the Swedes were repulsed in every assault, and 3000 of them were defeated, and almost entirely cut off, in an engagement with a party of Russians. To complete his misfortunes, Charles received a shot from a carabine in his heel, which shattered the bone. For six hours after he continued calmly on horseback, giving orders, till he fainted with the loss of blood; after which he was carried into his tent. It was imagined that amputation would be necessary, as the wound had already begun to mortify; but one Neuman undertook to save the limb. It was told the king that deep incisions would be necessary. "Fall to work then (said he), cut boldly, and fear nothing." He held out his leg while the operation was performing; never changed countenance; and while the dressing was laid on, ordered an assault for the next morning.

199 The Swedes [illegible] For some days the Czar, with an army of 70,000 men, had lain at a small distance, harassing the Swedish camp, and cutting off the convoys of provisions; but now intelligence was received, that he was advancing as if with a design of attacking the lines. In this situation, Charles, wounded, distressed, and almost surrounded by enemies, is said to have, for the first time, assembled a grand council of war; the result of which was, that it was expedient to march out and attack the Russians. Voltaire, however, totally denies that the king relaxed one jot of his wonted obstinacy and arbitrary temper; but that, on the 7th of July, he sent for general Renschild, and told him, without any emotion, to prepare for attacking the enemy next morning.

200 Battle of Pultowa. The 8th of July 1709 is remarkable for the battle which decided the fate of Sweden. Charles having left 8000 men in the camp to defend the works and repel the sallies of the besieged, began to march against his enemies by break of day with the rest of the army, consisting of 26,000 men, of whom 18,000 were Cossacks. The Russians were drawn up in two lines behind their intrenchments, the horse in front, and the foot in the rear, with chasms to suffer the horse to fall back in case of necessity. General Slippenbach was detached to attack the cavalry; which he did with such impetuosity, that they were broken in an instant. However, they rallied behind the infantry, and returned to the charge with such vigour, that they disordered the Swedes in their turn, and took Slippenbach prisoner. Charles was now carried in his litter to this scene of confusion. The troops were animated by his presence, and returned to the charge; the battle became doubtful, when general Creuk was dispatched by Charles to attack the enemy in flank. Creuk mistook his way, or, according to others, who had the best opportunities of information, was bribed by Russian gold, which occasioned the loss of the battle. Peter now dispatched prince Menzikoff with a strong detachment, to post himself between the Swedes and Pultowa, to cut off their communication with their camp, and to fall upon their rear. He executed his orders with great success; cut off a corps de reserve of 3000 men; and thus decided the fortune of the day. The king, however, had ranged his remaining troops in two lines; the foot in the centre, and the horse in the two wings. They had already been twice rallied, and were now attacked with fury on all sides. Charles, in his litter, with his sword drawn in one hand, and a pistol in the other, seemed to be everywhere present. New misfortunes, however, awaited him. A cannon ball killed both horses in the litter; and scarce were others put in their place, when a second broke the litter itself in pieces, and overturned the king. The soldiers now believing him killed, fell back in consternation. The first line was broke, and the second fled. Charles did every 201 The Swedes entirely defeated.
thing in his power to restore order; but the Russians pressed so hard, that rallying was impossible, especially as powder was also wanting. Renschild and several other general officers were taken prisoners; and the king himself must have fallen into the hands of the enemy, had not count Poniatowsky drawn up 500 horse, surrounded the royal person, and with desperate fury broke through ten regiments of the enemy. With these the king arrived on the banks of the Borysthenes. The Russians forced the Swedish camp, where they found six millions in specie; but could not hinder 202 The [illegible] the Swedish [illegible] killed [illegible]
Lewenhaupt, with 4000 foot and all the remaining cavalry, from retreating to the banks of the Borysthenes. This, however, availed them but little; for being pursued by prince Menzikoff, they were obliged, for want of boats or bridges, to surrender at discretion. Charles fled in a mean calash, attended by a little troop inviolably attached to his person, some on foot, and some on horseback. They were obliged to cross a sandy desert, where neither herb nor tree was to be seen, and where the burning heat and want of water were more intolerable than the extremities of cold they had formerly suffered. The whole had almost perished for want of water, when a spring was fortunately discovered; 203 Charles arrives in Turkey.
after which they reached Oczakow, a town in the Turkish dominions, the bashaw of which supplied the king with every necessary. It was some time, however, before boats could be got ready for transporting the whole of the king's attendants; by which accident 500 Swedes and Cossacks fell into the hands of the enemy. This loss affected him more than all his other misfortunes. He shed tears at seeing across the river Bog the greater part of his few remaining friends carried into captivity, without having it in his power to assist them. The bashaw waited upon him to apologize for the delay, and was severely reprimanded by Charles, as if he had been his own subject.

The king remained but a few days at Oczakow, when the serasquier of Bender sent an aga to compliment him on his arrival in the Turkish dominions, and to invite him to that city.

city. Here he was treated with the utmost hospitality: the Turks practised to its utmost extent their generous maxim of regarding as sacred the persons of unfortunate princes who had taken shelter in their dominions: and perhaps regarded him, notwithstanding his misfortunes, as an ally that might be useful to themselves against the Russians. Every one, indeed, regarded him in his distress. The French king offered him a safe passage from the Levant to Marseilles, from whence he might easily return to his own dominions. But Charles was too obstinate to receive advice. Puffed up with the notion of imitating Alexander the Great, he disdained to return except at the head of a numerous army; and he yet expected, by means of the Turks, to dethrone his adversary the Czar. Negotiations for this purpose, indeed, were carried on in the Turkish divan; and it was proposed to escort Charles with a numerous army to the frontiers of Poland: but the revolution which took place there quickly put an end to all such projects. Augustus thought himself no longer bound to observe the treaty which he had made, than Charles was at hand to force him to it. After the battle of Pultowa, therefore, he entered Poland, and took every measure, in concert with the Czar, for the recovery of his kingdom. Stanislaus was not able to stand before such enemies, but was obliged to leave his dominions and fly to Bender, in the disguise of a Swedish officer, in order to share the fortune of Charles.—It was not in Poland alone that the Swedish affairs began to suffer in consequence of the defeat at Pultowa. The Danes quickly invaded the province of Schonen with an army of 13,000 foot and 2500 horse. Only 15,000 Swedish forces remained to defend all the territories possessed by Charles in Germany; and of these only a small part were allotted for the defence of Schonen. The regency of Sweden, however, exerted themselves to the utmost to repel this ungenerous invasion; and having collected an army of 12,000 militia and 8000 regulars, dispatched them under general Steenboek into Schonen. Some Saxon troops were incorporated in this army; and among these a prodigious desertion took place, which the general found it impossible to prevent; and thus the Danes gained several advantages, and at last took Christianstadt. Their confidence on this success was so great, that the Swedes demanded to be instantly led against them. Here the good fortune of Sweden seemed once more to revive. The Danes were driven from a very strong situation, with the loss of 8000 killed and taken prisoners, besides a vast number wounded. The king received the intelligence of this victory with the greatest exultation; and could not help exclaiming, "My brave Swedes, should it please God that I once more join you, we shall conquer them all!"

In the mean time, Charles, by means of his agents the count Poniatowski and the Sieur Neugebar, used his utmost efforts to procure a rupture between the Porte and Russia. For a long time the money bestowed by Peter on the vizirs and janizaries prevailed; but at last, in 1711, the grand signior, influenced by his mother, who was strongly in the interest of Charles, and had been wont to call him *her lion*, determined to avenge his quarrel with Peter. He therefore gave orders to the vizir to fall upon the Russians with an army of 200,000 men. The vizir promised obedience; but at the same time professed his ignorance in the art of war, and dislike to the present expedition. The khan of Crim Tartary, who had been gained over by the reputation and presents of the king of Sweden, had orders to take the field with 40,000 of his men, and had the liberty of assembling his army at Bender, that Charles might see that the war was undertaken upon his account. The Czar, on these news, left the siege of Riga, where he had continued for some months; and with 20,000 men entered Moldavia, where he was joined by Cantemir, prince of that country. The vizir marched against him with a prodigious army, and, through the negligence of the Czar, enclosed him in such a manner that he could neither advance nor retreat. In this desperate situation, he perceived that he was now in as bad a situation as Charles at Pultowa; and gave orders for breaking through the enemy with fixed bayonets. The dispirited soldiers, however, were little disposed to execute these orders; when Catharine, wife to the czar, without his knowledge, set on foot a treaty with the vizir; and having soon obtained his consent, had the peace signed in six hours; by which means, in all probability, the whole Russian army was saved.

209 The Czar ... a treaty.

The new treaty was most violently opposed by count Poniatowski and the khan of Tartary. The former had made the king acquainted with the situation of both armies; on which he instantly set out from Bender, filled with the hopes of fighting the Russians, and taking ample vengeance. Having ridden 50 leagues post, he arrived at the camp just as the czar was drawing off his half-famished troops. He alighted at Poniatowski's tent; and being informed of particulars, instantly flew in a rage to the vizir, whom he loaded with reproaches, and accused of treachery. Recollecting himself, however, he proposed a method by which the fault might be remedied; but finding his proposal rejected, he posted back to Bender, after having by the grossest insults showed his contempt of the vizir.

210 Rage of Charles on this occasion.

The violent behaviour of Charles did not promote his interest. The vizir perceived that his stay in Turkey might prove fatal to himself; and therefore determined to get him out of the country as soon as possible, either by fair means or foul. Succeeding vizirs adopted the same plan; and at last the grand signior himself wrote a letter to the king, in which he desired him to depart by next winter, promising to supply him with a sufficient guard, with money, and every thing else necessary for his journey. Charles gave an evasive answer, and determined to procrastinate his journey, as well to gratify his own stubborn temper, as because he suspected a correspondence between Augustus and the khan of Tartary, the object of which, he had reason to believe, was to betray him to the Saxons. When he was therefore again pressed to fix the day of his departure, he replied, that he could not think of going before his debts were paid. Being asked how much was necessary for this purpose, he replied, 1000 purses (A). Twelve hundred purses were instantly sent to the serasquier at Bender, with orders to deliver them to the king of Sweden, but not before he should have begun his journey. By fair promises, however, Charles persuaded him to part with the money; after which, instead of setting out, he squandered away his treasure in presents and gratifications, and then demanded 1000 purses more before he would set out. The serasquier was astonished at this behaviour. He shed tears; and, turning to the king, told him, that his head would be the forfeit of having obliged him with the money. The grand signior, on being acquainted with this shameful behaviour of Charles, flew into a rage, and called an extraordinary divan, where he himself spoke, a thing very unusual for the Turkish monarchs. It was unanimously agreed that such a trouble-some

211 The Grand Signior desires him to depart.

212 Mean and unjust behaviour of Charles.

(A) Each purse contained 30 sequins.

Sweden.

[illegible] ought to be removed by force should other means fail. Orders were therefore positively sent to Charles to depart; and, in case of refusal, to attack him in his quarters. Nothing could equal his obstinacy on this occasion: in spite of the menaces of his enemies, in spite of the intreaties of his friends, he persisted in his resolution, and at last determined to resist, with 300 Swedes, being all the attendants he had, an army of 20,000 janisaries well armed and furnished with cannon. At length he was attacked in good earnest; though it must be owned, that even in this extremity, the Turks showed their regard to him, and were tender of his life, which the king did not return at all in a similar manner. Most of the Swedes surrendered at once, perhaps as thinking it the only method of saving the king's life. This misconduct, however, had a quite contrary effect. Charles became the more obstinate, the more desperate his affairs seemed to be. With 40 menial servants only, and the generals Hord and Dardoff, he determined to defend himself to the last extremity. Seeing his soldiers lay down their arms, he told the generals, "We must now defend the house. Come, (adds he with a smile), let us fight *pro aris et focis*." The house had been already forced by the Tartars, all but a hall which was near the door, and where his domestics had assembled themselves. Charles forced his way through the janisaries, attended by the generals Hord and Dardoff, joined his people, and then barricaded the door. The moment he entered, the enemy, who were in the house, threw down their booty, and endeavoured to escape at the windows. Charles pursued them from room to room with much bloodshed, and cleared the house in a few minutes. He then fired furiously from the windows, killed 200 of the Turks in a quarter of an hour, so that the bashaw who commanded them was at length forced to set the house on fire. This was done by arrows with lighted matches shot into the roof; but Charles, instead of quitting it, gave orders for extinguishing the fire, in which he himself assisted with great diligence. All efforts, however, were vain: the roof fell in; and Charles, with his few faithful companions, was ready to be buried in the ruins. In this extremity one called out, that there was a necessity for surrendering. "What a strange fellow! (cries the king), who would rather be a prisoner with the Turks than mix his ashes with those of his sovereign." Another had the presence of mind to cry out, that the chancery was but 50 paces off, had a stone roof, and was proof against fire. Pleased with the thoughts of again coming to blows, the king exclaimed, "A true Swede! Let us take all the powder and ball we can carry." He then put himself at the head of his troops, and sallied out with such fury that the Turks retreated 50 paces; but falling down in the hurry, they rushed in upon him, and carried him by the legs and arms to the bashaw's tent.

213
The Turks resolve to force him to depart.

214
He is for a desperate resistance.

215
Is abandoned by all his followers except 40.

216
Fights like a madman, but is taken prisoner with all his followers.

This extraordinary adventure, which savours not a little of insanity, happened on the 12th of February 1713. He was now kept prisoner, with all his retinue; and in this situation he was visited by the unfortunate Stanislaus. The latter, as we have already observed, came in the disguise of a Swedish officer, and had indeed served in the Swedish army in Pomerania, for which reason he was arrested in the Turkish dominions; but being known at Bender, notice was sent to the bashaw who was conducting the king of Sweden to Adrianople. The bashaw communicated the news to Baron Fabricius, a favourite of Charles, who immediately imparted it to the king. "Dear Fabricius, (says this inflexible monarch), run and tell him never to make peace with Augustus; we shall soon have a change in our affairs."

217
Stanislaus arrested in Turkey.

218
Extreme inflexibility of Charles.

Such were the considerations that still occurred to the mind of Charles; however, at last he seemed inclined to submit to his fate, and began seriously to think of returning to his kingdom, now reduced to the most deplorable situation. His habitation was now fixed at Demotica, a small town about six leagues from Adrianople. Here he was allowed provisions for his own table and those of his retinue; but only 25 crowns a-day in money, instead of 500 which he had received at Bender. During his residence here he received a deputation from Hesse-Cassel, soliciting his consent to the marriage of the landgrave with Eleonora princess royal of Sweden; to which he readily agreed: a deputation was also sent him by the regency of Sweden, requesting that he would prepare for returning to his own dominions, which were ready to sink under a ruinous war in his absence. What determined him, however, more than any thing to hasten his return, was the following accident. The new grand vizir Ibrahim Molla, having for private reasons determined to come to a rupture with the czar, invited Charles to a conference, in the style and with the familiarity of an equal. Charles was so much chagrined at this indignity, that he sent his chancellor Mullern to meet the vizir, with a pretence that he was sick. To avoid giving offence to this minister, Charles was obliged to keep his bed during his residence at Demotica, which was for 10 months after. At last, this vizir being strangled, and the Swedish interest at the Porte thereby entirely ruined, he determined to quit Turkey at all events. His departure was to be negotiated by his favourite Grothusen, whom he vested with the character of ambassador extraordinary; sending him to Adrianople with a train of 14 persons richly dressed. To equip this retinue the king was reduced to the most mortifying shifts, and to the necessity of borrowing money from usurers at 50 *per cent*. The great object was, to obtain from the vizir money and a passport. Grothusen was received with all the respect due to his rank; but the vizir started difficulties. With regard to the passport, he said, it could be of no use until the consent of the court of Vienna was first obtained; and as to money, he said, "his master knew how to *give* when he thought proper, but it was beneath his dignity to *lend*: that the king should have every necessary provided for his journey, and possibly the Porte might make some pecuniary present, but he would not have it expected." The imperial minister, however, removed every difficulty with regard to the passport, by granting it in the most full and ample manner, in the name of the emperor, the princes and states of Germany. He sent also a present to the king, consisting of a tent of scarlet richly embroidered with gold; a sabre, the handle of which was studded with jewels; and eight fine horses richly caparisoned. Money, the article most wanted, was entirely forgotten; however, the day was fixed for Charles's departure, and the vizir appointed 60 carriages loaded with all kinds of provisions, and several companies of janisaries and other troops to attend him to the frontiers of Transylvania.

Sweden.

219
Begins to think of returning to his dominions.

220
Obliged to keep his bed ten months.

221
Sends an ambassador to the vizir, who is very coolly received.

On the 14th of October 1714, Charles quitted his bed at Demotica, and set out for Sweden. All the princes through whose territories he was to pass, had given orders for his entertainment in the most magnificent manner; but the king, perceiving that these compliments only rendered his imprisonment and other misfortunes more conspicuous, suddenly dismissed his Turkish attendants, and assembling his own people, bid them take no care about him, but make the best of their way to Stralsund. After this he set out post, in the habit of a German officer, attended only by Colonel During. Keeping the by-roads through Hungary, Moravia, Austria, Bavaria, Wirtemberg, the Palatinate, Westphalia, and Mecklenburg, he arrived on the 21st of November at midnight before the gates of Stralsund. Being unknown, he was admitted with difficulty; but being soon recognized by

222
Sets out for Sweden.

223
Dismisses his retinue, and proceeds with only one attendant.

by the governor, the greateſt tokens of joy were ſhown all over the town. In the midſt of the tumult Charles went to bed. He had been booted for 16 days, and now his legs were ſwelled to ſuch a degree that it was neceſſary to cut his boots off. Having ſlept for ſome hours, he aroſe, reviewed his troops, and gave orders for renewing the war with redoubled vigour.

Sweden was now in the greateſt diſtreſs. We have already mentioned, that on the news of the defeat at Pultowa, the Danes had invaded Schonen, but were defeated by General Steenboek. This victory, however, did not put an end to the war. On the contrary, the kings of Denmark and Poland, with the czar of Muſcovy, entered into ſtricter bonds of amity than ever. They dreaded the return of Charles to his own dominions, and apprehended that numberleſs victories would ſoon efface the remembrance of Pultowa. They determined, therefore, to make the beſt uſe of their time; and perhaps Charles never took a more imprudent reſolution than obſtinately to remain ſo long in the Turkiſh dominions. The kings of Denmark and Poland invaded Pomerania; but after laying ſiege in vain to Stralſund, Wiſmar, and other places, they were obliged to retire with diſgrace into winter-quarters. In 1712, the king of Denmark invaded and reduced Bremen and Verden; but the ſame year met with a terrible defeat from Steenboek, with the loſs of a vaſt number killed and wounded, and almoſt all their artillery taken. The following year, however, this general being purſued, and ſurrounded by the united forces of the Ruſſians, Danes, and Saxons, was obliged to throw himſelf into the neutral town of Tommingen; where he was beſieged, and obliged to ſurrender at diſcretion, with his whole army. The conſequence of this diſaſter was an invaſion of Finland by the czar; which province he totally reduced, after defeating the Swedes in ſeveral engagements. Indeed, the Swediſh forces were now ſo much reduced, that they were unable to cope with almoſt any enemy. The return of Charles, however ſeemed to give new life to the whole nation. Though the number of inhabitants was viſibly diminiſhed, the levies he had ordered were completed in a few weeks: but the hands left to cultivate the earth conſiſted of the infirm, aged, and decrepid; ſo that a famine was threatened in conſequence of the military rage which had ſeized all the youth of the kingdom.

The preſence of Charles did not now produce thoſe conſequences which the allies had feared. The kingdom was too much reduced to be able to furniſh the neceſſary ſupplies of men and money; and though the king's courage and military ſkill were not in the leaſt diminiſhed, the efforts he made, inſtead of reſtoring Sweden to its ſplendour, ſerved entirely to ruin it. In 1715, Pruſſia declared againſt him, on account of his demanding back the town of Stetin, which that monarch had ſeized. To complete his embarraſſment, the elector of Hanover, George I. of Britain, alſo became his enemy. The forces of Denmark, Pruſſia, Saxony, and Hanover, joined to inveſt Wiſmar, while a body of 36,000 men formed the ſiege of Stralſund; at the ſame time that the czar, with a fleet of 20 large ſhips of war, and 150 tranſports, carrying 30,000 men, threw every part of the Swediſh coaſt into the greateſt conſternation. The heroiſm of Charles could not prevail againſt ſo many enemies; yet he was ſtill ſo dreadful, that the prince of Anhalt, with 12,000 brave troops, did not think himſelf a match for this furious enemy when at the head of only 2000, till he had entrenched his army behind a ditch, defended by chevaux de frize. It appeared, indeed, that his precaution was not unneceſſary; for in the night Charles with his men clambered up the ditch, and attacked the enemy in his uſual manner. Numbers, however, at laſt prevailed; and Charles was obliged to retire, after having ſeen his favourite Grothuſen, General Dardorff and During, the companions of his exile, killed by his ſide, he himſelf being wounded in the breaſt.

Sweden.

230 Stralſund beſieged,

This raſh attempt was made in order to ſave Rugen, from whence the town of Stralſund was ſupplied with proviſions. The place was well fortified, and garriſoned with 9000 men, with Charles himſelf at their head; but nothing could reſiſt the efforts of the enemy. The houſes were laid in aſhes by the bombs; the walls miſerably ſhattered, and large breaches made in them by the cannon; ſo that by the 17th of December it was propoſed to give the aſſault. The attack on the horn-work was deſperate: the enemy was twice repulſed; but at laſt, by dint of numbers, effected a lodgment. The next day Charles headed a ſally, in which he dealt terrible deſtruction among the beſiegers, but was at length overpowered and obliged to retreat into the town. At laſt his officers, apprehending that he muſt either fall into the hands of the enemy, or be buried in the ruins of the place, intreated him to retire. A retreat, however, was now almoſt as dangerous as to remain in the town, on account of the fleets of the enemy with which the ſea was covered; and it is thought that this very circumſtance induced the king to conſent to it. Setting out, therefore, in a ſmall boat with ſails and oars, he paſſed all the enemy's ſhips and batteries, and arrived ſafe at Yſtedt in Schonen.

231 And taken, in ſpite of the utmoſt efforts of the king.

232 Charles invades Norway to no purpoſe.

To revenge himſelf for theſe loſſes, Charles invaded Norway with an army of 25,000 men. The Danes were every where defeated and purſued with that vigour for which the king of Sweden was ſo remarkable; but ſtrong reinforcements arriving from Denmark, and proviſions failing, he was at laſt obliged to retire, and evacuate the country. Soon after this the Swedes loſt Wiſmar; but when every thing ſeemed to go to wreck, Baron Goertz the chief miniſter and favourite of Charles found means to ſet on foot a treaty with the czar of Moſcovy, by which the moſt formidable of all Charles's enemies was taken off. The miniſter found means to work upon the inflexible and ſtubborn temper of Charles, by repreſenting to him that the ceſſion of certain provinces to Peter would induce him to aſſiſt him in his projects of again dethroning Auguſtus, and of replacing James on the throne of Britain; which laſt ſcheme he had projected out of revenge for the elector of Hanover having ſeized on the duchies of Bremen and Verden. In conſequence of the conferences between the czar and Goertz, the former engaged to ſend into Poland an army of 80,000 men, in order to dethrone that prince whom he had ſo long defended. He engaged alſo to furniſh ſhips for tranſporting 30,000 Swedes to Germany and 10,000 into Denmark. This treaty, however, was not fully ratified; and the king's death, which happened in 1718, put a final ſtop to all the great proſpects of Sweden.

233 A treaty with the Czar of Muſcovy projected.

234 Charles invades Norway again, and lays ſiege to Frederickſhall.

The king had reſolved on the conqueſt of Norway before he dethroned Auguſtus; and as no difficulties ever deterred him, he marched his army into that cold and barren country in the month of October, when the ground was covered with froſt and ſnow. With 18,000 men he formed the ſiege of Frederickſhall, though the ſeverity of the froſt rendered it almoſt impoſſible to break ground. Charles, however, reſolved to form trenches; and his ſoldiers cheerfully obeyed, digging into the ground with the ſame labour as if they had been piercing a rock. On the 11th of December the king viſited the trenches in the midſt of a terrible fire from the enemy, imagining that his men might be animated by his preſence. He took his poſt in the moſt dangerous ſtation he could chooſe, ſtanding upon a gabion and leaning with his arm over the parapet, while the enemy were firing chain ſhot at the very ſpot where he ſtood. He was intreated

235 His extreme raſhneſs, in conſequence of which he is killed.

Sweden.

tempted to change his ftation: but he remained obftinate, as if he had been proof againft cannon bullets. At laft he was feen to fall on the parapet with a deep groan. A fmall cannon-ball had ftruck him on the temple, beat in the left eye, and forced the right eye quite out of its focket; his right hand in the mean time grafped the hilt of his fword, as if he had meant to revenge the blow (c).

2·6 Account of the Swedifh affairs from the death of Cha. XII. to the year 1772.

Charles XII. was fucceeded by his fifter the princefs Ulrica Eleonora, wife to the hereditary prince of Heffe. On this occafion the ftates took care to make a previous ftipulation for the recovery of their liberties, and obliged the princefs to fign a paper to this purpofe before entering on the government. Their firft care was to make a peace with Great Britain, which the late king intended to have invaded. The Swedes then, to prevent their farther loffes by the progrefs of the Ruffian, the Danifh, the Saxon, and other arms, made many great facrifices to obtain peace from thofe powers. The French, however, about the year 1738, formed a dangerous party in the kingdom, under the name of the ***Hats;*** which not only broke the internal quiet of the kingdom, but led it into a ruinous war with Ruffia, by which the province of Finland was loft. Their Swedifh majefties having no children, it was neceffary to fettle the fucceffion; efpecially as the duke of Holftein was defcended from the queen's eldeft fifter, and was, at the fame time, the prefumptive heir to the empire of Ruffia. Four competitors appeared; the duke of Holftein Gottorp, prince Frederic of Heffe-Caffel nephew to the king, the prince of Denmark, and the duke of Deux-Ponts. The duke of Holftein would have carried the election, had he not embraced the Greek religion, that he might mount the throne of Ruffia. The czarina interpofed, and offered to reftore all the conquefts fhe had made from Sweden, excepting a fmall diftrict in Finland, if the Swedes would receive the duke of Holftein's uncle, Adolphus Frederic bifhop of Lubec, as their hereditary prince and fucceffor to their crown. This was agreed to; and a peace was concluded at Abo, under the mediation of his Britannic majefty. This peace was fo firmly adhered to by the czarina, that his Danifh majefty thought proper to drop all refentment for the indignity done his fon. The prince-fucceffor married the princefs Ulrica, third fifter to the king of Pruffia; and in 1751 entered into the poffeffion of his new dignity, which proved to him a crown of thorns. Through a ftrange medley of affairs and views of intereft, the French had acquired vaft influence in all the deliberations of the Swedifh fenate, who of late have been little better than penfioners to that crown. The intrigues of the fenators forced Adolphus to take part in the late war againft Pruffia: but as that war was difagreeable not only to the people, but alfo to the king of Sweden, the nation never made fo mean an appearance; and upon Ruffia's making peace with the king of Pruffia, the Swedes likewife made their peace, upon the terms of leaving things as they ftood at the beginning of the war. Adolphus died difpirited in 1771, after a turbulent reign of twenty years; and was fucceeded by his fon Guftavus. The moft remarkable tranfaction of this reign is the revolution which took place in the government in the year 1772, by which the king, from being the moft limited became one of the moft defpotic monarchs in Europe. Ever fince the death of Charles XII. the whole power of the kingdom had been lodged in the ftates; and this power they had on all occafions moft grievoufly abufed. Guftavus therefore determined either to feize on that power of which they made fuch a bad ufe, or perifh in the attempt. The revolution was effected in the following manner. On the morning of the 19th of Auguft 1772, a confiderable number of officers, as well as other perfons known to be attached to the royal caufe, had been fummoned to attend his majefty. Before ten he was on horfeback, and vifited the regiment of artillery. As he paffed through the ftreets he was more than ufually courteous to all he met, bowing familiarly to the loweft of the people. On the king's return to his palace, the detachment which was to mount guard that day being drawn up together with that which was to be relieved, his majefty retired with the officers into the guard-room. He then addreffed them with all that eloquence of which he is faid to have been a perfect mafter; and after infinuating to them that his life was in danger, he expofed to them in the ftrongeft colours the wretched ftate of the kingdom, the fhackles in which it was held by means of foreign gold, and the diffenfions and troubles arifing from the fame caufe which had diftracted the diet during the courfe of fourteen months. He affured them that his only defign was to put an end to thefe diforders; to banifh corruption, reftore true liberty, and revive the ancient luftre of the Swedifh name, which had been long tarnifhed by a venality as notorious as it was difgraceful. Then affuring them in the ftrongeft terms that he difclaimed for ever all abfolute power, or what the Swedes call *fovereignty*, he concluded with thefe words: "I am obliged to defend my own liberty and that of the kingdom, againft the ariftocracy which reigns. Will you be faithful to me, as your forefathers were to Guftavus Vafa and Guftavus Adolphus? I will then rifk my life for your welfare and that of my country."

The officers, moft of them young men, of whofe attachment the king had been long fecure, who did not thoroughly perhaps fee into the nature of the requeft his majefty made them, and were allowed no time to reflect upon it, immediately confented to every thing, and took an oath of fidelity to him.

Three only refufed. One of thefe, Frederic Cederftrom, captain of a company of the guards, alleged he had already and very lately taken an oath to be faithful to the ftates, and confequently could not take that which his majefty then exacted

(c) Such is the account given by Voltaire of the untimely death of this northern hero. Many perfons, however, who had the beft opportunities of procuring authentic information at the time, have declared that they believed he was affaffinated by a Frenchman who was among his attendants. The famous earl of Peterborough, who, in his rapid marches and fearlefs intrepidity, bore no fmall refemblance to Charles XII. affured Bifhop Berkeley, that he had no doubt of the Swedifh monarch's having been affaffinated; and Mr Wraxall, in the account of his Travels through Sweden, gives fuch arguments for the truth of that opinion as leave very little doubt in our minds. It muft be confeffed, however, that Mr Coxe reafons plaufibly in fupport of the other opinion; and perhaps at this diftance of time nothing can be faid with certainty on this queftion, but what has been faid by Johnfon:

His fall was deftined to a barren ftrand,
A petty fortrefs, and a *dubious hand.*
He left the name, at which the world grew pale,
To paint a moral, or adorn a tale.
Vanity of Human Wifhes.

exacted of him. The king, looking at him ſternly, anſwered, "Think of what you are doing." "I do, replied Cederſtrom; and what I think to day, I ſhall think to-morrow: and were I capable of breaking the oath by which I am already bound to the ſtates, I ſhould be likewiſe capable of breaking that your majeſty now requeſts me to take."

The king then ordered Cederſtrom to deliver up his ſword, and put him in arreſt.

His majeſty, however, apprehenſive of the impreſſion which the proper and reſolute conduct of Cederſtrom might make upon the minds of the other officers, ſhortly afterwards ſoftened his tone of voice; and again addreſſing himſelf to Cederſtrom, told him, that as a proof of the opinion he entertained of him, and the confidence he placed in him, he would return him his ſword without inſiſting upon his taking the oath, and would only deſire his attendance that day. Cederſtrom continued firm; he anſwered, that his majeſty could place no confidence in him that day, and that he begged to be excuſed from the ſervice.

While the king was ſhut up with the officers, Senator Ralling, to whom the command of the troops in the town had been given two days before, came to the door of the guard room, and was told that he could not be admitted. The ſenator inſiſted upon being preſent at the diſtribution of the orders, and ſent to the king to deſire it; but was anſwered, he muſt go to the ſenate, where his majeſty would ſpeak to him.

The officers then received their orders from the king; the firſt of which was, that the two regiments of guards and of artillery ſhould be immediately aſſembled, and that a detachment of 36 grenadiers ſhould be poſted at the door of the council-chamber to prevent any of the ſenators from coming out.

But before the orders could be carried into execution, it was neceſſary that the king ſhould addreſs himſelf to the ſoldiers; men wholly unacquainted with his deſigns, and accuſtomed to pay obedience only to the orders of the ſenate, whom they had been taught to hold in the higheſt reverence.

40
king
over
oldiers.

As his majeſty, followed by the officers, was advancing from the guard room to the parade for this purpoſe, ſome of them more cautious, or perhaps more timid than the reſt, became, on a ſhort reflection, apprehenſive of the conſequences of the meaſure in which they were engaged: they began to expreſs their fears to the king, that unleſs ſome perſons of greater weight and influence than themſelves were to take a part in the ſame cauſe, he could hardly hope to ſucceed in his enterpriſe. The king ſtopped a while, and appeared to heſitate. A ſerjeant of the guards overheard their diſcourſe, and cried aloud,—"It ſhall ſucceed—Long live Guſtavus!" His majeſty immediately ſaid, "Then I will venture;"—and ſtepping forward to the ſoldiers, he addreſſed them in terms nearly ſimilar to thoſe he had made uſe of to the officers, and with the ſame ſucceſs. They anſwered him with loud acclamations: one voice only ſaid, No; but it was not attended to.

In the mean time ſome of the king's emiſſaries had ſpread a report about the town that the king was arreſted. This drew the populace to the palace in great numbers, where they arrived as his majeſty had concluded his harangue to the guards. They teſtified by reiterated ſhouts their joy at ſeeing him ſafe; a joy which promiſed the happieſt concluſion to the buſineſs of the day.

The ſenators were now immediately ſecured. They had from the window of the council-chamber beheld what was going forward on the parade before the palace; and, at a loſs to know the meaning of the ſhouts they heard, were coming down to inquire into the cauſe of them, when 30 grenadiers, with their bayonets fixed, informed them it was his majeſty's pleaſure they ſhould continue where they were. They began to talk in a high tone, but were anſwered only by having the door ſhut and locked upon them.

241
Secures the ſenators, and becomes maſter of the whole power in the kingdom.

The moment the ſecret committee heard that the ſenate was arreſted, they ſeparated of themſelves, each individual providing for his own ſafety. The king then mounting his horſe, followed by his officers with their ſwords drawn, a large body of ſoldiers, and numbers of the populace, went to the other quarters of the town where the ſoldiers he had ordered to be aſſembled were poſted. He found them all equally willing to ſupport his cauſe, and to take an oath of fidelity to him. As he paſſed through the ſtreets, he declared to the people, that he only meant to defend them, and ſave his country; and that if they would not confide in him, he would lay down his ſceptre, and ſurrender up his kingdom. So much was the king beloved, that the people (ſome of whom even fell down upon their knees) with tears in their eyes implored his majeſty not to abandon them.

242
Summons an aſſembly of the ſtates;

The king proceeded in his courſe, and in leſs than an hour made himſelf maſter of all the military force in Stockholm. In the mean time the heralds, by proclamation in the ſeveral quarters of the city, ſummoned an aſſembly of the ſtates for the enſuing morning, and declared all members traitors to their country who ſhould not appear. Thither his majeſty repaired in all the pomp of royalty, ſurrounded by his guards, and holding in his hand the ſilver ſceptre of Guſtavus Adolphus. In a very forcible ſpeech, he lamented the unhappy ſtate to which the country was reduced by the conduct of a party ready to ſacrifice every thing to its ambition, and reproached the ſtates with adapting their actions to the views of foreign courts, from which they received the wages of perfidy. "If any one dare contradict this, let him riſe and ſpeak."—Conviction, or fear, kept the aſſembly ſilent, and the ſecretary read the new form of government, which the king ſubmitted to the approbation of the ſtates. It conſiſted of fifty-ſeven articles; of which the following five were the chief.

243
Which accepts a new form of government.

1. The king has the entire power of convoking and diſſolving the aſſembly of the ſtates as often as he thinks proper. 2. His majeſty alone has the command of the army, fleet, and finances, and the diſpoſal of all offices civil and military. 3. In caſe of an invaſion, or of any preſſing neceſſity, the king may impoſe taxes, without waiting for the aſſembly of the ſtates. 4. The diet can deliberate upon no other ſubjects than thoſe propoſed by the king. 5. The king ſhall not carry on an offenſive war without the conſent of the ſtates. When all the articles were gone through, the king demanded if the ſtates approved of them, and was anſwered by a general acclamation. He then diſmiſſed all the ſenators from their employments, adding, that in a few days he would appoint others; and concluded this extraordinary ſcene by drawing out of his pocket a ſmall book of pſalms, from which, after taking off the crown, he gave out Te Deum. All the members very devoutly added their voices to his, and the hall reſounded with thankſgivings, which it is to be feared never roſe to heaven, if ſincerity was neceſſary to their paſſport.

244
The king makes a good uſe of his power.

The power thus obtained the king employed for the good of his ſubjects. He took care that the law ſhould be adminiſtered with impartiality to the richeſt noble and the pooreſt peaſant, making a ſevere example of ſuch judges as were proved to have made juſtice venal. He gave particular attention and encouragement to commerce, was a liberal

liberal and well informed patron of learning and ſcience, and laboured ſtrenuouſly to introduce into his kingdom the moſt valuable improvements in agriculture that had been made in foreign countries.

245 Reforms the army and navy.

But while thus active in promoting the arts of peace, he was not inattentive to thoſe of war. The fleet, which he found decayed and feeble, he in a few years reſtored to a reſpectable footing, and, beſides changing the regulations of the navy, he raiſed a new corps of ſailors, and formed them to the ſervice by continual exerciſe. The army, which, as well as the navy, had been neglected during the ariſtocracy, was next to be reformed. The king began by giving cloaks, tents, and new arms to all the regiments. Afterwards, under the direction of Field Marſhal Count de Heſſenſtein, a new exerciſe was introduced, and ſeveral camps were formed, in which the ſoldiery were manœuvred by the king himſelf. The ſale of military offices, which had been permitted for many years, was entirely ſuppreſſed; and the king provided not only for the re-eſtabliſhment of diſcipline and good order in the army, but for the future welfare of the individuals which compoſed it. Theſe warlike preparations were neceſſary to a plan which he had formed for entirely aboliſhing the power of the ariſtocracy, and freeing Sweden from the factions which had long been formed in it by the court of St Peterſburgh. The change which he had introduced into the conſtitution was very inimical to the intrigues of that court; and the Ruſſian ambaſſador exerted himſelf openly to bring about a rupture between the king and the diſcontented nobles. Guſtavus ordered him to quit the kingdom in eight days, and immediately prepared for war with Ruſſia. To this apparently raſh enterpriſe he was incited by the Ottoman Porte, at that time unable to oppoſe the armies of the two empires; and his own ambition, together with the internal

246 His conduct in the war with Ruſſia.

ſtate of his kingdom, powerfully concurred to make him lend every aſſiſtance to his ancient ally. It is needleſs for us to enter into a detail of the particulars of that war, which, as well as the aſtoniſhing activity and military ſkill diſplayed by the Swediſh monarch, are freſh in the memory of all our readers. Suffice it to ſay, that neither Guſtavus Adolphus nor Charles XII. gave greater proofs of undaunted courage and military conduct in their long and bloody wars than were given by Guſtavus the III. from the end of the year 1787 to 1790, when peace was reſtored between the courts of St Peterſburgh and Stockholm. Had his army remained faithful, it ſeems in a high degree probable that he would have penetrated to the metropolis of the Ruſſian empire in the firſt campaign; and when he was deſerted by that army, and his councils diſtracted by new hoſtilities commenced againſt him by the Danes, the vigour and reſources of his mind never forſook him. When the court of Copenhagen was compelled, by the means of England and Pruſſia, to withdraw its troops from the territories of Sweden, the king attacked Ruſſia with ſuch vigour both by ſea and land, diſplayed ſuch addreſs in retrieving his affairs when apparently reduced to the laſt extremity, and renewed his attacks with ſuch pertinacious courage, that the empreſs lowered the haughtineſs of her tone, and was glad to treat with Guſtavus as an equal and independent ſovereign.

247 Not an arbitrary deſpot, tho' in ſome degree artful and ambitious.

The king of Sweden was now at liberty to cheriſh again the arts of peace, and to humble the haughty ſpirit of the nobles. For his attempting to deprive thoſe men of that power which they had for many years employed againſt their country, he has been held up to the world as a deſpot who trampled on the liberties of his ſubjects; as a man without ſincerity or patriotiſm; and, in one word, as a perjured tyrant, who overthrew the conſtitution which he had ſworn to maintain. That he was not troubled with a ſcrupulous conſcience, when ſo artfully conducting the revolution of 1772, muſt be acknowleged; nor can it be denied, that in his treaties with other powers he ſometimes endeavoured to overreach them: but if the neceſſities of ſtate could in any caſe be an apology for falſehood, they would ſufficiently apologize for the duplicity of Guſtavus. He was engaged in the arduous enterpriſe of freeing his ſubjects from an ariſtocratic tyranny ſupported by a foreign power the moſt formidable in the north; he had been forced into a war with that power, and, as there is reaſon to believe, promiſed aſſiſtance which he never received; and it cannot excite wonder nor great indignation, that, as ſoon as he could make an honourable peace, he embraced the opportunity without paying much regard to the intereſts of an alliance, which tamely looked on while he was ſtruggling with difficulties apparently unſurmountable. That the revolution which he effected in his own country was calculated to promote the general good of the people, is unqueſtionable; and to gain ſuch an object he might ſurely reſtore the crown to its ancient ſplendor, without bringing upon his government the odious epithet of *deſpotiſm*. 248 The revolution beneficial.

The nobles, however, continued diſcontented, and a conſpiracy was planned againſt Guſtavus under his own roof. He had entered into the alliance that was formed againſt the revolutionary government of France; and to raiſe an army which he was to lead in perſon to co-operate with the emperor and the king of Pruſſia, he was obliged to negotiate large loans, and to impoſe upon his ſubjects heavy taxes. The nobles took advantage of that circumſtance to prejudice the minds of many of the people againſt the ſovereign who had laboured ſo long for their real good. On the 16th of March 1792 he received an anonymous letter, warning him of his immediate danger from a plot that was laid to take away his life, requeſting him to remain at home, and avoid balls for a year; and aſſuring him that, if he ſhould go to the maſquerade for which he was preparing, he would be aſſaſſinated that very night. The king read the note with contempt, and at a late hour entered the ball room. After ſome time he ſat down in a box with the compte D'Eſſen, and obſerved that he was not deceived in his contempt for the letter, ſince had there been any deſign againſt his life, no time could be more favourable than that moment. He then mingled, without apprehenſion, among the crowd; and juſt as he was preparing to retire in company with the Pruſſian ambaſſador, he was ſurrounded by ſeveral perſons in maſks, one of whom fired a piſtol at the back of the king, and lodged the contents in his body. A ſcene of dreadful confuſion immediately enſued. The conſpirators, amidſt the general tumult and alarm, had time to retire to other parts of the room; but one of them had previouſly dropped his piſtols and a dagger cloſe by the wounded king. A general order was given to all the company to unmaſk, and the doors were immediately cloſed: but no perſon appeared with any particular diſtinguiſhing marks of guilt. The king was immediately conveyed to his apartment; and the ſurgeon, after extracting a ball and ſome ſlugs, gave favourable hopes of his majeſty's recovery. 249 Produces a conſpiracy againſt the king's life. 250 The king dangerouſly wounded.

Suſpicions immediately fell upon ſuch of the nobles as had been notorious for their oppoſition to the meaſures of the court. The anonymous letter was traced up to colonel Liljehorn, major in the king's guards, and he was immediately apprehended. But the moſt ſucceſsful clue that ſeemed to offer was in conſequence of the weapons which had fallen from the aſſaſſin. An order was iſſued, directing all the armourers, gunſmiths, and cutlers in Stockholm, to give every information in their power to the officers of juſtice concerning the weapons. A gunſmith who had repaired the piſtols readily recognized them to be the ſame which

weden. he had repaired some time since for a nobleman of the name of Ankarstrom, a captain in the army; and the cutler who had made the dagger referred at once to the same person.

151 king The king languished from the 17th to the 29th of March. At first the reports of his medical attendants were favourable; but on the 28th a mortification was found to have taken place, which terminated his existence in a few hours. On opening his body, a square piece of lead and two rusty nails were found unextracted within the ribs.

152 ehaviour before death. During his illness, and particularly after he was made acquainted with the certainty of his approaching dissolution, Gustavus continued to display that unshaken courage which he had manifested on every occasion during his life. A few hours before his decease he made some alterations in the arrangement of public affairs. He had before, by his will, appointed a council of regency; but convinced, by recent experience, how little he could depend on the attachment of his nobles, and being also aware of the necessity of a strong government in difficult times, he appointed his brother, the duke of Sudermania, sole regent, till his son, who was then about fourteen, shall have attained the age of eighteen years. His last words were a declaration of pardon to the conspirators against his life. The actual murderer alone was excepted; and he was excepted only at the strong instance of the regent, and those who surrounded his majesty in his dying moments. Immediately on the death of the king, the young prince was proclaimed by the title of Gustavus IV.

153 of the ...irators. Ankarstrom was no sooner apprehended, than he confessed with an air of triumph, that he was the person "who had endeavoured to liberate his country from a monster and a tyrant." Suspicions at the same time fell on the counts Horn and Ribbing, baron Pechlin, baron Ehrensvard, baron Hartsmandorf, Von Engerstrom the royal secretary, and others; and these suspicions were confirmed by the confession of Ankarstrom. After a very fair and ample trial, this man was condemned to be publicly and severely whipped on three successive days, his right hand and his head to be cut off, and his body impaled; which sentence he suffered not till the 17th of May, long after the death of the king. —His property was given to his children, who, however, were compelled to change their name.

The counts Horn and Ribbing were condemned to lose their right hands, and to be decapitated. Col. Liljehorn and lieutenant Ehrenjwerd were also to be beheaded.—All these conspirators were degraded from the rank of nobles, and their property declared to be confiscated. Major Hartmansdorf was to forfeit his rank in the army, and to be imprisoned for one year. Engerstrom was to suffer perpetual imprisonment, and baron Pechlin and secretary Lilleftrahle to be imprisoned during pleasure. Four others, accused of being concerned in the conspiracy, were pardoned, and some were acquitted.

154 Division of Sweden. The kingdom of Sweden, in its present state, is divided into the following provinces: 1. Sweden Proper. 2. Gothland. 3. Finland. 4. Swedish Lapland. And, 5. The Swedish islands. Great abatements must be made for the lakes and unimproved parts of Sweden, which are so extensive that the habitable part is confined to narrow bounds.

155 Climate, soil, &c. The face of Sweden is pretty similar to those of its neighbouring countries; only it has the advantage of navigable rivers.

The same may be said with regard to its climate, soil, &c. Summer bursts from winter; and vegetation is more speedy than in southern climates. Stoves and warm furs mitigate the cold of winter, which is so intense, that the noses and extremities of the inhabitants are sometimes mortified. The Swedes, since the days of Charles XII. have been at incredible pains to correct the native barrenness of their country, by erecting colleges of agriculture, and in some places with great success. The soil is much the same with that of Denmark and some parts of Norway, generally very bad, but in some valleys surprisingly fertile. The Swedes, till of late years, had not industry sufficient to remedy the one, nor improve the other. The peasants now follow the agriculture of France and England; and some late accounts say, that they rear almost as much grain as maintains the natives. Gothland produces wheat, rye, barley, oats, pease, and beans; and in case of deficiency, the people are supplied from Livonia and the Baltic provinces. In summer, the fields are verdant, and covered with flowers; and produce strawberries, raspberries, currants, and other small fruits. The common people know, as yet, little of the cultivation of apricots, peaches, nectarines, pine-apples, and the like high-flavoured fruits; but melons are brought to great perfection in dry seasons.

Sweden produces crystals, amethysts, topazes, porphyry, lapis lazuli, agate, cornelian, marble, and other fossils. The chief wealth of the country, however, arises from her mines of silver, copper, lead, and iron. The last-mentioned metal employs no fewer than 450 forges, hammering-mills, and smelting-houses. A kind of a gold mine has likewise been discovered in Sweden; but so inconsiderable, that from the year 1741 to 1747, it produced only 2398 gold ducats, each valued at 9s. 4d. sterling. The first gallery of one silver mine is 100 fathoms below the surface of the earth; the roof is supported by prodigious oaken beams, and from thence the miners descend about 40 fathoms to the lowest vein. This mine is said to produce 20,000 crowns a-year. The product of the copper mines is uncertain; but the whole is loaded with vast taxes and reductions to the government, which has no other resources for the exigences of state. Those subterraneous mansions are astonishingly spacious, and at the same time commodious for their inhabitants, so that they seem to form a hidden world. The water-falls in Sweden afford excellent conveniency for turning mills for forges; and for some years the exports of iron from Sweden brought in 300,000l. sterling. Dr Busching thinks that they constituted two-thirds of the national revenue. It must, however, be observed, that the extortions of the Swedish government, and the importation of American bar-iron into Europe, and some other causes, have greatly diminished this manufacture in Sweden; so that the Swedes very soon must apply themselves to other branches of trade and improvements, especially in agriculture. 156

The animals differ little from those of Norway and Denmark, only the Swedish horse are known to be more serviceable in war than the German. The fishes found in the rivers and lakes of Sweden are the same with those in other northern countries, and taken in such quantities, that their pikes (particularly) are salted and pickled for exportation. The train-oil of the seals, taken in the gulph of Finland, is a considerable article of exportation. Animals. 157

There is a great diversity of characters among the people of Sweden; and what is peculiarly remarkable among them, they have been known to have different characters in different ages. At present, their peasants seem to be a heavy plodding race of men, strong and hardy; but without any other ambition than that of subsisting themselves and their families as well as they can: they are honest, simple, and hospitable; and the mercantile classes are much of the same cast; but great application and perseverance is discovered among them all. One could form no idea that the modern Swedes are the descendants of those who, under Gustavus Adolphus and Charles XII. carried terror in their names Character of the Swedes.

Sweden. names through the most distant countries, and shook the foundations of the greatest empires. The principal nobility and gentry of Sweden are naturally brave, polite, and hospitable; they have high and warm notions of honour, and are jealous of their national interests. The dress of the common people is almost the same with that of Denmark: the better sort are infatuated with French modes and fashion. The common diversions of the Swedes are, skating, running races in sledges, and sailing in yachts upon the ice. They are not fond of marrying their daughters when young, as they have little to spare in their own life time. The women go to plough, thresh out the corn, row upon the water, serve the brick layers, carry burdens, and do all the common drudgeries in husbandry.

258 Religion. Christianity was introduced here in the 9th century. Their religion is Lutheran, which was propagated among them by Gustavus Vasa, about the year 1523, as we have already related. The Swedes are surprisingly uniform and unremitting in religious matters; and have such an aversion to Popery, that castration is the fate of every Roman Catholic priest discovered in their country. The archbishop of Upsal has a revenue of about 400l. a-year; and has under him thirteen suffragans, besides superintendants, with moderate stipends. No clergyman has the least direction in the affairs of state; but their morals, and the sanctity of their lives, endear them so much to the people, that the government would repent making them its enemies. Their churches are neat, and often ornamented. A body of ecclesiastical laws and canons direct their religious economy. A conversion to Popery, or a long continuance under excommunication, which cannot pass without the king's permission, is punished by imprisonment and exile.

259 Language. The Swedish language is a dialect of the Teutonic, and resembles that of Denmark. The Swedish nobility and gentry are, in general, more conversant in polite literature than those of many other more flourishing states. They have of late exhibited some noble specimens of their munificence for the improvement of literature and science, particularly natural history.

260 Manufactures, &c. The Swedish commonalty subsists by agriculture, mining, grazing, hunting, and fishing. Their materials for traffic are the bulky and useful commodities of masts, beams, and other sorts of timber for shipping; tar, pitch, bark of trees, potash, wooden utensils, hides, flax, hemp, peltry, furs, copper, lead, iron, cordage, and fish.

Even the manufacturing of iron was introduced into Sweden so late as the 16th century; for till that time they sold their own crude ore to the Hanse-towns, and bought it back again manufactured into utensils. About the middle of the 17th century, by the assistance of the Dutch and Flemings, they set up some manufactures of glass, starch, tin, woollen, silk, soap, leather-dressing, and saw-mills. Bookselling was at that time a trade unknown in Sweden. They have since had sugar-baking, tobacco-plantations, and manufactures of sail-cloth, cotton, fustian, and other stuffs; also of linen, alum, brimstone, paper-mills, and gunpowder-mills. Vast quantities of copper, brass, steel, and iron, are now wrought in Sweden, dug from mines, some of them more than 1100 feet deep. The iron mine of Dannemora, which is much the most profitable of any of those with which every part of Sweden abounds, is said to yield 60lb. of metal in a 100lb. of ore, and the others about 30lb. The iron extracted from this is known in Europe under the name of *Oregrund*; which name is derived from a sea-port on the Baltic. A large portion of it is employed by different nations for making the best steel. The mine was discovered in 1470. The unwrought ore was first sold to the merchants of Lubeck. It was not until the reign of Gustavus Vasa that the Swedes worked it themselves. It is asserted, that the mine of Dannemora yields about 40,000 stones of bar-iron *per* year, which is supposed to be one tenth part of the quantity which all the iron-mines of Sweden produce. Of this product, amounting to 400,000 stones, 300,000 are annually exported; the remainder is manufactured at home. It is calculated that no less than 25,000 men are employed in mining, and the branches immediately connected with it, *viz.* 4000 for breaking the rocks, either by explosion or manual labour; 10,000 to hew timber and burn it into charcoal; 2000 are employed in smelting; 1800 in transporting the metal from the furnaces to the forges; 600 in transporting sand, fuel, &c. 4000 for transporting the charcoal, and 2400 at the forges. They have also founderies for cannon, forgeries for fire arms and anchors, armories, wire and flatting-mills, mills also for fulling, and for boring and stamping: and of late they have built many ships for sale.

There are likewise in Sweden some silver mines, of which that of *Sahla*, or *Sahlberg*, is the richest as well as the most ancient. It existed so early as 1188, and, during the whole of the 14th century, it yielded 24,000 marks of silver *per annum*. In the 15th century the quantity was diminished to 20,000. In the reign of Charles X. it gave only 2000, and it furnishes at present still less, the ore yielding only one ounce of pure metal *per* quintal. The chief gallery where the purest silver was obtained having fallen in, is not yet cleared, notwithstanding their incessant labour. They are also digging pits in a perpendicular direction, in order to arrive at the principal vein, which extends itself from the north to the south-east. Formerly lead employed in separating the metal was imported from England; but the mine furnishes at present a sufficient quantity for the purpose.

Certain towns in Sweden, being 24 in number, are called *Staple-towns*, where the merchants are allowed to import and export commodities in their own ships. Those towns which have no foreign commerce, though lying near the sea, are called *land-towns*. A third kind are termed *mine-towns*, as belonging to mine-districts. The Swedes, about the year 1752, had greatly increased their exports, and diminished their imports, most part of which arrive or are sent off in Swedish ships; the Swedes having now a kind of navigation act like that of the English. Those promising appearances were, however, blasted by the madness and jealousies of the Swedish government; and the people so oppressed with taxes, that some important revolution was daily expected in that kingdom. 26

Reven. The revenue of Sweden, since the unfortunate wars of Charles XII. has been greatly reduced. Her gold and silver species, in the reign of Ad. Frederic, arose chiefly from the king's German dominions. Formerly, the crown-lands, poll-money, tithes, mines, and other articles, are said to have produced a million sterling. The payments that are made in copper, which is here the chief medium of commerce, is extremely inconvenient; some of those pieces being as large as tiles; and a cart or wheelbarrow is often required to carry home a moderate sum. The Swedes, however, have gold ducats, and eight-mark pieces of silver, valued each at 5s. 2d. and the subsidies paid them by France help to increase their currency. 26

Milit. streng. No country in the world has produced greater heroes or braver troops than the Swedes; and yet they cannot be said to maintain a standing army, as their forces consist of a regulated militia. The cavalry is clothed, armed, and maintained, by a rate raised upon the nobility and gentry, according to their estates; and the infantry by the peasants. Each province is obliged to find its proportion of soldiers, according

according to the number of farms it contains; every farm of 60l. or 70l. *per annum* is charged with a foot-soldier, furnishing him with diet, lodging, and ordinary clothes, and about 20s. a-year in money; or else a little wooden house is built him by the farmer, who allows him hay and pasturage for a cow, and ploughs and sows land enough to supply him with bread. When embodied, they are subject to military law, but otherwise to the civil law of the country. It may therefore literally be said, that every Swedish soldier has a property in the country he defends. This national army is thought to amount to above 50,000 men. Sweden formerly could have fitted out 40 ships of the line.

SWEDENBORG (Emanuel), was born at Stockholm on the 29th of January 1689. His father was bishop of West-Gothia; member of a society for the propagation of the gospel, formed on the plan of that of England; and president of the Swedish church in Pennsylvania and London. To this last office he was appointed by Charles XII. who seems to have had a great regard for the bishop, and to have continued that regard to his son.

Of the course of young Swedenborg's education we have procured no account; but from the character of the father, it may be supposed to have been pious; and by his appearing with reputation as an author, when but 20 years of age, it is proved to have been successful. His first work was published in 1709; and the year following he sent into the world a collection of pieces on different subjects, in Latin verse, under the title of *Ludus Heliconius, sive Carmina Miscellanea quæ variis in locis cecinit*. The same year he began his travels, first into England, and afterwards into Holland, France, and Germany; and returning to Stockholm in 1714, he was two years afterwards appointed to the office of assessor in the Metallic College by Charles XII. who honoured him with frequent conversations, and bestowed upon him a large share of his favour. At this period of his life Swedenborg devoted his attention principally to physic and mathematical studies; and in 1718 he accompanied the king to the siege of Frederickshall, where he gave an eminent proof that he had not studied in vain. Charles could not send his heavy artillery to Frederickshall from the badness of the roads, which were then rendered much worse than usual by being deeply covered with snow. In this extremity Swedenborg brought the sciences to the aid of valour. By the help of proper instruments he cut through the mountains, and raised the valleys which separated Sweden from Norway, and then sent to his master two galleys, five large boats, and a sloop, loaded with battering pieces, to be employed in the siege. The length of this canal was about two miles and a half. The execution of this great work, however, did not occupy all his time. In 1716 he had begun to publish essays and observations on the mathematical and physical sciences, under the title of *Dædalus Hyperboreus*; and he found leisure during the siege to complete his intended collection, and also in the same year to publish an introduction to algebra, under the whimsical title of *The Art of the Rules*.

At the siege of Frederickshall he lost his patron Charles; but found another in Ulrica Eleonora, the sister and successor of that hero, by whom in 1719 he was ennobled, and took of course his seat among the senators of the equestrian order in the triennial assemblies of the states. His promotion did not lessen his ardour for the sciences; for he published in the same year *A Method to fix the Value of Money, and to determine the Swedish Measures in such a way as to suppress all the Fractions and facilitate the Calculations.* About the same time he gave the public a treatise on *the Position and Course of the Planets*; with another on *the Height of the Tides, and Flux and Reflux of the Sea*; which, from information gathered in different parts of Sweden, appeared to have been greater formerly than when he wrote. Swedenborg.

As Swedenborg continued, under the new sovereign, to hold the office of assessor to the Metallic College, he thought it necessary, for the discharge of his duty, to make a second journey into foreign countries, that he might himself examine their mines, particularly those of Saxony and Harts. During these travels, which were undertaken for the improvement of the manufactures of his native country, he printed at Amsterdam, 1. *Prodromus principiorum Naturalium, sive novorum tentaminum, Chemiam et Physicam experimentalem geometrice explicandi.* 2. *Nova observata & inventa circa Ferrum & Ignem, præcipue naturam Ignis Elementarium, una cum nova Camini inventione.* 3. *Methodus nova inveniendi Longitudines locorum terra marique ope Lunæ.* 4. *Modus construendi receptacula navalia, vulgo en Suedois, Docky-nadder.* 5. *Nova constructio aggeris aquatici.* 6. *Modus explorandi virtutes Navigiorum.* And at Leipsic and Hamburg, 7. *Miscellanea observata circa res naturales, præsertim Mineralia, Ignem, & Montium strata.* European Magazine, 1787, July.

This journey was made, and these tracts published, in the compass of a year and a half; and perhaps there has not been another man, Linnæus excepted, who has done so much in so short a time. After his return in 1722, Swedenborg divided his time so equally between the duties of his office and his private studies, that in 1733 he finished his grand work, entitled *Opera Philosophica & Mineralia*, and had it printed under his own direction in 1734, part at Dresden and part at Leipsic; in which year he also went to inspect the mines of Austria and Hungary. This work is divided into three volumes folio; the title of the first is *Principia rerum Naturalium sive novorum tentaminum, Phænomena Mundi elementaris philosophice explicandi*. The second, *Regnum subterraneum sive Minerale de Ferro*; and the third, *Regnum subterraneum sive Minerale de Cupro, & Orichalco*; all of them written with great strength of judgment, and ornamented with plates, to facilitate the comprehension of the text.

In the year 1729 he was enrolled among the members of the Society of Sciences at Upsal, and was, probably about the same time, made a Fellow of the Royal Academy of Sciences at Stockholm; nor were strangers less willing than his own countrymen to acknowledge the greatness of his merit. Wolfius, with many other learned foreigners, were eager to court his correspondence. The Academy of St Petersburg sent him, on the 17th of December 1734, a diploma of association as a correspondent member; and soon afterwards the editors of the *Acta Eruditorum* at Leipsic found in his works a valuable supplement to their own collection.

By many persons the approbation of learned academies would have been highly valued; but by Baron Swedenborg it was considered as of very little importance. "Whatever of wordly honour and advantage may appear to be in the things before mentioned, I hold them (says he) but as matters of low estimation, when compared to the honour of that holy office to which the Lord himself hath called me, who was graciously pleased to manifest himself to me, his unworthy servant, in a personal appearance, in the year 1743, to open in me a sight of the spiritual world, and to enable me to converse with spirits and angels; and this privilege has continued with me to this day. From that time I began to print and publish various unknown *Arcana*, which have been either seen by me or revealed to me, concerning heaven and hell, the state of men after death, the true wor- Short Account of the Honourable E. Swedenborg.

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ſhip of God, the ſpiritual ſenſe of the Scriptures, and many other important truths tending to ſalvation and true wiſdom."

We ſhall not affront the underſtandings of our readers by making upon this account of the Baron's *call* ſuch reflections as every perſon of a ſound mind will make for himſelf; but it is rather remarkable, that a man who had devoted the better part of his life to the ſtudy of ſuch ſciences as generally fortify the mind againſt the deluſions of fanaticiſm, and who had even excelled in theſe ſciences, ſhould have fallen into ſuch a reverie as this. After this extraordinary call, the Baron dedicated himſelf wholly to the great work which, he ſuppoſed, was aſſigned him, ſtudying diligently the word of God, and from time to time publiſhing to his fellow-creatures ſuch important information as was made known to him concerning another world. Among his various diſcoveries concerning the ſpiritual world, one is, that it exiſts not in ſpace. "Of this (ſays he) I was convinced, becauſe I could there ſee Africans and Indians very near me, although they are ſo many miles diſtant here on earth; nay, that I could be made preſent with the inhabitants of other planets in our ſyſtem, and alſo with the inhabitants of planets that are in other worlds, and revolve about other ſuns. By virtue of ſuch preſence (*i. e.* without real ſpace), not of place, I have converſed with apoſtles, departed popes, emperors, and kings; with the late reformers of the church, Luther, Calvin, and Melancthon, and with others from diſtant countries."

Swedenborg's Universal Theology, vol. i. p. 87.

Notwithſtanding the want of ſpace in the ſpiritual world, he tells us, "that after death a man is ſo little changed that he even does not know but he is living in the preſent world; that he eats and drinks, and even enjoys conjugal delight as in this world; that the reſemblance between the two worlds is ſo great, that in the ſpiritual world there are cities, with palaces and houſes, and alſo writings and books, employments and merchandizes; that there is gold, ſilver, and precious ſtones there. In a word (he ſays), there is in the ſpiritual world all and every thing that there is in the natural world, but that in heaven ſuch things are in an infinitely more perfect ſtate."

Ibid. N° 734.

Such was his zeal in the propagation of theſe whimſical and ſometimes ſenſual doctrines, that he frequently left his native country to viſit diſtant cities, particularly London and Amſterdam, where all his theological works were printed at a great expence, and with little proſpect or probability of a reimburſement. "Wherever he reſided when on his travels, he was (ſays one of his admirers) a mere ſolitary, and almoſt inacceſſible, though in his own country of a free and open behaviour. He affected no honour, but declined it; purſued no worldly intereſt, but ſpent his time in travelling and printing, in order to communicate inſtruction and benefit to mankind. He had nothing of the preciſe in his manner, nothing of melancholy in his temper, and nothing in the leaſt bordering on enthuſiaſm in his converſation or writings." This is too much. We believe he was an inoffenſive viſionary; of his converſation we cannot judge; but the ſpecimens that we have given of his writings are frantic enthuſiaſm. He died at London, March 29th, in the year 1772; and after lying in ſtate, his remains were depoſited in a vault at the Swediſh church, near Radcliff-Highway.

Short Account, &c. p. 11. and *Hartley's Preface to the Treatiſe on Influx*.

Though Baron Swedenborg's followers appear not to have been numerous during his life, they have increaſed ſince his death; and a ſect ſubſiſts at preſent in England which derives its origin from him, and is called *the New Jeruſalem Church*. The diſcriminating tenets of this ſect ſeem to be the following: "Holding the doctrine of one God, they maintain that this one God is no other than Jeſus Chriſt, and that he always exiſted in a human form; that for the ſake of redeeming the world, he took upon himſelf a proper human or material body, but not a human ſoul; that this redemption conſiſts in bringing the hells or evil ſpirits into ſubjection, and the heavens into order and regulation, and thereby preparing the way for a new ſpiritual church; that without ſuch redemption no man could be ſaved, nor could the angels retain their ſtate of integrity; that their redemption was effected by means of trials, temptations, or conflicts with evil ſpirits; and that the laſt of them, by which Chriſt glorified his humanity, perfecting the union of his divine with his human nature, was the paſſion of the croſs. Though they maintain that there is but one God, and one divine perſon, they hold that in this perſon there is a real Trinity; conſiſting of the divinity, the humanity, and the operation of them both in the Lord Jeſus; a Trinity which did not exiſt from all eternity, but commenced at the incarnation. They believe that the Scriptures are to be interpreted not only in a literal but in a ſpiritual ſenſe, not known to the world till it was revealed to B. Swedenborg; and that this ſpiritual ſenſe extends to every part of Scripture, except the Acts of the Apoſtles. They believe that there are angels attending upon men, reſiding, as B. Swedenborg ſays, in their affections; that temptation conſiſts in a ſtruggle between good and bad angels within men; and that by this means God aſſiſts men in theſe temptations, ſince of themſelves they could do nothing. Indeed B. Swedenborg maintains, that there is an univerſal influx from God into the ſouls of men, inſpiring them eſpecially with the belief of the divine unity. This efflux of divine light on the ſpiritual world he compares to the efflux of the light from the ſun in the natural world.

Prieſtley's Letters to the New Jeruſalem Church, p. 4.

"There are (ſays B. Swedenborg) two worlds, the natural and the ſpiritual, entirely diſtinct, though perfectly correſponding to each other; that at death a man enters into the ſpiritual world, when his ſoul is clothed with a body, which he terms *ſubſtantial*, in oppoſition to the preſent *material* body, which, he ſays, is never to riſe out of the grave."

SWEEP, in the ſea-language, is that part of the mould of a ſhip where ſhe begins to compaſs in the rung-heads. Alſo when the hauſer is dragged along the bottom of the ſea to recover any thing that is ſunk, they call this action *ſweeping for it*.

SWEET, in the wine trade, denotes any vegetable juice, whether obtained by means of ſugar, raiſins, or other foreign or domeſtic fruit, which is added to wines with a deſign to improve them.

SWEIN-MOT. See FOREST *Courts*.

SWERTIA, MARSH GENTIAN, in botany: A genus of plants belonging to the claſs of *pentandria*, and to the order of *digynia*; and in the natural ſyſtem ranging under the 20th order, *rotaceæ*. The corolla is wheel-ſhaped. There are nectariferous pores at the baſes of the ſegments of the corolla. The capſule is unilocular and bivalve. There are ſix ſpecies; the perennis, difformis, rotata, carinthiaca, corniculata, dichotoma. The perennis is a native of England. It is diſtinguiſhed by radical oval leaves. It flowers in Auguſt.

SWIETENIA, MAHOGANY, in botany: A genus of plants belonging to the claſs of *decandria*, and to the order of *monogynia*; and in the natural ſyſtem arranged under the 54th order, *Miſcellaneæ*. The calyx is quinquefid. There are five petals; the nectarium is cylindrical, ſupporting the antheræ with its mouth. The capſule is five-celled, woody, and opening at the mouth. The ſeeds are imbricated and winged. There is only one ſpecies, the mahagoni, which is a native of the warmeſt parts of America, and grows alſo in

is, in the iſland of Cuba, Jamaica, Hiſpaniola, and the Bahama iſlands. It abounded formerly in the low lands of Jamaica, but it is now found only on high hills and places difficult of acceſs.

It thrives in moſt ſoils, but varies in texture and grain according to the nature of the ſoil. On rocks it is of a ſmaller ſize, but very hard and weighty, of a cloſe grain, and beautifully ſhaded; while the produce of the low and richer lands is obſerved to be more light and porous, of a paler colour and open grain; and that of mixed ſoils to hold a medium between both. The tree grows very tall and ſtraight, and is uſually four feet in diameter; the flowers are of a reddiſh or ſaffron colour, and the fruit of an oval form, and about the ſize of a turkey's egg.

The wood is generally hard, takes a fine poliſh, and is found to anſwer better than any other ſort in all kinds of cabinet ware. It is now univerſally eſteemed, and ſells at a good price; but it is pity that it is not cultivated in the more convenient waſte lands of Jamaica It is a very ſtrong timber, and anſwers very well in beams, joiſts, plank, boards, and ſhingles; and has been frequently put to thoſe uſes in Jamaica in former times. It is ſaid to be uſed ſometimes in ſhip-building; a purpoſe for which it is remarkably adapted, if not too coſtly, being very durable, capable of reſiſting gun-ſhots, and burying the ſhots without ſplintering.

The ſeed-veſſels are of a curious form, conſiſting of a large cone ſplitting into five parts, and diſcloſing its winged ſeeds, diſpoſed in the regular manner of thoſe of an apocynum. The ſeeds being winged, are diſperſed on the ſurface of the ground, where ſome falling into the chinks of the rocks, ſtrike root; then creep out on the ſurface of it, and ſeek another chink, into which they creep and ſwell to ſuch a ſize and ſtrength, that at length the rock ſplits, and is forced to admit of the root's deeper penetration; and with this little nutriment the tree increaſes to a ſtupendous ſize in a few years.

The firſt uſe to which mahogany was applied in England, was to make a box for holding candles. Dr Gibbons, an eminent phyſician in the latter end of the laſt and beginning of the preſent century, had a brother, a Weſt India captain, who brought over ſome planks of this wood as ballaſt. As the Doctor was then building him a houſe in King-ſtreet, Covent-Garden, his brother thought they might be of ſervice to him. But the carpenters, finding the wood too hard for their tools, they were laid aſide for a time as uſeleſs. Soon after, Mrs Gibbons wanting a candle-box, the Doctor called on his cabinet maker (Wollaſton in Long-Acre) to make him one of ſome wood that lay in his garden. Wollaſton alſo complained that it was too hard. The Doctor ſaid he muſt get ſtronger tools. The candle-box was made and approved; inſomuch, that the Doctor then inſiſted on having a bureau made of the ſame wood, which was accordingly done; and the fine colour, poliſh, &c. were ſo pleaſing, that he invited all his friends to come and ſee it. Among them was the ducheſs of Buckingham. Her Grace begged ſome of the ſame wood of Dr Gibbons, and employed Wollaſton to make her a bureau alſo; on which the fame of mahogany and Mr Wollaſton was much raiſed, and things of this ſort became general. This account was given by Henry Mill, Eſq; a gentleman of undoubted veracity.

SWIFT (Dr Jonathan), ſo univerſally admired as a wit and claſſical writer of the Engliſh language, was born in Dublin on November 30th 1667. His father was an attorney, and of a good family; but dying poor, the expence of his ſon's education was defrayed by his friends. At the age of ſix young Swift was ſent to the ſchool of Kilkenny, whence he was removed in his 15th year to Trinity College, Dublin. Swift.

In his academical ſtudies (ſays Dr Johnſon) he was either not diligent or not happy. The truth appears to be, that he deſpiſed them as intricate and uſeleſs. He told Mr Sheridan, his laſt biographer, that he had made many efforts, upon his entering the college, to read ſome of the old treatiſes on logic writ by Smeglefius, Keckermannus, Burgerſdicius, &c. and that he never had patience to go thro' three pages of any of them, he was ſo diſguſted at the ſtupidity of the work. When he was urged by his tutor to make himſelf maſter of this branch, then in high eſtimation, and held eſſentially neceſſary to the taking of a degree, Swift aſked him, What it was he was to learn from thoſe books? His tutor told him, The art of reaſoning. Swift ſaid, That he found no want of any ſuch art; that he could reaſon very well without it; and that, as far as he could obſerve, they who had made the greateſt proficiency in logic had, inſtead of the art of reaſoning, acquired the art of wrangling; and inſtead of clearing up obſcurities, had learned how to perplex matters that were clear enough before. For his own part, he was contented with that portion of reaſon which God had given him; and he would leave it to time and experience to ſtrengthen and direct it properly; nor would he run the riſk of having it warped or falſely biaſſed by any ſyſtem of rules laid down by ſuch ſtupid writers, of the bad effects of which he had but too many examples before his eyes in thoſe reckoned the moſt acute logicians. Accordingly, he made a firm reſolution, that he never would read any of thoſe books; which he ſo pertinaciouſly adhered to, that though his degree was refuſed him the firſt time of ſitting for it, on account of his not anſwering in that branch, he went into the hall a ſecond time as ill prepared as before; and would alſo have been ſtopped a ſecond time, on the ſame account, if the intereſt of his friends, who well knew the inflexibility of his temper, had not ſtepped in, and obtained it for him; though in a manner little to his credit, as it was inſerted in the College Regiſtry, that he obtained it *ſpeciali gratia*, "by ſpecial favour;" where it remains upon record.

"He remained in the college near three years after this, not through choice, but neceſſity, little known or regarded. By ſcholars he was reckoned a blockhead; and as the lowneſs of his circumſtances would not permit him to keep company with perſons of an equal rank with himſelf, upon an equal footing, he ſcorned to take up with thoſe of a lowe claſs, or to be obliged to thoſe of a higher. He lived there for much alone, and his time was employed in purſuing his courſe of reading in hiſtory and poetry, then very unfaſhionable ſtudies for an academic; or in gloomy meditations on his unhappy circumſtances. Yet, under this heavy preſſure, the force of his genius broke out, in the firſt rude draught of the Tale of a Tub, written by him at the age of 19, though communicated to nobody but his chamber-fellow Mr Waryng; who, after the publication of the book, made no ſcruple to declare, that he had read the firſt ſketch of it in Swift's hand-writing when he was of that age."

In 1688, being, by the death of Godwin Swift his uncle, who had chiefly ſupported him, left without ſubſiſtence, he went to conſult his mother, who then lived at Leiceſter, about the future courſe of his life; and, by her direction, ſolicited the advice and patronage of Sir William Temple, whoſe father had lived in great friendſhip with Godwin Swift. Temple received him with great kindneſs, and was ſo much pleaſed with his converſation, that he detained him two years in his houſe, and recommended him to king William, who offered to make him a captain of horſe. This not ſuiting his diſpoſition, and Temple not having it quickly

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in his power to provide for him otherwise, Swift left his patron (1694) in discontent; having previously taken his master's degree at Oxford, by means of a testimonial from Dublin, in which the words of disgrace were omitted. He was resolved to enter into the church, where his first preferment was only L. 100 a year, being the prebend of *Kilroot* in *Connor*; which some time afterwards, upon Sir William Temple's earnestly inviting him back to his house at Moorpark, he resigned in favour of a clergyman far advanced in years and burdened with a numerous family. For this man he solicited the prebend, to which he himself inducted him.

In 1699, Swift lost his patron Sir William Temple, who left him a legacy in money, with the property of his manuscripts; and, on his death bed, obtained for him a promise from the king of the first prebend that should become vacant at Westminster or Canterbury. That this promise might not be forgotten, Swift dedicated to the king the posthumous works with which he was entrusted, and for a while attended the court; but soon found his solicitations hopeless. He was then invited by the earl of Berkeley to accompany him into Ireland, where, after suffering some cruel disappointments, he obtained the livings of Laracor and Rathbeggin in the diocese of Meath; and soon afterwards invited over the unfortunate Stella, a young woman of the name of Johnson, whose life he contrived to embitter, and whose days, though he certainly loved her, we may confidently affirm that he shortened by his caprice.

This lady is generally believed to have been the daughter of Sir William Temple's steward; but her niece, a Mrs Hearn, assured Mr Berkeley, the editor of a volume of letters intitled *Literary Relics*, that her father was a merchant, and the youngest brother of a good family in Nottinghamshire; that her mother was the intimate friend of lady Gifford, Sir William's sister; and that she herself was educated in the family with his niece, the late Mrs Temple of Moorpark by Farnham*. This story would be intitled to the fullest credit, had not Mrs Hearn affirmed, in the same letter, that, before the death of Sir William Temple, Mrs Johnson's little fortune had been greatly injured by the South-Sea bubbles, which are known to have injured no person till the year 1720: (See COMPANY, II. 1.) When one part of a narrative is so palpably false, the remainder will always be received with hesitation. But whether Miss Johnson was the daughter of Temple's steward or of the friend of lady Gifford, it is certain that Sir William left her L. 1000; and that, accompanied by Mrs Dingley, whose whole fortune amounted to an annuity of L. 27 for life, she went, in consequence of Swift's invitation, to Laracor. With these two ladies he passed his hours of relaxation, and to them he opened his bosom; but they never resided in the same house, nor did he see either without a witness.

* See *Inquiry into the Life of Dean Swift, prefixed to Literary Relics*, printed in 1789, for Elliot and Kay.

In 1701 Swift published *A discourse of the contests and dissensions in Athens and Rome*. It was his first work, and indeed the only which he ever expresly acknowledged. According to his constant practice he had concealed his name; but after its appearance, paying a visit to some Irish bishop, he was asked by him if he had read that pamphlet, and what its reputation was in London. Upon his replying that he believed it was very well liked in London; "Very well liked!" said the bishop with some emotion. "Yes, Sir, it is one of the finest tracts that ever was written, and bishop Burnet is one of the best writers in the world." Swift, who always hated Burnet with something more than political rancour, immediately questioned his right to the work, when he was told by the bishop that he was "a young man;" and still persisting to doubt of the justice of Burnet's claim, on account of the dissimilarity of the style of the pamphlet from that of his other works, he was told that he was "a very positive young man," as no person in England but bishop Burnet was capable of writing it. Upon which Swift replied, with some indignation, I am to assure your lordship, however, that bishop Burnet did *not* write the pamphlet, for I wrote it myself. And thus was he forced in the heat of argument to avow what otherwise he would have for ever concealed.

Early in the ensuing spring king William died; and Swift, on his next visit to London, found queen Anne upon the throne. It was generally thought, upon this event, that the Tory party would have had the ascendant; but, contrary to all expectation, the Whigs had managed matters so well as to get entirely into the queen's confidence, and to have the whole administration of affairs in their hands. Swift's friends were now in power; and the Whigs in general, knowing him to be the author of the Discourse on the Contests, &c. which was written in defence of king William and his ministers against the violent proceedings of the house of commons, considered themselves as much obliged to him, and looked upon him as fast to their party. But Swift thought with the Whigs only in the state; for with respect to the church his principles were always those of a Tory. He therefore declined any intimate connection with the leaders of the party, who at that time professed what was called *low church principles*. But what above all shocked him, says Mr Sheridan, was their inviting Deists, Freethinkers, Atheists, Jews, and Infidels, to be of their party, under pretence of moderation, and allowing a general liberty of conscience. As Swift was in his heart a man of true religion, he could not have borne, even in his private character, to have mixed with such a motely crew. But when we consider his principles in his political capacity, that he looked upon the church of England, as by law established, to be the main pillar of our newly erected constitution, he could not, consistently with the character of a good citizen, join with those who considered it more as an ornament than a support to the edifice; and could therefore look on with composure while it was undermining, or could even open the gate to a blind multitude, to try, like Sampson, their strength against it, and consider it only as sport. With such a party, neither his religious nor political principles would suffer him to join; and with regard to the Tories, as is usual in the violence of factions, they had run into opposite extremes, equally dangerous to the state. He was therefore during the earlier part of the queen's reign of no party, but employed himself in discharging the duties of his function, and in publishing from time to time such tracts as he thought might be useful. In the year 1704 he published the *Tale of a Tub*, which, considered merely as a work of genius, is unquestionably the greatest which he ever produced; but the levity with which religion was thought to be there treated, raised up enemies to him among all parties, and eventually precluded him from a bishopric. From that period till the year 1708, he seems to have employed himself in solitary study; but he then gave successively to the public *The Sentiments of a Church of England man*, the ridicule of astrology under the name of *Bickerstaff*, the *Argument against abolishing Christianity*, and the defence of the *Sacramental Test*.

Soon after began the busy and important part of Swift's life. He was employed (1710) by the primate of Ireland to solicit the queen for a remission of the first fruits and twentieth parts to the Irish clergy. This introduced him to Mr Harley, afterwards earl of Oxford, who, though a Whig himself, was at the head of the Tory ministry, and in great need of an auxiliary so able as Swift, by whose pen he and the other ministers might be supported in pamphlets, poems,

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poems, and periodical papers. In the year 1710 was commenced the *Examiner;* of which Swift wrote 33 papers, beginning his first part of it on the 10th of November 1711. The next year he published *the Conduct of the Allies* ten days before the parliament assembled; and soon afterwards, *Reflections on the barrier Treaty.* The purpose of these pamphlets was to persuade the nation to a peace, by showing that "mines had been exhausted and millions destroyed" to secure the Dutch and aggrandize the emperor, without any advantage whatever to Great Britain. Though these two publications, together with his *Remarks on the Bishop of Sarum's Introduction to the third Volume of his History of the Reformation*, certainly turned the tide of popular opinion, and effectually promoted the designs of the ministry, the best preferment which his friends could venture to give him was the deanery of St Patrick's, which he accepted in 1713. In the midst of his power and his politics he kept a journal of his visits, his walks, his interviews with ministers, and quarrels with his servant, and transmitted it to Mrs Johnson and Mrs Dingley, to whom he knew that whatever befel him was interesting; but in 1714 an end was put to his power by the death of the queen, which broke down at once the whole system of Tory politics, and nothing remained for him but to withdraw from persecution to his deanery.

In the triumph of the Whigs, Swift met with every mortification that a spirit like his could possibly be exposed to. The people of Ireland were irritated against him beyond measure; and every indignity was offered him as he walked the streets of Dublin. Nor was he only insulted by the rabble, but persons of distiguished rank and character forgot the decorum of common civility to give him a personal affront. While his pride was hurt by such indignities, his more tender feelings were also often wounded by base ingratitude. In such a situation he found it in vain to struggle against the tide that opposed him. He silently yielded to it, and retired from the world to discharge his duties as a clergyman, and attend to the care of his deanery. That no part of his time might lie heavy on his hands, he employed his leisure hours on some historical attempts relating to the change of the ministers and the conduct of the ministry; and completed the history of the four last years of the queen, which had been begun in her lifetime, but which he never published. Of the work which bears that title, and is said to be his, Dr Johnson doubts the genuineness; and it certainly is not such as we should have expected from a man of Swift's sagacity and opportunities of information.

In the year 1716 he was privately married to Mrs Johnson by Dr Ashe bishop of Clogher; but the marriage made no change in their situation, and it would be difficult to prove (says Lord Orrery) that they were ever afterwards together but in the presence of a third person. The dean of St Patrick's lived in a private manner, known and regarded only by his friends, till about the year 1720 that he published his first political pamphlet relative to Ireland, intitled *A Proposal for the Universal Use of Irish Manufactures;* which so roused the indignation of the ministry that they commenced a prosecution against the printer, which drew the attention of the public to the pamphlet, and at once made its author popular.

Whilst he was enjoying the laurels which this work had wreathed for him, his felicity, as well as that of his wife, was interrupted by the death of Mrs Van Homrigh, and the publication of his poem called *Cadenus and Vanessa*, which brought upon him much merited obloquy. With Mrs Van Homrigh he became acquainted in London during his attendance at court; and finding her possessed of genius and fond of literature, he took delight in directing her studies, till he got insensibly possession of her heart. From being proud of his praise, she grew fond of his person; and despising vulgar restraints, she made him sensible that she was ready to receive him as a husband. She had wit, youth, beauty, and a competent fortune to recommend her; and for a while Swift seems to have been undetermined whether or not he should comply with her wish. She had followed him to Ireland, where she lived in a house about twelve miles distant from Dublin; and he continued to visit her occasionally, and to direct her studies as he had done in London; but with these attentions she was not satisfied, and at last sent to him a letter written with great ardour and tenderness, insisting that he should immediately accept or refuse her as a wife. His answer, which probably contained the secret of his marriage, he carried himself; and having indignantly thrown it on the lady's table, instantly quitted the house, we believe without speaking to her, and returned to Dublin to reflect on the consequences of his own conduct. These were dreadful. Mrs Van Homrigh survived her disappointment but a few weeks; during which time she cancelled a will that she had made in his favour, and ordered the poem to be published in which Cadenus had proclaimed her excellence and confessed his love.

His patriotism again burst forth in 1724 to obstruct the currency of Wood's halfpence; and his zeal was crowned with success. Wood had obtained a patent to coin 180,000 l. in halfpence and farthings for the kingdom of Ireland; and was about to turn his brass into gold, when Swift, finding that the metal was debased to an enormous degree, wrote letters under the name of *M. B. Drapier* to show the folly of giving gold and silver for coin not worth a third part of its nominal value. A prosecution was carried on against the printer; and lord Carteret, then lord-lieutenant, issued a proclamation, offering L. 300 for discovering the author of the fourth letter. The day after it was published there was a full levee at the castle. The lord-lieutenant was going round the circle, when Swift abruptly entered the chamber, and pushing his way through the crowd, never stopped till he got within the circle; where, with marks of the highest indignation in his countenance, he addressed the lord-lieutenant with the voice of a Stentor, that re-echoed through the room, "So, my lord lieutenant, this is a glorious exploit that you performed yesterday, in issuing a proclamation against a poor shop-keeper, whose only crime is an honest endeavour to save his country from ruin. You have given a noble specimen of what this devoted nation is to hope for from your government. I suppose you expect a statue of copper will be erected to you for this service done to Wood." He then went on for a long time, inveighing in the bitterest terms against the patent, and displaying in the strongest colours all the fatal consequences of introducing that execrable coin. The whole assembly were struck mute with wonder at this unprecedented scene. For some time a profound silence ensued. When lord Carteret, who had listened with great composure to the whole speech, made this fine reply, in a line of Virgil's:

> *Res duræ, & regni novitas me talia cogunt*
> *Moliri.*

From this time Swift was known by the name of *the Dean*, and was known by the populace as the champion, patron, and instructor of Ireland.

In 1727 he returned to England; where, in conjunction with Pope, he collected three volumes of miscellanies; and the same year he sent into the world his *Gulliver's Travels*, a production which was read by the high and the low, and filled every reader with a mingled emotion of merriment and amazement. Whilst he was enjoying the reputation of this work, he was suddenly called to a home of sorrow. Poor Stella was sinking into the grave; and after a languishing

decay of about two months, died in her 44th year, on January 28. 1728. How much he wiſhed her life is ſhown by his papers; nor can it be doubted that he dreaded the death of her whom he loved moſt, aggravated by the conſciouſneſs that himſelf had haſtened it. With her vaniſhed all his domeſtic enjoyments, and of courſe he turned his thoughts more to public affairs; in the contemplation of which he could ſee nothing but what ſerved to increaſe the malady. The advances of old age, with all its attendant infirmities; the death of almoſt all his old friends; the frequent returns of his moſt diſpiriting maladies, deafneſs and giddineſs; and, above all, the dreadful apprehenſions that he ſhould outlive his underſtanding, made life ſuch a burden to him, that he had no hope left but a ſpeedy diſſolution, which was the object of his daily prayer to the Almighty.

The ſeverity of his temper increaſing, he drove his acquaintance from his table, and wondered why he was deſerted. In 1732, he complains, in a letter to Mr Gay, that "he had a large houſe, and ſhould hardly find one viſitor if he was not able to hire him with a bottle of wine:" and, in another to Mr Pope, "that he was in danger of dying poor and friendleſs, even his female friends having forſaken him; which," as he ſays, "vexed him moſt." Theſe complaints were afterwards repeated in a ſtrain of yet greater ſenſibility: "All my friends have forſaken me.

"*Vertiginoſus, inops, ſurdus, male gratus amicis.*

"Deaf, giddy, helpleſs, left alone,

"To all my friends a burden grown."

The fits of giddineſs and deafneſs to which he had been ſubjected from his boyiſh years, and for which he thought walking or riding the beſt remedy, became more frequent and violent as he grew old; and the preſentiment which he had long entertained of that wretchedneſs which would inevitably overtake him towards the cloſe of life, clouded his mind with melancholy and tinged every object around him. How miſerable he was rendered by that gloomy proſpect, we may learn from the following remarkable anecdote mentioned by Mr Faulkner in his letter to lord Cheſterfield. "One time, in a journey from Drogheda to Navan, the dean rode before the company, made a ſudden ſtop, diſmounted his horſe, fell on his knees, lifted up his hands, and prayed in the moſt devout manner. When his friends came up, he deſired and inſiſted on their alighting; which they did, and aſked him the meaning. "Gentlemen," ſaid he, "pray join your hearts in fervent prayers with mine, that I may never be like this oak-tree, which is decayed and withered at top, while the other parts are ſound." In 1736, while he was writing a ſatire called the *Legion Club* againſt the Iriſh parliament, he was ſeized with ſo dreadful a fit of his malady, that he left the poem unfiniſhed; and never after attempted a compoſition that required a courſe of thinking. From this time his memory gradually declined, his paſſions perverted his underſtanding, and, in 1741, he became utterly incapable of converſation; and it was found neceſſary to appoint legal guardians to his perſon and his fortune. He now loſt all ſenſe of diſtinction. His meat was brought to him cut into mouthfuls; but he would never touch it while the ſervant ſtaid; and at laſt, after it ſtood perhaps an hour, would eat it walking; for he continued his old habit, and was on his feet ten hours a-day. During next year a ſhort interval of reaſon enſuing, gave hopes of his recovery; but in a few days he ſunk into lethargic ſtupidity, motionleſs, heedleſs, and ſpeechleſs. After a year of total ſilence, however, when his houſe-keeper told him that the uſual illuminations were preparing to celebrate his birth, he anſwered, "It is all folly; they had better let it alone." He at laſt ſunk into a perfect ſilence, which continued till the 29th of October 1745, when he expired without a ſtruggle, in his 78th year. The behaviour of the citizens on this occaſion gave the ſtrongeſt proof of the deep impreſſion he had made on their minds. Though he had been ſo many years to all intents and purpoſes dead to the world, and his departure from that ſtate ſeemed a thing rather to be wiſhed than deplored, yet no ſooner was his death announced, than they gathered from all quarters, and forced their way in crowds into the houſe, to pay the laſt tribute of grief to their departed benefactor. Nothing but lamentations were heard all around the quarter where he lived, as if he had been cut off in the vigour of his years. Happy were they who firſt got into the chamber where he lay, to procure, by bribes to the ſervants, locks of his hair, to be handed down as ſacred relics to their poſterity; and ſo eager were numbers to obtain at any price this precious memorial, that in leſs than an hour, his venerable head was entirely ſtripped of all its ſilver ornaments, ſo that not a hair remained. By his will, which was dated in May 1740, juſt before he ceaſed to be a reaſonable being, he left about L. 1200 in ſpecific legacies; and the reſt of his fortune, which amounted to about L. 11,000, to erect and endow an hoſpital for lunatics and idiots. He was buried in the moſt private manner, according to directions in his will, in the great aiſle of St Patrick's cathedral, and, by way of monument, a ſlab of black marble was placed againſt the wall, on which was engraved the following Latin epitaph, written by himſelf:

Hic depoſitum eſt corpus
JONATHAN SWIFT, S. T. P.
Hujus Eccleſiæ Cathedralis
Decani:
Ubi ſæva indignatio
Ulterius cor lacerare nequit.
Abi, viator,
Et imitare, ſi poteris,
Strenuum pro virili libertatis vindicem.
Obiit anno (1745)
Menſis (Octobris) die (29.)
Ætatis anno 78.

Swift undoubtedly was a man of native genius. His fancy was inexhauſtible; his conceptions were lively and comprehenſive; and he had the peculiar felicity of conveying them in language equally correct, free, and perſpicuous. His penetration was as quick as intuition; he was indeed the critic of nature; and no man ever wrote ſo much, and borrowed ſo little.

As his genius was of the firſt claſs, ſo were ſome of his virtues. The following anecdote will illuſtrate his filial piety. His mother died in 1710, as appears by a memorandum in one of the account-books which Dr Swift always made up yearly, and on each page entered minutely all his receipts and expences in every month, beginning his year from November 1. He obſerved the ſame method all his lifetime till his laſt illneſs. At the foot of that page which includes his expences of the month of May 1710, at the glebe houſe of Laracor in the county of Meath, where he was then reſident, are theſe remarkable words, which ſhow at the ſame time his filial piety, and the religious uſe which he thought it his duty to make of that melancholy event. "*Mem.* On Wedneſday, between ſeven and eight in the evening, May 10. 1710, I received a letter in my chamber at Laracor (Mr Percival and Jo. Beaumont being by) from Mrs F—, dated May 9. with one incloſed, ſent by Mrs Worral at Leiceſter to Mrs F—, giving an account that my dear mother, Mrs Abigail Swift, died that morning, Monday April 24. 1710, about ten o'clock, after a long ſickneſs: being ill all winter, and lame; and extremely ill about a month or ſix weeks before her death. I have now loſt my barrier between me and death. God grant I may live to be as well prepared

Swift.

for it as I confidently believe her to have been! If the way to heaven be through piety, truth, justice, and charity, she is there. J. S." He always treated his mother, during her life, with the utmost duty and affection; and she sometimes came to Ireland to visit him after his settlement at Laracor.

The liberality of the dean hath been a topic of just encomium with all his admirers; nor could his enemies deny him this praise. In his domestic affairs, he always acted with strict economy. He kept the most regular accounts; and he seems to have done this chiefly with a view to increase his power of being useful. "His income, which was little more than L. 700 *per annum*, he endeavoured to divide into three parts, for the following purposes. First, to live upon one-third of it. Secondly, to give another third in pensions and charities, according to the manner in which persons who received them had lived: and the other third he laid by, to build an hospital for the reception of idiots and lunatics." "What is remarkable in this generous man, is this (says Mr F.), that when he lent money upon bond or mortgage, he would not take the legal interest, but one *per cent.* below it."

His charity appears to have been a settled principle of duty more than an instinctive effort of good nature: but as it was thus founded and supported, it had extraordinary merit, and seldom failed to exert itself in a manner that contributed most to render it beneficial. He did not lavish his money on the idle and the worthless. He nicely discriminated characters, and was seldom the dupe of imposition. Hence his generosity always turned to an useful account: while it relieved distress, it encouraged industry, and rewarded virtue. We dwell with great pleasure on this truly excellent and distinguishing part of the dean's character: and for the sake of his charity we can overlook his oddities, and almost forgive his faults. He was a very peculiar man in every respect. Some have said, "What a man he would have been, had he been without those whims and infirmities which shaded both his genius and his character!" But perhaps the peculiarities complained of were inseparable from his genius. The vigour and fertility of the root could not fail now and then of throwing out superfluous suckers. What produced these, produced also the more beautiful branches, and gave the fruit all its richness.

It must be acknowledged, that the dean's fancy hurried him into great absurdities and inconsistencies, for which nothing but his extraordinary talents and noble virtues, discovered in other instances, could have atoned. The rancour he discovered on all occasions towards the dissenters is totally unjustifiable. No sect could have merited it in the degree in which he always showed it to them; for, in some instances, it bordered on downright persecution. He doubtless had his reasons for exposing their principles to ridicule, and might perhaps have sufficient grounds for some of his accusations against their principal leaders in Ireland; but nothing could justify his virulence against the whole body. In a short poem on one class of dissenters he bestowed a stricture upon Bettesworth, a lawyer eminent for his insolence to the clergy, which, from a very considerable reputation, brought him into immediate and universal contempt. Bettesworth, enraged at his disgrace and loss, went to the dean, and demanded whether he was the author of that poem? "Mr Bettesworth (answered he), I was in my youth acquainted with great lawyers, who, knowing my disposition to satire, advised me, if any *scoundrel* or *blockhead* whom I had lampooned should ask, 'Are you the author of this paper?' to tell him that I was not the author; and therefore, I tell *you*, Mr Bettesworth, that I am not the author of these lines."

Swift has been accused of irreligion and misanthropy, on account of his Tale of a Tub, and his Yahoos in Gulliver's Travels; but both charges seem to be ill-founded, or at least not supported by that evidence. The *Tale of a Tub* holds up to ridicule superstitious and fanatical absurdities; but it never attacks the essentials of religion: and in the story of the *Yahoos*, disgusting we confess, there appears to us as little evidence that the author hated his own species, as in the poems of *Strephon and Chloe*, and the *Ladies Dressing Room*, that he approved of grossness and filth in the female sex. We do not indeed, with his fondest admirers, perceive the moral tendency of the Voyage to the Houyhnhnms, or consider it as a satire admirably calculated to reform mankind; but neither do we think that it can possibly corrupt them, or lead them to think meanly of their rational nature. According to Sheridan, "the design of this apologue is to place before the eyes of man a picture of the two different parts of his frame, detached from each other, in order that he may the better estimate the true value of each, and see the necessity there is that the one should have an absolute command over the other. In your merely animal capacity, says he to man, without reason to guide you, and actuated only by a blind instinct, I will show you that you would be degraded below the beasts of the field. That very form, that very body, you are now so proud of, as giving you such a superiority over all other animals, I will show you, owe all their beauty, and all their greatest powers, to their being actuated by a rational soul. Let that be withdrawn, let the body be inhabited by the mind of a brute, let it be prone as theirs are, and suffered like theirs to take its natural course, without any assistance from art, you would in that case be the most deformed, as to your external appearance, the most detestable of all creatures. And with regard to your internal frame, filled with all the evil dispositions and malignant passions of mankind, you would be the most miserable of beings, living in a continued state of internal vexation, and of hatred and warfare with each other.

"On the other hand, I will show another picture of an animal endowed with a rational soul, and acting uniformly up to the dictates of right reason. Here you may see collected all the virtues, all the great qualities, which dignify man's nature, and constitute the happiness of his life. What is the natural inference to be drawn from these two different representations? Is it not evidently a lesson to mankind, warning them not to suffer the animal part to be predominant in them, lest they resemble the vile Yahoo, and fall into vice and misery; but to emulate the noble and generous Houyhnhnm, by cultivating the rational faculty to the utmost; which will lead them to a life of virtue and happiness."

Such *may* have been the author's intention; but it is not sufficiently obvious to produce the proper effect, and is indeed hardly consistent with that incapability under which he represents the Yahoos of ever acquiring, by any culture, the virtues of the noble Houyhnhnms.

With respect to his religion, it is a fact unquestionable, that while the power of speech remained, he continued constant in the performance of his private devotions; and in proportion as his memory failed, they were gradually shortened, till at last he could only repeat the Lord's prayer, which he continued to do till the power of utterance for ever ceased. Such a habit as this could not have been formed but by a man deeply impressed with a conviction of the truth and importance of revelation.

The most inexcusable part of Swift's conduct is his treatment of Stella and Vanessa, for which no proper apology can be made, and which the vain attempts of his friends have only tended to aggravate. One attributes his sin-

gular

Swift. Swimming.

gular conduct to a peculiarity in his constitution; but if he knew that he was incapable of fulfilling the duties of the married state, how came he to tie one of the ladies to himself by the marriage-ceremony, and in the most explicit terms to declare his passion to the other? And what are we to think of the sensibility of a man who, though attached as he seems to have been to both, could, without speaking, fling a paper on the table of the one, which "proved (as our author expresses it) her death-warrant," and could throw the other, his beloved Stella, in her last illness, into unspeakable agonies, and "never see her more, for only adjuring him, by their friendship, to let her have the satisfaction of dying at least, though she had not lived, his acknowledged wife?" Another apologist intimates, upon something like evidence, that Stella bore a son to Swift, and yet labours to excuse him for not declaring her his wife, because she had agreed at the marriage that it should remain a secret from all the world unless the discovery should be called for by *urgent necessity*; but what could be meant by the term *urgent necessity*, unless it alluded to the birth of children, he confesses that it would be hard to say. The truth we believe to be what has been said by Johnson, that the man whom Stella had the misfortune to love was fond of singularity, and desirous to make a mode of happiness for himself, different from the general course of things and the order of Providence; he wished for all the pleasures of perfect friendship, without the uneasiness of conjugal restraint. But with this state poor Stella was not satisfied; she never was treated as a wife, and to the world she had the appearance of a mistress. She lived sullenly on, hoping that in time he would own and receive her. This, we believe, he offered at last to do, but not till the change of his manners and the depravation of his mind made her tell him, that "it was too late."

The natural acrimony of Swift's temper had been increased by repeated disappointments. This gave a splenetic tincture to his writings, and amidst the duties of private and domestic life it too frequently appeared to shade the lustre of his more eminent virtues.—The dean hath been accused of avarice, but with the same truth as he hath been accused of infidelity. In detached views, no man was more liable to be mistaken. Even his genius and good sense might be questioned, if we were only to read some passages of his writings. To judge fairly and pronounce justly of him as a man and as an author, we should examine the uniform tenor of his disposition and conduct, and the general nature and design of his productions. In the latter he will appear great, and in the former good; notwithstanding the puns and puerilities of the one, and the absurdities and inconsistencies of the other.

SWIFT, in ornithology. See HIRUNDO.

SWIMMING, the art of suspending one's self on water, and at the same time making a progressive motion thro' it.

1 Swimming not natural to man.

As swimming is not natural to man, it is evident that at some period it must have been unknown among the human race. Nevertheless there are no accounts of its origin to be found in the history of any nation; nor are there any nations so barbarous but that the art of swimming is known among them, and that in greater perfection than among civilized people. It is probable, therefore, that the art, though not absolutely natural, will always be acquired by people in a savage state from imitating the brute animals, most of whom swim naturally. Indeed so much does this appear to be the case, that very expert swimmers have recommended it to those who wished to learn the art, to keep some frogs in a tub of water constantly beside them, and to imitate the motions by which they move thro' that element.

2 Theory is on a simple principle.

The theory of swimming depends upon one very simple principle; namely, that if a force is applied to any body, it will always move towards that side where there is the least resistance. Thus, if a person standing in a boat pushes with a pole against the side or any other part of the vessel in which he stands, no motion will ensue; for as much as he presses in one direction with the pole, just so much does the action of his feet, on which the pressure of the pole must ultimately rest, push the vessel the other way: but if, instead of the side of the vessel, he pushes the pole against the shore, then only one force acts upon it, namely, that of the feet; which being resisted only by the fluid water, the boat begins to move from the shore. Now the very same thing takes place in swimming, whether the animal be man, quadruped, bird, or fish. If we consider the matter simply, we may suppose an animal in such a situation that it could not possibly swim: thus, if we cut off the fins and tail of a fish, it will indeed float in consequence of being specifically lighter than the water, but cannot make any progressive motion, or at least but very little, in consequence of wriggling its body; but if we allow it to keep any of its fins, by striking them against the water in any direction, the body moves the contrary way, just as a boat moves the contrary way to that in which the oars strike the water. It is true, that as the boat is but partly immerged in the water, the resistance is comparatively less than when a frog or even any other quadruped swims; but a boat could certainly be rowed with oars tho' it was totally immerged in water, only with less velocity than when it is not. When a man swims, he in like manner strikes the water with his hands, arms, and feet; in consequence of which the body moves in a direction contrary to the stroke. Upon this principle, and on this only, a man may either ascend, descend, or move obliquely, in any possible direction in the water. One would think, indeed, that as the strength of a man's arms and legs is but small, he could make but very little way by any stroke he could give the water, considering the fluidity of that element. Nevertheless it is incredible what expert swimmers will perform in this way; of which Mr Forster gives a most remarkable instance in the inhabitants of Otaheite; whose agility, he tells us, was such, that when a nail was thrown overboard, they would jump after it into the sea, and never fail to catch it before it came to the bottom.

As to the practice of swimming, there are but few directions which can be given. The great obstacle is the natural dread which people have of being drowned; and this it is impossible to overcome by any thing but accustoming ourselves to go into the water. With regard to the real danger of being drowned, it is but little; and on innumerable occasions arises entirely from the terror above mentioned, as will appear from the following observations by Doctor Franklin.

3 Observations by Dr Franklin.

"1st, That though the legs, arms, and head, of a human body, being solid parts, are specifically somewhat heavier than fresh water, yet the trunk, particularly the upper part, from its hollowness, is so much lighter than water, as that the whole of the body, taken together, is too light to sink wholly under water, but some part will remain above until the lungs become filled with water; which happens from drawing water into them instead of air, when a person in the fright attempts breathing while the mouth and nostrils are under water.

"2dly, That the legs and arms are specifically lighter than salt water, and will be supported by it; so that a human body would not sink in salt water though the lungs were filled as above, but from the greater specific gravity of the head.

"3dly, That therefore a person throwing himself on his back in salt water, and extending his arms, may easily lie

so as to keep his mouth and nostrils free for breathing; and by a small motion of his hands may prevent turning, if he should perceive any tendency to it.

"4thly, That in fresh water, if a man throws himself on his back near the surface, he cannot long continue in that situation, but by a proper action of his hands on the water. If he uses no such action, the legs and lower part of the body will gradually sink till he comes into an upright position; in which he will continue suspended, the hollow of the breast keeping the head uppermost.

"5thly, But if in this erect position the head is kept upright above the shoulders, as when we stand on the ground, the immersion will, by the weight of that part of the head that is out of the water, reach above the mouth and nostrils, perhaps a little above the eyes; so that a man cannot long remain suspended in water with his head in that position.

"6thly, The body continued suspended as before, and upright, if the head be leaned quite back, so that the face looks upwards, all the back part of the head being then under water, and its weight consequently in a great measure supported by it, the face will remain above water quite free for breathing, will rise an inch higher every inspiration, and sink as much every expiration, but never so low as that the water may come over the mouth.

"7thly, If therefore a person unacquainted with swimming, and falling accidentally into the water, could have presence of mind sufficient to avoid struggling and plunging, and to let the body take this natural position, he might continue long safe from drowning, till perhaps help would come; for as to the clothes, their additional weight while immersed is very inconsiderable, the water supporting it; though when he comes out of the water, he would find them very heavy indeed."

5 Method of learning to swim. The method of learning to swim is as follows: The person must walk into water so deep that it will reach to the breast. He is then to lie down gently on the belly, keeping the head and neck perfectly upright, the breast advancing forward, the thorax inflated, and the back bent; then withdrawing the legs from the bottom, and stretching them out, strike the arms forwards in unison with the legs. Swimming on the back is somewhat similar to that on the belly; but with this difference, that although the legs are employed to move the body forwards, the arms are generally unemployed, and the progressive motion is derived from the movement of the legs. In diving, a person must close his hands together, and, pressing his chin upon his breast, make an exertion to bend with force forwards. While in that position, he must continue to move with rapidity under the surface; and whenever he chooses to return to his former situation, he has nothing to do but bend back his head, and he will immediately return to the surface.

It is very common for novices in the art of swimming to make use of corks or bladders to assist in keeping the body above water. Some have utterly condemned the use of these; however, Dr Franklin allows that they may be of service for supporting the body while one is learning what is called the *stroke*, or that manner of drawing in and striking out the hands and feet that is necessary to produce progressive motion. "But (says he) you will be no swimmer till you can place confidence in the power of the water to support you: I would therefore advise the acquiring that confidence in the first place, especially as I have known several who, by a little of the practice necessary for that purpose, have insensibly acquired the stroke, taught as it were by nature.

Practice recommended. "The practice I mean is this: Choosing a place where the water deepens gradually, walk coolly into it till it is up to your breast: then turn round your face to the shore, and throw an egg into the water, between you and the shore; it will sink to the bottom, and be easily seen there, if the water is clear. It must lie in the water so deep as that you cannot reach it to take it up but by diving for it. To encourage yourself in order to do this, reflect that your progress will be from deeper to shallower water; and that at any time you may, by bringing your legs under you, and standing on the bottom, raise your head far above the water: then plunge under it with your eyes open, throwing yourself towards the egg, and endeavouring, by the action of your hands and feet against the water, to get forward till within reach of it. In this attempt you will find that the water buoys you up against your inclination; that it is not so easy a thing to sink as you imagined; that you cannot but by active force get down to the egg. Thus you feel the power of the water to support you, and learn to confide in that power; while your endeavours to overcome it, and to reach the egg, teach you the manner of acting on the water with your feet and hands; which action is afterwards used in swimming to support your head higher above water, or to go forward through it."

6 Swimming a healthful exercise. As swimming is a healthy exercise and a pleasant amusement, and as a dexterity in it may frequently put it in a man's power to save his own life and the lives of his fellow-creatures, perhaps of his dearest friends, it can neither be useless nor uninteresting to consider a few of the evolutions which a swimmer must be master of, that he move in any direction without difficulty, without danger, and without being unnecessarily fatigued.

7 How to turn right or left. There are several different ways of turning one's self in swimming. You may do it in this way: Turn the palm of the hand the right hand outwards, extend the arm in the same manner, and make a contrary movement with the left hand and left arm; then, by a gradual motion, incline your head and whole body to the left side, and the evolution will be finished. There is another way which is easier still: Bend your head and body toward that side to which you are going to turn. If you wish to turn to the left, incline the thumb and the right hand toward the bottom, bend the fingers of the right hand, stretch it out, and use it for driving away the water sidewise, or, which is the same thing, for pushing yourself the contrary way. At the same time, with your left hand, the fingers being close, push the water behind you, and all at once turn your body and your face to the left, and the manœuvre will be accomplished. If you wish to turn to the right, you must do with your right hand what you did with your left, and with your left what you did with your right. You must be careful when turning yourself never to stretch out your legs, and be sure that the water be so deep that you be in no danger of hurting yourself.

8 How to turn from the belly to the back. When you are swimming on your belly, and wish to turn yourself on your back, draw your feet in quickly, and throw them out before you; stretch out your hands behind you, and keep your body firm and steady. When you wish to turn from swimming on your back, fold your feet at once under your body as if you were throwing them to the bottom, and at the same instant dart your body forwards, that you may fall upon your belly.

9 The eyes ought to be turned to heaven. In swimming, the eyes ought to be turned towards heaven. This is a most important rule, and to the neglect of it many of the accidents which befal swimmers are owing. For when they bend their eyes downwards, they insensibly bend their head too, and thus the mouth being too deep in the water, may admit a quantity of it in breathing; besides, the more the body is stretched, it covers a greater part of the surface of the water, and consequently its specific gravity is less. Any person who will make the experiment will find

Swimming. it impoffible to dive while he keeps his head erect and his eyes fixed on the heavens (A).

10 How to fwim on the back.

The eafieft pofture in fwimming is lying on the back. When you wifh to fwim in this pofture, lay yourfelf foftly on your back, and raife your breaft to the furface of the water, keeping your body extended in the fame line. Put your hands eafily over the upper part of your thighs, and throw out your legs and draw them in alternately, keeping them within two feet of the furface. In this way you may advance in any direction you pleafe. You may perhaps not like having fo much of your head under water; there is, however, no way of fwimming fo eafy, fo fafe, and fo little fatiguing. If you wifh to fwim with great rapidity, you may ufe your arms as well as your feet; and you will find this the eafieft way of breaking the force of the waves.

11 And advance forwards.

In fwimming on the back, one may advance forward as well as backward. For this purpofe the body muft be kept ftraight and extended; the breaft inflated, fo that the hollow of the back may affume a femicircular form. The hands muft recline over the upper parts of the thighs. It is alfo neceffary to raife the legs one after another, and draw them in ftrongly towards the hams, and then leave them fufpended in the water. This way of fwimming is not only pleafant, but may ferve to reft you when fatigued.

12 How to fwim on one fide.

When you are tired with fwimming on your back and belly, you may fwim on one fide. When you wifh to do this, fink a little your left fide and raife your right; you will immediately find yourfelf on your left fide. Move then your left hand without either raifing or finking it; you have only to ftretch it and draw it back, as in a ftraight line, on the furface of the water. Independent of the pleafure which this kind of motion will give you, you will have the fatisfaction of feeing both fides of the river.

13 How to fwim on the belly without the affiftance of the hands.

It is poffible to fwim on the belly without the affiftance of the hands. For this purpofe you muft keep your breaft erect, your neck ftraight, and fix your hands behind your head, or upon your back, while you move forward by employing your feet. This way is not without its advantages. It is an excellent refource when the arms are feized with a cramp, or with any indifpofition which makes it painful to exert them. This in fome cafes may be preferable to fwimming on the back; for while in that attitude, one cannot fee before them without turning every inftant. If one of your legs be feized with a cramp, take hold of it with the hand oppofite to it, and ufe the other hand and leg to advance or fupport yourfelf.

14 How to fwim with the hands joined.

A very ancient and graceful mode of fwimming, is that of fwimming with the hands joined. When you wifh to put this in practice, join your hands, keeping the thumbs and fingers towards heaven, fo that they may appear above the water; then draw them back and pufh them forwards alternately from your breaft. This method of fwimming may be ufeful in feveral circumftances, but above all if you are entangled with grafs or weeds. Your hands will then open a paffage for you.

15 With the hands elevated.

As a perfon may fometimes have occafion to carry fomething in his hand in fwimming, which he is anxious to preferve from the water, he may fwim eafily with one hand and hold a parcel in the other, as Cæfar fwam with his Commentaries at Alexandria; or one may fwim with both hands elevated. To perform this well, the fwimmer muft raife his breaft, and keep it as much inflated as he can, at the fame time that he fupports the arms above the water. It muft not be concealed, that this method of fwimming is attended with fome danger to one who is not dexterous at the art; for if one fhould imprudently draw in his breaft, when his arms are raifed, he would immediately fink to the bottom.

How to rife to the furface after diving.

Every one knows that when a man plunges into the water, and when he has reached the bottom, he has nothing to do but to give a fmall ftroke with his foot againft the ground, in order to rife; but an experienced fwimmer, if he miffes the ground, has recourfe to another expedient, which is very pretty, and which has not been confidered with fufficient attention. We fuppofe him at a confiderable depth, when he perceives that he cannot reach the bottom. In fuch a cafe, he firfts puts his hands before his face, at the height of his forehead, with the palms turned outwardly; then holding the fore part of his arm vertically, he makes them move backwards and forwards from right to left; that is to fay, thefe two parts of his arms, having the elbow as a kind of pivot, defcribe very quickly, both the hands being open, and the fingers joined, two fmall portions of a circle before the forehead, as if he would make the water retire, which he in fact does; and from thefe ftrokes given to the water, there refults an oblique force, one part of which carries the fwimmer upwards.

There are many artificial methods of fupporting one's felf in water, but we have not room to defcribe them.— Thofe who wifh to fee a full account of them may confult the *Encyclopédie Methodique*.

Swimming of Fifh. A great proportion of the inhabitants of the waters have an air-bladder, by which they poife themfelves. Their movements chiefly depend upon their tail. See Comparative Anatomy, n° 147, 155; and Ichthyology, n° 3.

SWINDLER, a word which has been lately adopted into the Englifh language, derived from the German word *fchwindel*, "to cheat." Swindling has now become fo common in feveral of the great towns of this country, that it is unfortunately too well known to require any defcription.

SWINE, in zoology. See Sus.

Swine-Stone. See *Swine*-Stone.

SWINGING, a kind of exercife ftrongly recommended to perfons in confumption by fome phyficians, and difapproved of by others. See Medicine, p. 224.

SWING-tree of a waggon, is the bar faftened acrofs the fore-guide, to which the traces of the horfes are faftened.

Swing-Wheel, in a royal pendulum, that wheel which drives the pendulum. In a watch or balance clock it is called the crown-wheel.

SWINGLE, in the fire-works in England, the wooden fpoke which is fixed to the barrel that draws the wire, and which,

(A) An interefting queftion occurs here, which deferves to be confidered. Since the body, when fpread upon the furface, can be fupported with fo little exertion, and frequently without any at all, as in fwimming on the back, how comes it to pafs that a perfon when drowned finks and frequently rifes again fome time afterwards? The reafon is this: In the act of drowning, the lungs are filled with water, and confequently the body, being fpecifically heavier, finks. It is well known that the human body contains a great quantity of air: this air is at firft compreffed by the water; and while this is the cafe the body remains at the bottom: but as foon as the air by its elafticity endeavours to difengage itfelf from the compreffion, the body is fwelled and expanded, becomes fpecifically lighter than the water, and confequently rifes to the top.

which, by its being forced back by the cogs of the wheel, is the occasion of the force with which the barrel is pulled.

SWITZ, or SCHWEITS, the capital of one of the cantons of Switzerland, to which it gives name, seated on the east side of the lake Lucern, in N. Lat. 46. 55. E. Long. 8. 30.

SWITZERLAND, or SWISSERLAND, is bounded on the north by Swabia; on the east by Tirol; on the south by Savoy and the Milanese; and on the west by France, being about 260 miles long and 100 broad. It is divided into 13 cantons, viz. *Berne, Zurich, Schaffhausen, Basil, Lucerne, Underwalden, Uri, Switz, Friburg, Zug, Soleure, Glaris*, and *Appenzel*. See these articles.

The Swiss were anciently called *Helvetii*; and being subdued by the Romans, they continued in subjection to that power till the empire declined, when they became a part of the kingdom of Burgundy. After that they fell under the dominion of the Franks, then of the Germans; but being oppressed by the latter, they threw off the yoke, and erected several states and republics, which, at the treaty of Westphalia in 1648, were recognized as free and independent. The cantons of Switz, Uri, and Underwalden, having, as early as the year 1308, entered into a confederacy in the canton of Switz, and having also obtained their first victory, in 1315, over Leopold archduke of Austria in the same canton, its name was given to the whole confederacy, which it still retains. The other cantons successively acceded to this association, but some of them not until upwards of 100 years after. With respect to the government and constitution of these cantons, some of them are aristocracies and some democracies. In the former, both the legislative and executive power is lodged in the burghers or citizens of the capital of each canton; and of these there are seven, viz. Zurich, Berne, Basil, Friburg, Soleure, and Schaffhausen; an account of the most important of which may be seen under their respective names. In the others, the legislative power is lodged in the whole body of the people; and every male above 16, whether master or servant, has a vote in making laws and in the choice of magistrates. For what concerns the whole Helvetic body, there are diets ordinary and extraordinary: the former are held annually, and the others upon particular emergencies; and both are summoned by the city of Zurich, which appoints the time and place of their meetings. Besides the general diets since the Reformation, there have been particular diets of the two religions, at which all public affairs of consequence that regard the two parties are treated separately; for though a sense of their common interest obliges them to study to maintain the league and union, yet it is certain, that the mutual confidence between the cantons is in some measure lost through the zeal of each party for their particular opinions, especially of the Roman Catholics. The annual general diets are held always at Frauenfeld or Baden, principally to regulate the affairs of the common bailiages. Lucern takes the lead of the Roman Catholic cantons, being the most powerful of that denomination; but Zurich, tho' less powerful than that of Berne, takes the precedence of all the other cantons, both Protestant and Popish. These cantons do not make one commonwealth, but are so many independent states, united together by strict alliances for their mutual defence. The extraordinary diets or congresses are held at Aldorf. Each canton usually deputes two envoys both to the ordinary and extraordinary, to which also the abbot and the town of St Gall, and the town of Biel, send representatives as allies. To the 13 cantons belong in common 21 bailiages, two towns, and two lordships. The allies, or incorporated places as they are called, are the abbot and town of St Gall, the three Grison leagues, the republic of the Valais, the towns of Muhlhausen and Biel, the principality of Neuenberg or Neufchatel, Geneva, and the bishop of Basil. Of these the abbot and town of St Gall, and the town of Biel, are regarded as members of the Helvetic body, but the rest only as allies.

As to the air, soil, and produce of Switzerland, that part of the canton of Berne to the east of the lake of Geneva, together with the cantons of Uri, Switz, Underwalden, Glaris, Appenzel, and part of the canton of Lucern, consist of stupendous mountains, whose tops are said to be from 9000 to 12,000 feet above the level of the sea, consisting of craggy inaccessible rocks, of which some are quite bare, while others are always covered with ice and snow. Among the mountains are many excellent medicinal and other springs, cold and warm baths, water-falls, craggy precipices, deep narrow valleys, and caverns. They yield also a great variety of herbs, thickets, and bushes, in the upper parts; and in the lower, rich pastures and woods. The highest are those in the canton of Uri. Many of the valleys are covered with lakes, or watered by brooks and rivers. In some of them are towns, villages, woods, vineyards, and corn-lands. Both on the mountains and in the valleys the air is extremely cold in winter; but in summer it is very pleasant, cool, and refreshing on the former, but excessively hot in the latter. Sometimes it is winter on the north side of a mountain when it is summer on the other; nay, flowers may be gathered sometimes with one hand, and snow with the other. Prodigious masses of ice and snow often fall from them in winter, and do a great deal of damage (see GLACIER); and most of the streams and rivers take their rise from the thawing of the ice and snow on their sides and tops. From the rising or descending of the clouds, with which they are commonly enveloped, the inhabitants can, for the most part, pretty exactly foretel the changes of the weather; so that they serve them instead of weather-glasses. The other and lower parts of Switzerland are very pleasant and fertile, being diversified with vineyards, corn-fields, meadows, and pasture-grounds. The mountains in these are but mole-hills in comparison of the others: there is neither snow nor ice on them in summer; and they frequently afford not only good pasturage, but arable ground. Many petrifactions are found both among these and the others, with a variety of fossils. The sands of the rivers yield gold-dust, particularly those of the Rhine, the Emmet, and the Aar, the Reuss, the Arve, and the Inn. The metals of this country being generally found to be brittle, the only mines that are worked are a few iron ones. In the lower parts of Switzerland they sow rye, oats, barley, spelt, flax, and hemp. Wines of various sorts are also produced in some of them, with a variety of fruits. Of wood for fuel and other uses there is generally plenty; in some places, however, they are obliged to burn sheeps dung, and in others a kind of heath and small shrubs. In the valleys they cultivate saffron with success. The Switzers derive their principal subsistence from their flocks and herds of cattle, which in summer graze upon the mountains. Their cheese is much esteemed, especially that of Berne and Griers in the canton of Friburg. Great numbers of horses are also bred here, and bought up for the French cavalry. Besides the above mentioned rivers, the Rhone and the Tesin have their sources in this country. The lakes are very numerous; but the chief are those of Geneva, Neufchatel, Biel, Zurich, Thun, Brien, Constance, and Lucern. Both rivers and lakes abound with fish, and afford a cheap water-carriage. Switzerland is not so populous as many other countries in Europe; and the Popish cantons less so than the Protestant. The total number of the inhabitants is computed at two millions.

The language generally spoken here is the German, in which also all public affairs are transacted; but in those

parts

Switzerland. parts of the country that border on Italy or France, a corrupt French or Italian prevails. The two predominant religions are Calviniſm and Popery. Of the former are the cantons of Zurich and Berne, the town of St Gall, Geneva, Mulhauſen, and Biel, the principality of Neufchatel, the greater part of Baſil, Schaffhauſen, the country of the Griſons, the Thurgau, Toggenburg, Glaris, and the Rhine valley; the frontiers of Appenzel, with a ſmall part of Solothurn, and ſome places in the countries of Baden and Sargans. The reſt of the Swiſs cantons, allies and dependents, are Popiſh. For the education of youth there is an univerſity at Baſil, and academies at Zurich, Berne, Lauſanne, and Geneva, beſides gymnaſiums and ſcholæ illuſtres, both in the Popiſh and Proteſtant cantons. There are alſo ſocieties among them for the improvement of the German language and the ſciences.

The principal manufactures are ſnuff and tobacco, linen of ſeveral ſorts, lace, thread, ſilk, and worſted ſtockings, neckcloths, cotton ſtuffs, gloves, handkerchiefs, ſilks of ſeveral ſorts, gold and ſilver brocades, a variety of woollen manufactures, hats, paper, leather of all ſorts, earthen wares, porcelain, toys, watches, clocks, and other hardwares, &c. The trade of Switzerland is greatly promoted by many navigable lakes and rivers. In ſome of the above manufactures, and in cheeſe, butter, ſheep, horſes, black cattle, hides, and ſkins, the exports are conſiderable; and as the imports are chiefly grain and ſalt, with ſome American and Aſiatic goods, there is probably a large balance in their favour. In ſome parts of Switzerland dreſs is reſtrained by ſumptuary laws.

The public revenues are in general very inconſiderable, ariſing chiefly from the uſual regalia, appropriated everywhere to the ſovereign, the demeſnes, and public granaries, voluntary contributions, the ſale of ſalt, and a land-tax; in the Proteſtant cantons, from the church-lands alſo that were ſeized at the Reformation. Except in Zurich, Berne, Baſil, and Schaffhauſen, where the people are more induſtrious, have a greater trade, and are richer than in the others, they defray the ordinary charges, and that is all.

The cantons never keep any ſtanding troops, except for a few garriſons; but their militia is reckoned to be the beſt regulated of any in Europe. Every male from 16 to 60 is enrolled, and about one-third of them regimented. They muſt all provide themſelves with arms, clothing, and accoutrements, and appear on the ſtated days for exerciſe; and the ſeveral cantons and diſtricts muſt be furniſhed with a ſufficient train of artillery, and all the other implements of war. The Switzers of the ſeveral cantons are allowed to engage in the ſervice of ſuch foreign princes and ſtates as are in alliance with thoſe cantons, or with whom they have made a previous agreement. Such ſtates, paying an annual ſubſidy to the reſpective cantons, are allowed to make levies. Every man enliſts voluntarily, and for what number of years he pleaſes; at the expiration of which he is at liberty to return home. A great many thus always returning from foreign ſervice, Switzerland is never unprovided with able and experienced officers and ſoldiers. With reſpect to their character, they are a brave, honeſt, hoſpitable, hardy people; very true to their engagements, friendly, and humane. In ſhort, there is not a people in Europe whoſe national character is better. In their perſons they are generally tall, robuſt, and well-made; but their complexions are none of the beſt, and thoſe that live in the neighbourhood of the mountains are ſubject to wens. The women are ſaid to be generally handſome and well-ſhaped, ſenſible and modeſt, yet frank, eaſy, and agreeable in converſation. Few of the peaſants are miſerably poor; many of them are rich, eſpecially in the Proteſtant cantons, and that of Berne in particular.

SWIVELS, a kind of ring made to turn round in a ſtaple, or other ring. These are uſed when a ſhip lies at her moorings; alſo in tedders for cattle, that they may turn round without unwarping the tedder. Swivels Sydenham.

Swivel-Cannon, is a ſmall piece of artillery belonging to a ſhip of war, which carries a ſhot of half a pound, and is fixed in a ſocket on the top of the ſhip's ſide, ſtern, or bow, and alſo in her tops. The trunnions of this piece are contained in a ſort of iron crotch, of which the lower end terminates in a cylindrical pivot reſting in the ſocket, ſo as to ſupport the weight of the cannon. The ſocket is bored in a ſtrong piece of oak, reinforced with iron hoops, in order to enable it to ſuſtain the recoil. By means of this frame, which is called the *ſwivel*, and an iron handle on its caſcable, the gun may be directed by the hand to any object. It is therefore very neceſſary in the tops, particularly when loaded with muſket-balls, to fire down on the upper decks of the adverſary in action.

SWOONING. See MEDICINE, n° 274.

SWORD, an offenſive weapon worn at the ſide, and ſerving either to cut or ſtab. Its parts are, the handle, guard, and blade; to which may be added the bow, ſcabbard, pummel, &c.

Sword of State, which is borne before the king, lords, and governors of counties, cities, or boroughs, &c. For or before the king, it ought to be carried upright; the hilt as low as the bearer's waiſt, the blade up between his eyes. For or before a duke, the blade muſt decline from the head, and be carried between the neck and the right ſhoulder. For or before an earl, the blade is to be carried between the point of the ſhoulder and the elbow: and for or before a baron, the blade is to be borne in the bend of the arm. This ceremonial form no leſs denotes the dignity of a governor than the coronet ſet on his coat of arms.

Sword-Fiſh. See XIPHIAS.

SWORN BROTHERS (*fratres jurati*), perſons who, by mutual oath, covenanted to ſhare each others fortune. Formerly, in any notable expedition to invade and conquer an enemy's country, it was the cuſtom for the more eminent ſoldiers to engage themſelves by reciprocal oaths to ſhare the rewards of their ſervice. This practice gave occaſion to the proverb of *ſworn brothers* or *brethren in iniquity*, becauſe of their dividing plunder and ſpoil.

SYCAMORE-TREE, in botany. See ACER.

SYCOPHANT, an appellation given by the ancient Athenians to thoſe who informed of the exportation of figs contrary to law; and hence it is ſtill uſed in general for all informers, paraſites, flatterers, cheats, &c.

SYDENHAM (Dr Thomas), an excellent Engliſh phyſician, was the ſon of William Sydenham of Winford Eagle in Dorſetſhire, and was born there about the year 1624. He ſtudied at Magdalen-hall, Oxford; but left that univerſity when Oxford was garriſoned for king Charles I. and went to London: where, becoming acquainted with Dr Thomas Cox, an eminent phyſician, that gentleman perſuaded him to apply himſelf to the ſtudy of phyſic; accordingly, after the garriſon was delivered up to the parliament, he retired again to Magdalen-hall, entered on the ſtudy of medicine, and in 1648 was created bachelor of phyſic. Soon after, he was made a fellow of All-Souls college, and continued there ſeveral years: when, leaving the univerſity, he ſettled at Weſtminſter, became doctor of his faculty at Cambridge; grew famous for his practice; and was the chief phyſician in London from the year 1660 to 1670; at which period he began to be diſabled by the gout. He died in 1689. His works are highly eſteemed both at home and abroad. He was famous for his cool regimen in the ſmall-pox; for giving the bark after the paroxyſm in agues; and for

for his use of laudanum. He regulated his practice more by his own observations and inquiries, than by the method either of his predecessors or contemporaries.

SYDEROPŒCILUS, in natural history, the name of a stone mentioned by the ancients. It was found in Arabia, and seems to have obtained this name from its being spotted with a ferruginous colour. The descriptions of the ancients are, however, in this, as in many other instances, too short to suffer us to guess what stone they meant.—This might possibly be a granite with spots of this peculiar colour.

SYENE, an ancient city of Egypt, situated, according to Mr Bruce, in north latitude 24° 0′ 45″. Pliny and Strabo both say that it lay directly under the tropic of Cancer. Whether Mr Bruce's authority be sufficient to overturn the evidence of Pliny and Strabo, we shall leave to others to determine.

Syene is remarkable for being the place where the first attempt was made to measure the circumference of the earth. This was done by Eratosthenes, whom Ptolemy Euergetes had invited from Athens to Alexandria. In this attempt two positions were assumed, viz. that Alexandria and Syene were exactly 5000 stadia distant from each other, and that they were precisely under the same meridian; but both these are denied by Mr Bruce, who has made many observations on the subject, which our limits will not allow us to take notice of at present. He tells us, that there is at Asum an obelisk erected by Ptolemy Euergetes, the patron of Eratosthenes, without hieroglyphics, directly facing the south, with its top first cut into a narrow neck, then spread out like a fan into a semicircular form, with pavements curiously levelled to receive the shade, and make the separation of the true shadow from the penumbra as distinct as possible. This is supposed by Mr Bruce to have been constructed with a design to vary the experiment of Eratosthenes with a larger radius; and the inquiry concerning the dimensions of the earth, in our author's opinion, was the occasion of many obelisks being erected in this kingdom; a demonstration of which is, that the figure of the top is varied; being sometimes very sharp, and sometimes a portion of a circle, in order to get rid of the great impediment arising from the penumbra, which makes it difficult to determine the length of the shadow with precision. It is now called *Assouan*.

SYLLA (Lucius Cornelius), was descended from the illustrious family of the Scipios. His behaviour in his younger years by no means corresponded with the excellent education which he had received. But debauchery, instead of bringing along with it infamy and ruin, its usual attendants, served only to increase the wealth of this fortunate Roman; for Nocopolis, a rich courtezan, whose affections he had gained, left him heir to her great estate.—He learned the art of war under Marius, whom he attended to Numidia in quality of questor. Though hitherto unaccustomed to arms, he became in a short time the most skilful soldier in the army, while by his polite and obliging behaviour he gained the love and esteem of every body. His courage and dexterity contributed a great deal towards the success of the war; it was his eloquence in particular that persuaded Bocchus to deliver up Jugurtha. He served afterwards in the social war, where his actions entirely eclipsed those of every other commander. As a reward for this conduct he was raised to the prætorship. It is pretended by some that Sylla purchased this dignity; and that when he threatened one day to make use of the powers of *his* office against Strabo the father of Pompey, that Roman replied with a smile, "You are in the right to say so; your office is certainly *yours*, since you purchased it." Be this as it may, after the conclusion of the social war he was made consul, and soon after declared general of the army which was to be sent against Mithridates king of Pontus. Marius, at that time the most renowned of the Roman generals, expected that the management of this war would have been committed to him, and was therefore much exasperated at the disappointment. The people were persuaded by his intrigues to reverse the former decree, and substitute him in place of Sylla. Upon this he sent down officers to take the command of the army; but Sylla by this time had gained over the soldiers; who, instead of obeying the decree of the people, slew Marius's officers, and intreated Sylla to lead them instantly to Rome. Accordingly he entered the city sword in hand, slew Sulpicius the consul, obliged Marius to flee, new-modelled the laws, and afterwards marched into the East, and immediately laid siege to Athens; for that city, together with the rest of Greece, had fallen into the power of Mithridates. He wrote to the Amphyctions, who were assembled at Delphi, to send him all the gold which was deposited in the temple of Apollo, because he stood in need of money; promising, at the same time, to restore it again at the end of the war. When he received this treasure, he observed, with an air of raillery, that he now no longer despaired of victory, since the gods themselves furnished him with money to pay his troops. Famine soon obliged the Athenians to think of a surrender. Their ambassadors waited on Sylla, and began to harangue about Theseus and Codrus, and Marathon and Salamis,—when he interrupted them, and exclaimed, "Go, repeat these fine orations in your schools; I have come hither, not to learn your history, but to chastise rebels." Athens was at last taken by assault, and Sylla was upon the point of destroying it, when he recollected its ancient glory, and spared (as he said) the living for the sake of the dead. After burning the Piræus, he gained two decisive victories over the generals of Mithridates. In the second battle, which was fought at Orchomenus, he was almost defeated; his troops began to flee, when, leaping from his horse, he snatched up a standard, and advanced against the enemy, crying out, "I will die here gloriously; and, soldiers, when you are asked where you abandoned your general, answer, At Orchomenus." This reproach recalled the courage of the Romans; they followed him to the charge, and gained a complete victory. Mithridates, humbled by these disasters, sent ambassadors to sue for peace.

Mean time Cinna had declared against Sylla in Italy; and Marius returning from banishment, had taken the most severe vengeance on all his enemies. Sylla was declared a traitor; his laws were reversed, his friends murdered, and the government new-modelled. The news of these transactions induced Sylla to conclude a treaty with Mithridates, and march directly to Rome. His approach terrified the Romans. Marius and Cinna were both dead; but the consuls made vigorous preparations to oppose him. A civil war was begun; but Sylla in the end subdued all his enemies, and entirely ruined the Marian faction. He entered Rome at the head of his victorious army, and publicly assumed the surname of *Happy*. Happy, indeed, had he ceased to live when he ceased to conquer. The remainder of his life contains nothing else but a catalogue of the most abominable cruelties. He declared that every one who expected pardon for their late offences, must gain it by destroying the enemies of the state. The sword of the assassin was thus unsheathed, and murder encouraged as the path to power and distinction. The noblest of the Romans were everywhere massacred; slaves were rewarded for cutting off their masters; children were seen dragging their parents to execution; and brothers claiming a recompense for the mur-

der of brothers. Sylla ordered 8000 wretches, who had thrown themselves upon his clemency, to be butchered in the Campus Martius. In the mean time he entered the senate-house, and began to talk with great coolness about his exploits. The senate, alarmed at the horrid outcries of the sufferers, at first thought that the city was given up to be plundered; but Sylla informed them, with an unembarrassed air, that it was only some criminals punishing by his orders, and that they needed not be apprehensive about their own fate.

To carry on these cruelties with the appearance of justice, he commanded the people to elect him dictator. He kept this office for more than two years; and then, to the amazement of all, laid it down, and offered to stand his trial before the people. Soon afterwards he retired into the country, and plunged headlong into every kind of debauchery. Nor did he relinquish his cruelty together with his power: His wife falling ill in the midst of a sumptuous feast, he divorced her immediately; and ordered her to be carried away, lest her death should interrupt the festivity of his house.

He died of the morbus pedicularis, in the 60th year of his age. His body, according to his orders, was burnt. A little before his death he wrote his epitaph; the tenor of which was, that no man had ever exceeded him in doing good to his friends or injury to his enemies.

His person was elegant, his air noble, his manners easy and apparently sincere. He was fond of pleasure, but fonder of glory; indulging without scruple in sensual delights, but never suffering them to interrupt his serious business: He was eloquent, liberal, crafty, insinuating; a profound master of dissimulation; he spoke of himself with modesty, while he lavished praises on every other person: He stooped even to an acquaintance with the meanest soldier, and constantly adapted himself to the humours, pursuits, and opinions, of those with whom he conversed. Such was his character during the earlier part of his life; but when success had raised him above the necessity of dissimulation, he displayed a hideous train of vices, which his ambition had formerly taught him to conceal.—It was Sylla who recovered the works of Aristotle at the taking of Athens.

SYLLABLE, in grammar, one or more letters pronounced by a single impulse of the voice, forming a complete sound, and constituting a word or a part of a word. No single letter can form a syllable except a vowel. The longest syllable in the English language is the word *strength*.

The most natural way of dividing words into syllables is, to separate all the simple sounds of which any word consists, so as not to divide those letters which are joined close together according to the most accurate pronunciation.

SYLLABUB, a kind of compound drink, most usual in the summer season; ordinarily made of white wine and sugar, into which is squirted new milk with a syringe or wooden cow. Sometimes it is made of canary in lieu of white wine; in which case the sugar is spared, and a little lemon and nutmeg are added in lieu of it. To prepare it the best way, the wine and other ingredients, except the milk, are to be mixed over night, and the milk or cream added in the morning. The proportion is, a pint of wine to three of milk. For

SYLLABUB, *whipt*, to half a pint of white wine or Rhenish is put a pint of cream, with the whites of three eggs. This they season with sugar, and beat with birchen rods, or work with a syringe. The froth is taken off as it rises, and put into a pot; where, after standing to settle two or three hours, it is fit to eat.

SYLLABUS, in matters of literature, denotes a table of contents, or an index of the chief heads of a book or discourse.

SYLLOGISM, in logic, an argument or term of reasoning, consisting of three propositions; the two first of which are called *premises*; the last, the *conclusion*. See LOGIC, Part III.

SYLVIA, in natural history, a new genus of birds, belonging to the order of passeres, formed by Dr Latham by limiting the motacilla to the wagtail, and arranging the other species, formerly classed under that genus, under the sylvia.

The motacilla he thus describes: The beak is subulated, slender, and somewhat indented at the point. The tongue seems torn at the end, and the tail is long. He thus characterizes the sylvia: The beak is subulated, straight, and small; the mandibles are nearly equal. The nostrils are obovate, and a little depressed. The exterior toe is joined at the under part to the base of the middle one. The tongue is cloven, and the tail is small. He makes 13 species of the motacilla, and 174 species of the sylvia. See MOTACILLA.

SYMBOL, a sign or representation of something moral, by the figures or properties of natural things. Hence symbols are of various kinds; as hieroglyphics, types, enigmas, parables, fables, &c.

SYMMACHUS, a citizen and senator of ancient Rome, and consul in the year 391, has left us ten books of epistles; from which, as well as from other things, we collect, that he was a warm opposer of the Christian religion. He was banished from Rome by Valentinian on some account or other, but afterwards recalled and received into favour by Theodosius. Ammianus Marcellinus speaks of him as a man of great learning and modesty. Scioppius, Pareus, and other learned men, have written notes upon the epistles of Symmachus: we know of no later edition of them than that of Frankfort, 1642, 8vo. Ambrose bishop of Milan wrote against Symmachus, and so did the Christian poet, Prudentius.

SYMMETRY, the just proportion of the several parts of any thing, so as to compose a beautiful whole.

SYMMETRY, in painting. See PAINTING, Part I. Sect. III.

SYMONDSBOROUGH, a remarkable large barrow of Flints, near Wellington in Devonshire, in the northern extremity of Hemyock. The common people have a notion that a king called *Symon* was buried here. The tradition of the country plainly shows that it was the burial-place of some person or persons of eminence.

SYMPATHETIC, something that acts or is acted upon by sympathy. Thus we say, sympathetic diseases, inks, &c.

SYMPATHETIC Inks. See *Sympathetic INK*.

SYMPATHY, an agreement of affections and inclinations, or a conformity of natural qualities, humours, temperaments, which make two persons delighted and pleased with each other.

SYMPATHY, also denotes the quality of being affected by the affection of another; and may subsist either between different persons or bodies, or between different parts of the same body. It is either similar or dissimilar; similar, when the affection or action in the sympathiser is similar to the affection or action in the sympathant; and dissimilar, when those are different.—Sympathy, too, is often an imitative faculty, sometimes involuntary, frequently without consciousness: thus we yawn when we see others yawn, and are made to laugh by the laughing of another.

Sympathy, according to Dr Jackson *, relates to the operations of the affections of the mind, to the operations of the imagination, and to the affections of the external senses.

* *Treatise on Sympathy.*

1. The passions and affections of the mind produce in the body different sensations and impressions, and, as sympathies of

of consciousness, determine in general the spirits to those parts which labour most, or are most apt to be affected. Thus fear and anger determine to the heart; lust to the eyes, &c.; joy, pity, wonder, and the like, to the head. See PASSION, page 12.

The affections of the mind of one person will often work upon the spirits of many. Thus whole companies are sometimes disposed to be sad and melancholy, or merry and jovial, when any one is present much inclined to either of those states of mind; and it has been observed, that old people, who have loved the company of the young, and have been conversant continually with them, have generally lived long. But young people must not conclude from this, that the company and conversation of the grave and old will operate upon their living and sensitive principle, thro' the affections of their mind, and dispose them to be short-lived. On the contrary, by thus improving their understanding, they will be more enabled to fortify their constitution and resist the ravages of youthful indulgence.

It may also be further observed, that those tender sympathetic affections which lay hold of the mind, at the representation of theatrical performances, originate from the same principle, while they are to be considered as the surest test of just execution in the actor, and of the expressive language of the author. Indeed all stage-effect depends on sympathy.

It has been said, that the passions of the mind are occasionally infectious, particularly some of them. Thus *fear* and *shame* are sometimes very suddenly so. We frequently may have occasion to see, that the starting of one will make another ready to start. Again, when one man is out of countenance in company, others will often blush in his behalf. However, the serious passions may surely be so under the controul of reason as to resist infection, whatever may be the case of temporary, muscular, or nervous attraction.

2. Our author is inclined to think, that a connection between the affections and sensations of the female mind and uterus, is very materially concerned in the process of generation, and probably can alone give efficacy to those actions and impressions subservient to conception, through the sympathizing affections of the mind. But this is a subject of which we know so little, that the speculations of even the most distinguished philosophers respecting it have been nothing but the wild ravings of imagination.

With respect to the depravity and force of the imagination in the production of sympathies, they always operate most upon "weak minds and spirits, and therefore most on women, superstitious and fearful persons, sick people, children, and young creatures." "Their effects, however, sometimes fail to appear, because they are encountered and overcome by the mind and spirit before they work any manifest effects."

Such effects are obviated upon the same principle which establishes the prevention of bodily disease: "for in infection and contagion from body to body (as, for example, during the plague), the miasma may be received; but from the strength and good disposition of the body, it is expelled and wrought out before it has had sufficient time to form the disease."

It has been said, and many are of the opinion, that the force of imagination doth often forward the end proposed. Thus, for instance, it has been put as a question, "Whether a man, when he constantly and strongly believes that such a thing shall be (as that such a one will love him, and the like), helps any thing to the effecting the thing desired?" Certainly not in the manner which has been advanced, namely, "by a secret operation on the spirit of another." If he succeeds, it is either because he persevered, or because his perseverance and earnestness (and not any occult operation) makes him at length be attended to.

There is not a doubt but the force of imagination often gives energy to our actions. It may, however, unless we are much on our guard, easily delude us aside from reason. It has been the tree which has yielded the fruits of superstition in former times, and which has often fed the human mind with the most extravagant notions of sympathy. Sympathies of this kind, such as the power of charms, and the like, are now pretty generally exploded.

3. The five senses, *hearing*, *tasting*, *smelling*, *feeling*, and *seeing*, are conscious of a sympathetic impression from odious objects. "1. A disagreeable sound will set the teeth on edge, and make all the body shiver. 2. The swallowing of a nauseous medicine will be attended with a shaking of the head and neck. 3. Disagreeable smells produce nearly the same effect, which are less perceived, because there is a remedy at hand by stopping the nose. 4. If you come suddenly out of the sun into the shade, the sense of feeling is disturbed by a chillness or shivering of the whole body. 5. And even sudden darkness produces a propensity to shivering.

There is a very apparent reason why a sympathy should take place between the eyes. Hence their motions are synchronous. It may be said, that custom and habit dispose the eyes to move one and the same way; "for when one eye moveth towards the nose, the other eye moveth from the nose."

Though the eyes are by nature prone to move in concert, custom will, however, destroy this natural concert, and produce the contrary effect. Thus some people can squint when they will. Our author therefore gives this caution to mothers and nurses: "Let them not suffer infants to sit with a candle placed behind them; for both their eyes will be disposed to move outwards, as affecting to see the light of the candle, which may bring on the habit of squinting."

It appears as a quality in the senses of hearing and seeing, "that the instrument of each separate sense has a sympathy and similitude to that which giveth the reflection." Thus it has been observed, "that the eye will sympathize with a crystal glass or water, and the ear with caves and such hollow places as are suited to report echo."

Sympathies have been compared to unisons of sound in music. Unisons of sound produce agreeable sympathetic feelings; the reverse produce disagreeable feelings. "All concords and discords of music are (no doubt) sympathies and antipathies of sound." Moreover, "they are said to work as well by report of sound as by motion."

The most agreeable as well as odious objects operate in a secondary way, in producing those sympathetic impressions and actions which they commonly give rise to. An increased secretion of saliva often takes place at the sight of a favourite dish: and the running of water from a bottle, or otherwise, will sometimes affect individuals of a particular temperament, with an involuntary propensity to void urine.

Many have attempted to account for the remarkable sympathy which takes place between parts of the body seemingly unconnected with each other; but as these attempts are merely conjectures, without any solid principles to rest on, we pass them over as the dreams of ingenious men. It would be fortunate for science, if men would confine themselves to those subjects which can be known, and never draw conclusions till they have established principles.

SYMPHONIA, in botany; a genus of plants, belonging to the class of *monadelphia*, and order of *pentandria*.—There is one pistil. The corolla is globular, and the berry five celled. There is only one species yet discovered, the globulifera.

SYMPHONY, in muſic, properly denotes a conſonance or concert of ſeveral ſounds agreeable to the ear, whether vocal or inſtrumental, called alſo *harmony*. See HARMONY.

SYMPHYSIS, in anatomy, one of the kinds of junctures or articulation of the bones. See ANATOMY, n° 2.

Cutting the Symphyſis of the Pubes. See MIDWIFERY, Part II. Chap. VII.

SYMPHYTUM, COMFREY, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *monogynia*; and in the natural ſyſtem, ranging under the 41ſt order *aſperifoliæ*. The limb of the corolla is tubular and ventricoſe, and the throat is ſhut with awl ſhaped rays. There are three ſpecies; the officinale, tuberoſum, and orientale.—The officinale is a Britiſh plant. The ſtem is about two feet high, round, branched, green, and rough. The radical leaves are very large and rough; thoſe on the ſtalk are decurrent, and alternate. The flowers grow on looſe ſpikes, and are either of a yellowiſh or purple colour. It grows on the banks of rivers, and flowers from May to October.

SYMPLOCE, συμπλοκη, in rhetoric, a figure, where the ſame word is repeated ſeveral times in the beginning and end of a ſentence, including the ANAPHORA and EPISTROPHE: thus, *Quis legem tulit? Rullus. Quis majorem populi partem ſuffragiis privavit? Rullus. Quis comitiis præfuit? Idem Rullus.*

SYMPLOCOS, in botany: A genus of plants belonging to the claſs of *polyadelphia*, and to the order of *polyandria*; and in the natural ſyſtem ranging under thoſe the order of which has not been determined. The calyx is quinquefid and inferior: the corolla is pentapetalous: the ſtamina are attached to the tube of the corolla in a fourfold ſeries. Only one ſpecies, the martinicenſis, is mentioned by Linnæus; but l'Heritier of the Academy of Sciences at Paris had added four more, the ciponima, arechea, tinctoria, and alſtonia.

SYMPOSIARCH, in antiquity, the director or manager of an entertainment. This office was ſometimes performed by the perſon at whoſe charge the entertainment was provided; ſometimes by another named by him; and at other times, eſpecially in entertainments provided at the common expence, he was elected by lot, or by the ſuffrages of the gueſts.

SYMPTOM, in medicine, any circumſtance which indicates the exiſtence, nature, or ſtage of a diſeaſe. Pain, waking, drowſineſs, convulſions, ſuppreſſion of urine, difficulties of breathing and ſwallowing, coughs, diſtaſtes, nauſeas, thirſts, ſwoonings, faintings, looſeneſs, coſtiveneſs, dryneſs and blackneſs of the tongue, are the principal *ſymptoms* of diſeaſes. See MEDICINE, n° 41. and 58.

SYMPTOMATICAL, in medicine, is a term often uſed to denote the difference between the primary and ſecondary cauſes in diſeaſes: thus a fever from pain is ſaid to be ſymptomatical, becauſe it riſes from pain only.

SYNÆRESIS, CONTRACTION, in grammar, a figure whereby two ſyllables are united in one; as *vemens* for *vehemens*.

SYNAGOGUE, among the Jews, was a place where people met to worſhip God. Authors are not agreed about the time when the Jews firſt began to have ſynagogues:—Some will have them as old as the Ceremonial Law, and others fix their beginning to the times after the Babyloniſh captivity. They erected ſynagogues not only in towns and cities, but alſo in the country, eſpecially near rivers, that they might have water for their purifications and ceremonious waſhings. No ſynagogue was built in any town, unleſs there were ten perſons of leiſure in it; but there might be many in one town, or in one quarter of a town, provided it was very populous. Jeruſalem is ſaid to have contained 480. The chief things belonging to a ſynagogue were, 1. The ark or cheſt, made after the model of the ark of the covenant, containing the *Pentateuch*. 2. The pulpit and deſk in the middle of the ſynagogue, in which he that was to read or expound the law ſtood. 3. The ſeats or pews for the people. 4. The lamps to give light at evening ſervice, and the feaſt of dedication. 5. Rooms or apartments for the utenſils and alms cheſts. The ſynagogue was governed by a council or aſſembly, over whom was a preſident, called *The Ruler of the Synagogue*. Theſe are ſometimes called *Chiefs of the Jews*, *The Rulers*, *The Prieſts* or *Elders*, *The Governors*, *The Overſeers*, *The Fathers of the Synagogue*. Their buſineſs was to puniſh the diſobedient by cenſures, by excommunication, or by penalties, ſuch as fines and ſcourging; to take care of the alms, which are frequently called by the name of righteouſneſs. The chief ruler, or one of the rulers, gave leave to have the law read and expounded, and appointed who ſhould do it. In every ſynagogue, there were ſeveral miniſters who had different offices aſſigned to them. Service was performed three times a day, viz. in the morning, in the afternoon, and at night; at the time of morning ſacrifice, evening ſacrifice, and after the evening ſacrifice on Mondays, Thurſdays and Saturdays, there was a more forcible obligation upon the people to attend than upon the other days. There are ſynagogues at London, Amſterdam, Rotterdam, Avignon, Metz, &c.

SYNALŒPHA, in grammar, a contraction of ſyllables, performed principally, by ſuppreſſing ſome vowel or diphthong at the end of a word, on account of another vowel or diphthong at the beginning of the next. As, *ill' ego*, for *ille ego*, &c.

Conticuer' omnes intentiqu' ora tenebant. Virg.

It is called by the Latins *colliſio*.

SYNARTHROSIS, } See ANATOMY, n° 2.
SYNCHONDROSIS, }

SYNCELLUS, or SINCELLUS, an ancient officer in the family of the patriarchs, and other prelates of the eaſtern church. The word, in the corrupt Greek, συγκελλος, ſignifies a perſon who lies in the chamber with another; a *chamber-fellow*, or *chum*. The ſyncellus was an eccleſiaſtic, who lived with the patriarch of Conſtantinople, to be a witneſs of his conduct; whence it is, that the ſyncellus was alſo called the *patriarch's eye*, becauſe his buſineſs was to obſerve and watch. The other prelates had alſo their ſyncelli, who were clerks living in the houſe with them, and even lying in the ſame chamber, to be witneſſes of the purity of their manners. Afterwards the office degenerated into a mere dignity; and there were made ſyncelli of churches.—At laſt it became a title of honour, and was beſtowed by the emperor on the prelates themſelves; whom they called *pontificial ſyncelli*, and *ſyncelli Auguſtales*.

SYNCHRONISM denotes the happening of ſeveral things at the ſame time. See CHRONOLOGY.

SYNCOPATION, in muſic, denotes a ſtriking or beating of time, whereby the diſtinction of the ſeveral times or parts of the meaſure is interrupted. However, it is more properly uſed for the connecting the laſt note of any meaſure, or bar, with the firſt of the following meaſure, ſo as only to make one note of both. A ſyncope is ſometimes alſo made in the middle of a meaſure. Syncopation is alſo uſed when a note of one part ends or terminates on the middle of a note of the other part. This is otherwiſe denominated *binding*. It is likewiſe uſed for a driving note; that is, when ſome ſhorter note at the beginning of a meaſure, or half meaſure, is followed by two, three, or more longer notes before another ſhort note occurs,

curs, equal to that which occasioned the driving, to make the number even, *e. gr.* when an odd crotchet comes before two or three minims, or an odd quaver before two, three, or more crotchets. In syncopated or driving notes, the hand or foot is taken up, or put down, while the note is sounding.

SYNCOPE, FAINTING; a deep and sudden swooning, wherein the patient continues without any sensible heat, motion, sense, or respiration, and is seized with a cold sweat over the whole body; all the parts, in the mean time, turning pale and cold, as if he was dead. See MEDICINE, n° 98. and 272.

SYNCOPE, in grammar, an elision or retrenchment of a letter or syllable out of the middle of a word, as *caldus* for *calidus*.

SYNDIC, in government and commerce, an officer, in divers countries, intrusted with the affairs of a city or other community, who calls meetings, makes representations and solicitations to the ministry, magistracy, &c. according to the exigency of the case.

SYNECDOCHE, in rhetoric, a kind of trope frequent among orators and poets. See ORATORY, n° 56.

SYNECPHONESIS, in grammar, a coalition, whereby two syllables are pronounced as one; being much the same as SYNALOEPHA and SYNÆRESIS.

SYNEUROSIS. See ANATOMY, n° 2.

SYNGENESIA, (συν and γενεσις, "congeneration)," the name of the 19th class in Linnæus's artificial system; comprehending those plants which have the anthers united into a cylinder. The orders are six: 1. Polygamia æqualis. 2. Polygamia superflua. 3. Polygamia frustranea. 4. Polygamia necessaria. 5. Polygamia segregata. 6. Monogamia. The five first orders contain the compound flowers, and form a class truly natural.

SYNGNATHUS, PIPE-FISH, according to Linnæus, a genus belonging to the class of *amphibia*, and order of *nantes*, but arranged by Gmelin more properly under the class of *pisces*, and order of *branchiostegi*. The head is small; the rostrum somewhat cylindrical, long, and turned up at the point, where the mouth is placed, which is covered with a lid or valve. The gills are covered in the same manner. The body is covered with a strong crust, and has no ventral fins. There are eight species; the tetragonus, typhele, acus, pelagicus, æquoreus, ophidion, barbarus, and hippocampus. Three of these are found in the British seas, *viz*.

1. The *barbarus*, or longer pipe-fish. One described by Sir Robert Sibbald, was two feet in length; that examined by Mr Pennant only 16 inches. The nose was an inch long, compressed sidewise, and the end of the lower mandible turned up; the aperture of the mouth was very small. The irides were red; behind each eye was a deep brown line. The body, in the thickest part, was about equal to a swan's quill, hexangular from the end of the dorsal fin; from thence to the tail, quadrangular. The belly was slightly carinated, and marked along the middle with a dusky line. Under the tail, commencing at the anus, is a sulcus or groove six inches and a half long, covered by two longitudinal valves, which concealed a multitude of young fish. On crushing this part, hundreds may be observed to crawl out.

2. The *acus*, or shorter pipe-fish, is thicker than the former, yet it has been seen of the length of 16 inches. The middle of the body in some is hexangular, in others heptangular. The mouth is formed like that of the former: the irides are yellow: close behind the head are the pectoral fins, which are small and short. On the lower part of the back is one narrow fin; beyond the vent the tail commences, which is long and quadrangular. At the extremity is a fin round and radiated. The body is covered with a strong crust, elegantly divided into small compartments. The belly is white; the other parts are brown. Syngnathus. Synonymous.

3. The *ophidion*, or little pipe-fish, seldom exceeds five inches in length, is very slender, and tapers off to a point. It wants both the pectoral and tail fins; is covered with a smooth skin, not with a crust as the two former kinds are. The nose is short, and turns a little up; the eyes are prominent. On the back is one narrow fin. This species is not viviparous: on the belly of the female is a long hollow, to which adhere the eggs, disposed in two or three rows. They are large, and not numerous. The synonym of *serpent* is used in several languages to express these fish: the French call one species *orueul*, from a sort of snake not unlike the blindworm: the Germans call it *meherschlange*; and the Cornish the *sea-adder*.

The Sea-horse, which was classed by Artedi under the Syngnathus, is now, by later ichthyologists, arranged under TRICHECUS; which see.

SYNOCHA, and SYNOCHUS, in medicine, the names of two species of continued fever. See MEDICINE, n° 164.

SYNOD, in astronomy, a conjunction or concourse of two or more stars or planets, in the same optical place of the heavens.

SYNOD signifies also a meeting or assembly of ecclesiastical persons to consult on matters of religion.

Of these there are four kinds, viz. 1. *General*, or *œcumenical*, where bishops, &c. meet from all nations. These were first called by the emperors, afterwards by Christian princes; till in later ages the pope usurped to himself the greatest share in this business, and by his legates presided in them when called. 2. *National*, where those of one nation only come together, to determine any point of doctrine or discipline. The first of this sort which we read of in England, was that of Herudford or Hertford, in 673, and the last was that held by cardinal Pole, in 1555. 3. *Provincial*, where those only of one province meet, now called the *convocation*. 4. *Diocesan*, where those of but one diocese meet, to enforce canons made by general councils, or national and provincial *synods*, and to consult and agree upon rules of discipline for themselves. These were not wholly laid aside, till by the act of submission, 25 Hen. VIII. c. 19. it was made unlawful for any *synod* to meet, but by royal authority. See COUNCIL and CONVOCATION.

SYNODS, *Provincial, in the Government of the Church of Scotland*. See PRESBYTERIANS, n° 14.

SYNODALS, or SYNODIES, were pecuniary rents (commonly of two shillings), paid to the bishop, or archdeacon, at the time of their Easter visitation, by every parish priest. They were thus called, because usually paid in synods; because anciently bishops used to visit and hold their diocesan synods once.—For the same reason, they are sometimes also denominated *synodalica*; but more usually, *procurations*.

SYNODICAL, something belonging to a synod. Thus, synodical epistles are circular letters written by the synods to the absent prelates and churches; or even those general ones directed to all the faithful, to inform them of what had passed in the synod.

SYNOECIA, in Grecian antiquity, a feast celebrated at Athens in memory of Theseus's having united all the petty communities of Attica into one single commonwealth; the seat whereof was at Athens, where all the assemblies were to be held. This feast was dedicated to Minerva; and, according to the scholiast on Thucydides, it was held in the month *Metagitnion*.

SYNONYMOUS, is applied to a word or term that has the same import or signification with another.

Several

Synonyms.
Syracuse.

Several works have been composed for the express purpose of explaining synonymous words. In 17– a work was published on the Latin synonyma at Paris by M. Gardin Dumesnil. The abbé Girard published one on the synonymous terms of the French language many years ago. Another was published on the same subject in the year 1785 by the abbé Roubaud. An account of the English synonyma was published by an anonymous author in 1766; which is a close imitation, and in some parts a literal translation, of the abbé Girard's *Synonymes François*. We recollect, too, of seeing some essays of Mrs Piozzi on the same subject.

SYNOVIA, in medicine, a term used by Paracelsus and his school for the nutritious juice proper and peculiar to each part. Thus they talk of the synovia of the joints, of the brain, &c.

SYNTAX, in grammar, the proper construction or due disposition of the words of a language into sentences and phrases. See GRAMMAR and LANGUAGE.

SYNTHESIS, in logic, denotes a branch of method, opposite to analysis.

In the synthesis or synthetic method, we pursue the truth by reasons drawn from principles before established or assumed, and propositions formerly proved; thus proceeding by a regular chain, till we come to the conclusion. Such is the method in Euclid's Elements, and most demonstrations of the ancient mathematicians, which proceed from definitions and axioms, to prove propositions, &c. and from these propositions proved to prove others. This method we also call *composition*, in opposition to *analysis* or *resolution*. See ANALYSIS.

SYPHILIS. See MEDICINE, n° 350.

SYPHON. See HYDROSTATICS, n° 25, 26. Some uncommon phenomena in nature may be accounted for upon the principles of the syphon; as, for instance, that of reciprocating springs. See PNEUMATICS, n° 373.

1
At what time built.

SYRACUSE, once a celebrated city of Sicily, and the capital of the island. It was built, according to Thucydides and Strabo, by Archias, one of the Heraclidæ, who came from Corinth into Sicily in the second year of the 11th Olympiad, deriving its name from a neighbouring marsh named *Syraco*. What form of government first prevailed in the city is not known. Many have supposed it originally to have been governed by kings: but if this was the case, the monarchical government must have continued only for a very short time; since Aristotle, Diodorus Siculus, and Justin, mention it as being very early subject to a democracy. The history, however, is obscure and unimportant till the time of Gelon, when it first began to make a conspicuous figure.

2
Government originally monarchical.

3
Soon becomes democratical.

4
Gelon seizes the sovereignty.

Gelon was born in the city of Gela in Sicily, of the family of Telines, who had been created priest of the infernal gods. He signalized himself in a war carried on by Hippocrates tyrant of Gela against the Syracusians, whom he defeated in a pitched battle, and had well nigh taken their city afterwards. Having thus become very powerful among his countrymen, he soon found means to seize on the sovereignty for himself. In a short time, having put himself at the head of some Syracusian exiles, he marched towards that place, where he was received with loud acclammations by the faction to which they belonged; and by their means obtained possession of the city.

5
Takes several cities, and removes the inhabitants to Syracuse.

Gelon, in order to people the capital of his new dominions, first demolished the neighbouring city of Camarina, and transplanted the inhabitants to Syracuse. Soon after, entering into a war with the Megareans, he defeated them, took and rased their cities, and in like manner transplanted the people. Syracuse thus became very powerful, and full of inhabitants; and the friendship of Gelon was courted both by Athens and Lacedæmon at the time of the Persian invasion. His assistance, however, was afterwards rejected, as he insisted upon being made commander in chief either of the fleet or the army. In the mean time the Carthaginians had entered into a treaty with the Persians; by which it was agreed, that the former should attack those of the Greek name in Sicily and Italy, in order to divert them from assisting one another. Sicily was accordingly 6
invaded by the Carthaginians with a vast army; but they were utterly overthrown by Gelon, as is related under the article CARTHAGE, n° 7—9. After this victory, the people out of gratitude obliged him to take upon himself the title of king; which till that time he had refused. A decree was also passed without opposition, by which the crown was settled on his two brothers Hiero and Thrasybulus after his death.

7
The new king, instead of keeping his subjects in greater awe, studied the more to make them happy as he found his power increased; and, according to Diodorus Siculus, was the first man who became more virtuous by being raised to a throne. He was particularly famous for his honesty, truth, and sincerity; is said never to have wronged the meanest of his subjects, nor ever to have promised a thing which he did not perform. 8

Gelon died in the year 471 B. C. after having reigned three or four years; and was succeeded by his brother Hiero, whose character is differently drawn by different historians. He was twice engaged in a war with the Agrigentines, and drove from their habitations the people of Catana and Naxus, settling in their room a colony of Syracusians and Peloponnesians. He is highly celebrated in the odes of Pindar; and it is certain that his court was the resort of men of wit and learning, to whom he behaved in the most courteous manner and with the greatest liberality. 9

In 459 B. C. Hiero was succeeded by Thrasybulus; who proving a tyrant, was in ten months driven out, and a popular government restored; which continued for the space of 55 years. Several persons continued for some time to aspire at the sovereign power; and to rid themselves 10
of these aspiring geniuses, the inhabitants made a law not unlike that of the ostracism at Athens. By this law they were to write on a leaf the names of those whom they supposed to be powerful enough to aspire at the crown; and when the leaves were counted, he who had the most suffrages against him was, without further inquiry, banished for five years. This method of weakening the interests of the 11
overgrown citizens was called *petalism*, from the Greek word πεταλον, signifying a leaf; but being found to be productive of great inconveniences, by driving out of the country all those who were most capable of governing the commonwealth, the law was repealed soon after it had been enacted. 12

About this time the Syracusians entered into a war with the Siculi, which terminated in the total subjection of the latter; after which Syracuse became so powerful, that it in a manner gave law to the whole island. The Greek cities 13
indeed enjoyed a perfect liberty; but they all acknowledged Syracuse as their metropolis: by degrees, however, the latter began to assume such an authority over them as was totally inconsistent with liberty; and this occasioned many wars, which involved them in much distress and danger. They began with the Leontines, whose territory they laid 14
waste, and reduced their city to great straits. Leontini was an Athenian colony; and this furnished the Athenians, who had already meditated the conquest of Sicily, with a pretence to attack the Syracusians with their whole force. Under colour of assisting their countrymen, therefore, they sent a fleet of 250 sail to Sicily: but the Leontines, sensible that

that their pretended allies aimed at nothing less than the conquest of the whole island, concluded a peace with Syracuse; and the disappointed Athenians vented their rage upon those who had advised and conducted the expedition.

In 416 B. C. a dispute happening between the inhabitants of Egesta and Selinus concerning some lands which the latter had seized, the Egestines applied for assistance to Agrigentum, Syracuse, and even to Carthage. But as none of these states chose to interest themselves in their quarrel, they applied at last to the Athenians, who joyfully accepted of the opportunity of again interfering in the affairs of Sicily. Though the Egestines were but an inconsiderable people, they had engaged to pay all the troops that should be employed in the war; but this appearing doubtful to the Athenians, they sent ambassadors to inquire into the state of the island in general, and particularly that of Egesta. The Egestines imposed on these ambassadors by producing a great number of gold and silver vessels which they had borrowed for the purpose; so that the populace of Athens, dreaming of nothing but conquests to be made without any expence, became obstinately bent on the war. Nicias, a man of great influence at Athens, attempted to show, that as Athens was then engaged in a dangerous war with Sparta, it was impossible to spare a force sufficient to reduce the island; but the contrary opinion being espoused by Alcibiades, at that time the most eloquent speaker in Athens, Nicias was overruled, and obliged to engage in the expedition. The force he required was only 5000 land forces and 100 galleys, with which, however inadequate to the purpose it may seem, the Athenians were so sure of success, that the officers, before they set sail, had a conference with the senate concerning the disposal of the Sicilians. In this conference it was agreed, that the Selinuntines and Syracusians their supposed allies should be carried off and sold for slaves, and the rest obliged to pay an annual tribute and live according to the Athenian laws.

With these sanguine expectations the Athenian forces embarked to the number of 7000; for such was their eagerness for the expedition, that 2000 more enlisted themselves than Nicias had required. They first sailed to the island of Ægina, and from thence to Corcyra, where they had appointed the place of rendezvous for their allies and the transports. On their arrival they set sail again, and landed on the coast of Italy, with a view to engage some of the Italian cities in their quarrel; but finding this impossible, they sent some ships to cruise off the coast of Sicily, in order to find out a proper place for landing, and at the same time to know what measure the Egestines could contribute towards carrying on the war, which had been undertaken for their sake. These, on their return, acquainted the generals, that the Egestines had imposed on them, and were a poor indigent people, who had only 30 talents in the treasury. On this information a council of war was called, in which Nicias gave it as his opinion that they should sail to Selinus, which had been the first occasion of this expedition; and then, if the Egestines performed their promise, and supplied the army with a month's pay, to oblige the Selinuntines and Egestines to come to an agreement, and then return to Athens without engaging in such an expensive war. Alcibiades, however, again opposed Nicias; thinking it highly dishonourable to return home without doing any thing, after having been at the expence of fitting out an armament. He therefore urged, that they should solicit the cities of Sicily to enter into a confederacy against the Syracusians and Selinuntines; and, in case they found them disposed to come into their measures, to attack either Syracuse or Selinus. Another of the Athenian generals was for laying siege immediately to Syracuse; but the opinion of Alcibiades prevailing, they set sail for Sicily. Having accordingly landed in that island, they reduced several places; but Alcibiades in the mean time being recalled, Nicias and Lamachus were left to conduct the war as they best could. At first they were successful, possessing themselves of a strong post, and put the Syracusians to flight; soon after which they received considerable supplies both of men, money, and provisions, from Athens, as well as from their Sicilian allies. The Syracusians also received assistance from the Lacedæmonians under the command of an experienced officer named *Gylippus*. Before these arrived, the Athenians had possessed themselves of an important post named *Epipolæ*, which being a very steep hill, stood without the city and commanded it. Immediately after this the city was invested in form. The inhabitants made frequent and vigorous sallies; but were always repulsed with loss. In one of these sallies Lamachus was slain; and thus Nicias became sole commander. He then caused the canals to be cut by which water was conveyed into the city; upon which the Syracusians began to think of capitulating. From this, however, they were soon after prevented by the arrival of Gylippus with the Spartan auxiliaries. On this they prepared for making vigorous sallies, in order to facilitate the entrance of Gylippus. While they were making these preparations, Gylippus himself appeared at the head of 3000 foot and 200 horse. Making directly for Epipolæ, where Nicias had fortified himself in a castle named *Labdalon*, he drew up his small army under the walls; and sent an herald to Nicias, letting him know that he would allow him only five days to leave Sicily. To this message Nicias returned no answer; but Gylippus soon after attacked the fort, carried it by storm, and put to the sword all the Athenians that were in it. This opened for him a way into the city, where he was received with loud acclamations.

Syracuse.

19 Reduce several places.

20 Defeat the Syracusians and possess themselves of a strong post.

21 Syracuse invested.

22 Gylippus arrives with some Spartans to the relief of Syracuse.

23 Takes a fort, and enters the city.

The fortune of the war was again changed. The Athenians gained an advantage by land, but were next day defeated with considerable loss. The Syracusians received fresh supplies from Corinth, and the Athenians from their own country. Many engagements both by sea and land took place, in which the success was ultimately in favour of the Syracusians. At last the Athenian affairs were totally ruined by the loss of a sea-fight, in which 60 of their ships were taken or destroyed, and the rest left quite unserviceable. In this desperate situation it was determined to abandon their ships, and retire that very night to the city of their confederates. The Syracusian commander, suspecting that this would be the case, ordered all his forces to be in readiness to prevent them from effecting their purpose. But as the people were then in the height of their rejoicing for the late victory, they refused to take up arms again until they had rested for some days. On this Hermocrates the general sent to the Athenian camp some horsemen, who were to pass for friends, and to advise Nicias not to quit his camp, which was well fortified, since the Syracusians lay in ambush for him, and had seized on all the passes leading to the cities of their allies. To this false advice Nicias gave too easy credit, and did not march out till the third day, when his antagonist Hermocrates had prevailed upon his forces to march out. The Athenians and their allies also marched out to the number of no less than 40,000; but finding themselves shut up on all sides, and being obliged to fight their way through every outlet, they soon sunk into the deepest despair. Nicias did his utmost to encourage them; and at last succeeded so far that they marched out in two bodies, both drawn up in proper order. The vanguard led by Nicias continued to keep together, and advanced in good order; but half the rear, commanded by Demosthenes, lost their way in the night, and were obliged to surrender. Nicias

24 Athenians totally defeated at sea.

25 Outwitted by the Syracusian general.

26 Harassed in their retreat.

27 Part of the army surrenders.

Syracuse.

cias being informed of this misfortune, offered to pay the whole expence of the war, provided he was allowed to march off with his men. But this being rejected, he set out, tho' galled all the way by showers of darts from his enemies.

28 The rest defeated with great slaughter.

Arriving at a river called *Asinarus*, they rushed into it without any order; in which confusion the Syracusian cavalry attacked them so desperately, that 18,000 perished, and the river for many miles was dyed with their blood. On this occasion the Athenians were so pressed with thirst, that, unmindful of their danger, they drank the waters of the river all bloody as they were, which gave their enemies the better opportunity of slaughtering them without resistance. The remainder surrendered, on the single condition of having their lives saved; but the terms were shamefully broke by the Syracusians.

29 The remainder surrender, and are cruelly used.

The generals were first ignominiously whipt, and then put to death: the common soldiers were thrust down into quarries, where they were allowed only two small measures of flour and one of water a-day; and where, being crowded upon one another, they suffered inexpressible miseries for many months. Most of them perished by this cruel treatment, and the few who survived were sold for slaves.

30 New invasion by the Carthaginians.

The war was scarce ended, when a new and formidable invasion by the Carthaginians took place; but the event of that expedition was as unfortunate to the Carthaginians as the former had been, of which a particular account is given under the article CARTHAGE, n° 12. *et seq.*

In the mean time, however, a considerable revolution had happened in Syracuse. The city of Agrigentum had been taken by the Carthaginians, and of the few inhabitants who escaped, some fled to Syracuse, where they accused the Syracusian commanders of having betrayed the city into the hands of the enemy.

31 Rise of Dionysius.

Dionysius, a man of great valour and address, but who had become very obnoxious to the populace, took this opportunity of attempting to retrieve his credit. He therefore supported the accusations brought against his countrymen by the Agrigentines, and even impeached the magistrates as having a secret intelligence with the enemy, and attempting to introduce an oligarchy. As his speech was entirely levelled against the more wealthy citizens, it was very agreeable to the lower class: the commanders were instantly degraded; and others, among whom was Dionysius, were appointed. Having once gained this point, he began to consider how he might get all his colleagues turned out. For this purpose he never joined in any council of war with the other commanders, nor imparted to them his resolutions, giving out that he could not trust them, and that they had more regard for their own interest than the welfare of their country. But while he was proceeding in this manner, the more prudent part of the citizens, perceiving what he aimed at, complained of him to the senate and magistrates, and fined him as a disturber of the public peace. According to the laws, the fine was to be paid before he could speak in public, and the circumstances of Dionysius did not allow him to discharge it. In this dilemma he was assisted by Philistus the historian, a man of great wealth, who not only paid this fine for him, but encouraged him to speak his mind freely, as it became a zealous citizen to do, promising to pay all the fines that should be laid upon him.

Being extricated out of this difficulty, Dionysius next proceeded to inveigh, with all the eloquence he was master of, against those who by means of their power or interest were able to oppose his designs, and by degrees brought them into discredit. His next scheme was to get those exiles recalled whom the nobility had banished at different times; as thinking that they would support him with all their power, as well out of gratitude as out of hatred to the opposite party. Having gained this point also, he next found means to ingratiate himself with the soldiery to such a degree, that, under pretence of taking proper measures for resisting the Carthaginians, he was chosen commander in chief, with absolute and unlimited power. This was no sooner done, than, pretending that his life was in danger, he chose out 1000 men for his guard, whom he attached to his interest by great promises. As no person durst now oppose him, he possessed himself of the citadel, where all the arms and provisions were kept; after which he publicly took the title of king of Syracuse in the year 404 B. C.

The Syracusians did not tamely submit to their new master; but Dionysius managed matters so well, that their frequent revolts answered no other purpose than more certainly to entail slavery on themselves; and he was allowed to possess the throne without much opposition till his death, which happened in the year 366 B. C.

On the death of Dionysius, he was succeeded by his son, called also *Dionysius*. He was naturally of a mild and peaceable temper, averse from cruelty, and inclined to learning; but his father, to whom all merit, even in his own children, gave umbrage, stifled as far as possible his good qualities by a mean and obscure education. He no sooner ascended the throne, than Dion, brother to Aristomache the other wife of Dionysius the Elder, undertook to correct the faults of his education, and to inspire him with thoughts suitable to the high station in which he was placed. For this purpose he sent for the philosopher Plato, under whose care he immediately put the young king. This instantly produced a reformation on Dionysius; but the courtiers, dreading the effects of the philosopher's instructions, prevailed on him to banish Dion, and to keep Plato himself in a kind of imprisonment in the citadel. At last, however, he set him at liberty; upon which Plato returned to his own country.

Dion, in the mean time, visited several of the Grecian cities, and at last took up his residence in Athens; but the honours which were everywhere paid him, raised such jealousies in the breast of the tyrant, that he stopped his revenue, and caused it to be paid into his own treasury. In a short time Dionysius again sent for Plato; but finding it impossible to dissolve the friendship between him and Dion, disgraced, and placed him in a very dangerous situation, in the midst of assassins who hated him. Not daring, however, to offer him any violence, he allowed him soon after to depart; revenging himself on Dion, whose estate he sold, and gave his wife Arete in marriage to Timocrates one of his own flatterers.

Dion now resolved to revenge himself on the tyrant for the many injuries he had sustained, and at once to deliver his country from the oppression under which it groaned. He began with raising foreign troops privately, by proper agents, for the better execution of his design. Many Syracusians of distinction entered into his scheme, and gave him intelligence of what passed in the city; but of the exiles, of whom there were upwards of 1000 dispersed up and down Greece, only 25 joined him; so much were they awed by the dread of the tyrant. The troops were assembled at the island of Zacynthus, in number only about 800; but who had all been tried on many occasions, were well disciplined, and capable of animating by their example the forces which Dion hoped to find in Sicily. When they were about to sail, Dion acquainted them with his design, the boldness of which at first occasioned no small consternation among them; but Dion soon removed their fears, by telling them that he did not lead them as soldiers, but as officers, to put them at the head of the Syracusians and all the people of Sicily, who were ready to receive them with open

arms. Having then embarked in two small trading vessels, they arrived in 12 days at Cape Pachynum near Syracuse. Their pilot advised them to land immediately, lest they should be overtaken by a violent storm, which he perceived was approaching; but Dion, judging it improper to land so near the enemy, commanded him to put to sea again, and double the Cape. — This was no sooner done than the storm came on; and the two vessels were driven on the coast of Africa, where they were in great danger of being lost. At last they arrived at the port of Minoa, not far from Agrigentum. Here they received intelligence that Dionysius had set sail for Italy, attended by a fleet of 80 galleys. On this Dion resolved to take advantage of the tyrant's absence; and immediately set sail for Syracuse. On his march he prevailed upon the inhabitants of Agrigentum, Gela, Camarina, and other cities, to join him. As soon as he entered the territories of Syracuse, multitudes flocked to him; and as nobody appeared to oppose him, he boldly entered the city, where he quickly found himself at the head of 50,000 men. As soon as he had landed in Sicily, Timocrates, to whom his wife Arete had been given by Dionysius, and to whom the care of the city had been left, dispatched a courier to let the tyrant know the danger in which he was. The messenger, when almost at his journey's end, found himself so much oppressed by fatigue, that he could not help lying down on the ground to take some rest. In the mean time, a wolf, smelling some meat which he had in his wallet, came to the place, and carried off the bag in which was the meat, together with the dispatches. By this means Dionysius was prevented from receiving a timely account of Dion's arrival; so that when he entered the citadel by sea, seven days after Dion's arrival, he found his affairs in a desperate situation. Upon this he had recourse to artifice; and having amused the Syracusians by a feigned negotiation, until he observed that they kept a negligent guard, he attacked them all at once with such fury, that he had almost taken the city. But Dion encouraged the soldiers by his example so much, that he at last obtained a complete victory; for which they presented him with a crown of gold.

It was not long, however, before the ungrateful Syracusians began to think of conferring quite different rewards on their benefactor. Dionysius had the address to render him suspected by the multitude; at the same time that Heraclides, an excellent officer, but a secret enemy to Dion, did all that lay in his power to sink his credit. In a short time Dionysius was obliged to fly into Italy: after which Heraclides, in order to ingratiate himself with the populace, proposed a new division of lands; insinuating, that they could never enjoy perfect liberty as long as there was so much inequality in wealth and power among the citizens. This scheme was opposed by Dion, in consequence of which a general combination was formed against him; and he was deserted by all excepting the foreign troops whom he had brought with him into the island. The Syracusians solicited even these to abandon the cause of their general: but their offers were rejected with disdain; and Dion, with his faithful adherents, getting clear of the tumultuous and riotous populace, took the road to Leontini. The rabble pursued him, but were soon driven back: and Dion resided for some time at Leontini, where he was received with all the respect due to his character.

In the mean time, the citadel still continued in the hands of the adherents of Dionysius. Being blocked up on all sides, they were reduced to great straits, and were actually making proposals of capitulation, when Nypsius, an experienced general, and greatly attached to Dionysius, appeared with a numerous squadron of galleys, and a large fleet of transports laden with provisions. The general landed his men, and got them into the citadel; but almost all his galleys and ships laden with corn were sunk or taken. This victory proved the ruin of the Syracusians; for, giving themselves up to feasting and debauchery, the enemy sallied out in the night time from the citadel, and massacred the citizens without mercy. Being thus made sensible of the error they had committed, an embassy was sent to Dion, intreating him to return and save the city a second time. To this he agreed without hesitation, and instantly set out on his march; but in the mean time, as the soldiers of Dionysius, satiated with slaughter, had retired into their fortress, the ungrateful Syracusians began to repent of their having sent an embassy to Dion. The chief commanders, therefore, sent messengers to stop his march; but as some of his friends sent deputies to him at the same time, desiring him to pay no regard to the former message, he proceeded on his journey. The infatuated multitude seized the gates in order to dispute his entrance; but they paid dear for their frenzy. The Dionysians again sallied out upon them, and made such slaughter, that one would have thought they had left none alive in the city. As the troops of the tyrant well knew that Dion was hastening to the relief of the city, they used their utmost endeavours to destroy it entirely before his arrival; for, after they had murdered all the inhabitants they could find, they set fire to the houses, by which great numbers perished. During this confusion Dion unexpectedly arrived; and having briskly attacked the enemy, at last defeated them with great slaughter, driving the remainder into the citadel. During the rest of the night, instead of refreshing themselves after their fatigues, they assisted in extinguishing the fire; which was not done without great danger and difficulty. The citadel soon after surrendered; and Dion allowed Apollocrates the tyrant's son, who commanded there, to retire with five galleys to his father. As soon as Dion entered the citadel, he was met by his sister and wife Arete, whom he received with affection, notwithstanding her having lived so long with Timocrates. He then left the Syracusians in possession of the citadel, rewarded his followers, dismissed his guards, and continued to live like a private citizen.

Syracuse.

45 The whole inhabitants massacred by the garrison of the citadel.

46 A second massacre, and the city set on fire.

47 The Dionysians defeated with great slaughter by Dion.

As soon as Dion had got possession of the city, Heraclides had submitted to him, and been received into favour; but as his seditious and turbulent behaviour still continued, Dion at last gave orders to put him to death. This action, however necessary, so affected the mind of Dion, that he became melancholy; and ever after imagined himself haunted by a frightful spectre, resembling a woman of gigantic stature, with the haggard looks and air of a fury. In a short time after he lost his life, through the base treachery of Calippus, or Gylippus, who pretended to be his intimate friend, and who immediately after caused his wife and sister to be carried to prison.

48 Dion becomes melancholy, and is murdered.

Calippus having thus removed Dion, soon made himself master of Syracuse, where he committed all manner of cruelties; but was driven out, and forced to fly to Rhegium, where he was murdered with the same dagger which had killed Dion. In 350 B. C. Dionysius again made himself master of Syracuse; and being exasperated by his past misfortunes, tyrannized worse than ever. The Syracusians first had recourse to Icetas tyrant of Leontini; but as the Carthaginians took this opportunity to invade them with a powerful fleet and army, they were obliged to apply to the Corinthians. By them Timoleon, a celebrated commander, was sent to the assistance of the Syracusians, whom he found in a very distressed situation; Icetas being master of the city, the Carthaginians of the harbour, and Dionysius of the citadel. As all parties were equally the enemies of Diony-

49 Dionysius restored.

Syracufe.

fin, he found it impoffible to hold out, and therefore furrendered himfelf to Timoleon, by whom he was fent to Corinth; where at laft he was reduced to the neceffity of teaching a fchool for his fupport.

After the expulfion of the tyrant, Timoleon withdrew to Catana, leaving only 400 Corinthians, under the command of an experienced officer named *Leon*, to guard the citadel. Thefe were immediately befieged by Icetas and the Carthaginians, but Timoleon found means to relieve them in fpite of all oppofition; and having difperfed emiffaries through the army of Mago the Carthaginian general, exhorting the

51 Cowardice of the Carthaginians.

mercenary Greeks to forfake him, he was fo much intimidated, that in fpite of all the remonftrances Icetas could make, he fet fail for Africa, leaving his colleague to carry on the war in the beft manner he could.

The day after the departure of Mago, Timoleon affaulted the city fo brifkly, that the troops of Icetas were driven from the walls, and the Corinthians became mafters of the

52 Citadel of Syracufe and other nefts of tyrants demolifhed by Timoleon.

place. Timoleon, by found of trumpet, invited the inhabitants to come and affift in demolifhing the citadel and other caftles, which he called the *nefts of tyrants*; after which he caufed edifices to be erected in the place where the citadel had ftood, for the adminiftration of juftice. He found the city in a moft miferable fituation: for many having perifhed in the wars and feditions, and others having fled to avoid the oppreffion of tyrants, Syracufe, once fo wealthy and populous, was now become almoft a defert; infomuch that the horfes were fed on the grafs which grew on the

53 He repeoples the city.

market-place. Timoleon fupplied the city with inhabitants from Corinth and other cities of Greece, at the fame time that great multitudes from Italy and the other parts of Sicily reforted thither. Timoleon diftributed the lands among them *gratis*; but fold the houfes, and with the money arifing from the fale eftablifhed a fund for the fupport of the poor. Having thus reftored Syracufe, he in like manner delivered all the Greek cities of Sicily from the tyrants who had taken poffeffion of them, all of whom he put to death. After this he refigned his authority, and led a retired life, honoured in the higheft degree by the Syracufians, and by

54 Dies, and is honoured as a god.

all the cities in Sicily. After his death he was honoured as a god; the expence of his funeral was defrayed by the public; fports, with horfe-races and gymnaftic exercifes, were held annually on the day of his death; and it was decreed, that whenever the Syracufians were at war with the barbarians, they fhould fend to Corinth for a general.

55 Syracufe again falls under the power of tyrants.

For 20 years the Syracufians enjoyed the fruits of Timoleon's victories; but new difturbances arifing, in a fhort time another tyrant ftarted up, who exceeded all that had gone before him in cruelty and other vices. This was the celebrated Agathocles, of whofe exploits againft the Carthaginians a full account is given under the article CARTHAGE, n° 33—53. He was poifoned by one Mænon in the year 289 B. C. after having reigned 28 years, and lived 95.—A fucceffion of tyrants followed, till at laft the city, being

56 Pyrrhus king of Epirus invited into Sicily.

held by two rivals, Tœnion and Sofiftratus, who made war within the very walls, Pyrrhus king of Epirus was invited into Sicily, in order to put an end to thefe diftractions. He willingly complied with the invitation; and was everywhere received with loud acclamations, as the deliverer not only of

57 Conquers a great part of the ifland.

Syracufe, but of all Sicily. As he had a fine army of 30,000 foot and 5000 horfe, with a fleet of 200 fail, he drove the Carthaginians from place to place, till he left them only the two ftrong pofts of Eryx and Lilybæum. The former of thefe he took by affault, and was himfelf the firft man who mounted the walls, after having killed a great number of Africans with his own hand. The Mamertines likewife, who had conquered a confiderable part of the ifland, were everywhere defeated and driven out, till at laft they were fhut up in the city of Meffina. The Carthaginians, alarmed at the rapidity of his conquefts, fent ambaffadors with propofals of peace upon very advantageous terms; but Pyrrhus, puffed up with the expectation of reducing the whole ifland, refufed to hearken to any terms unlefs they would inftantly abandon it. So firm was he in the belief of this, that he caufed his fon take upon him the title of *king of Sicily*; but in the mean time, having difpleafed the Sicilians by his arbitrary behaviour, they deferted from him in fuch numbers that he was glad to fet out for Italy, for which retreat the embaffies he received from the Samnites, Tarentines, and other Italians, furnifhed him with an honourable pretext.

58 Behaves in a haughty manner and is obliged to return into Italy.

He embarked in the fhips which he had brought with him from Italy; but was met at fea by the Carthaginians, who funk 70 of his veffels, and difperfed or took the reft; fo that he faved himfelf in Italy only with 12 veffels, the poor remains of a fleet of 200 fail. No fooner were the Mamertines apprifed of his departure, than they difpatched a body of 18,000 men to harafs him after his landing. Thefe, having paffed the ftraits before him, pofted themfelves in the road which Pyrrhus muft take in marching by land to Tarentum; and concealing themfelves among woods and rocks, attacked him unexpectedly, and with great refolution. But Pyrrhus behaved on this occafion with his ufual bravery. The attack being made on his rear, he haftened thither, and made a dreadful flaughter of the enemy, till a wound on his head obliged him to retire. As he was fuppofed to be difabled by this wound, a proud Mamertine, of an extraordinary fize, and fhining in bright armour, advanced, and with a loud voice challenged the king of Epirus, if he was yet alive, to a fingle combat. Pyrrhus immediately turned about, and making a dreadful appearance by reafon of the blood which ran down his face, flew at this new champion, on whofe head he difcharged fuch a furious blow, that he cleft his body afunder; one half falling to the right, and the other to the left. This incredible feat, which has fince been afcribed to other warriors, perhaps with as much truth as to Pyrrhus, fo much intimidated the Mamertines, that they allowed his troops to continue their march unmolefted.

59 Harafled by the Mamertines.

60 Aftonifhing exploit of Pyrrhus.

61 Hiero chofen general of the Syracufian forces.

After the departure of Pyrrhus, Hiero the fon of Hierocles, a defcendant of Gelon the firft king of Syracufe, was chofen general of the forces, along with another named *Artemidorus*. The two generals had nothing more at heart than to put an end to the confufion and diforder which reigned in the city; for which reafon they entered it at the head of their forces. On this occafion Hiero difcovered extraordinary talents for government. By mere dint of infinuation and addrefs, without fhedding blood, or hurting a fingle citizen, he calmed the minds of the people; reconciled the factions; and fo gained the affections of all, that he was invefted with the whole civil as well as military power in the ftate. Soon after this, he married the daughter of one of the firft citizens; and having diftinguifhed himfelf by his exploits againft the Mamertines, was unanimoufly elected king of Syracufe, in the year 265 B. C.

62 Is elected king of Syracufe.

Some time after Hiero's acceffion to the throne, he again defeated the Mamertines, and reduced them to fuch ftraits, that they were obliged to call in the Romans to their affiftance. The confequences of this have been fully related under the articles ROME and CARTHAGE. Hiero, who had allied himfelf with the Carthaginians, being himfelf defeated by the Romans, and finding his allies unable to protect him againft the power of that republic, concluded an alliance with them; and continued faithful to them even in the time of the fecond Punic war, when they were in the greateft diftrefs. In his reign flourifhed the celebrated mathematician Archimedes, whofe genius he employed in fortifying the

63 Lives in ftrict friendfhip with the Romans.

Syracuse. the city of Syracuse, by innumerable machines, in such a manner as rendered it absolutely impregnable to every method of attack known at that time.

64 Hieronymus allies with the Carthaginians. Hiero died about 211 B. C. and was succeeded by his grandson Hieronymus: but he imprudently forsook the counsels of his grandfather, and entered into an alliance with the Carthaginians. Soon after this he was murdered, in consequence of his tyranny and cruelty, and the greatest disorders took place in the city; which Hannibal, though then in Italy, found means to foment, in hopes of keeping the Syracusians in his interest. This indeed he effected; but as his own affairs in Italy began to decline *, he could not prevent Marcellus from landing in Sicily with a formidable army, which the Sicilians could by no means resist. Syracuse was soon invested; but the machines invented by Archimedes baffled all attempts to take it by assault. It was 22 miles in compass, and consisted properly of five cities in one, viz. Ortygia, Acradina, Tyche, Neapolis, and Epipolæ.— Ortygia was a small island very near the continent, and might be called the *citadel of Syracuse*, being joined to Acradina by a bridge. The immense preparations which the consul had made for taking the city by storm, could not have failed to accomplish his purpose, had the place been otherwise defended than by the contrivance of Archimedes. The Roman fleet consisted of 60 quinqueremes, besides a far greater number of other ships. The decks were covered with soldiers armed with darts, slings, and bows, to drive the besieged from the ramparts, which on the side of Acradina were washed by the sea, and to facilitate the approach to the walls. But a machine of Marcellus's own invention was what he chiefly depended on. He had fastened together sidewise eight galleys of different lengths, which made but one large body, and were rowed only by the oars of the outermost galleys. These eight galleys thus joined, served only as a basis for a machine, which was raised up higher than the highest towers of the walls, and had at the top a platform guarded with parapets in front and on each side. This machine was called a *sambuca*, from its resemblance to a musical instrument of that name, not unlike an harp. The consul's design was to bring his sambuca to the foot of the walls of Acradina; but, while it was at a considerable distance (and it advanced very slow, being moved only by two ranks of rowers), Archimedes discharged from one of his engines a vast stone, weighing, according to Plutarch's account, 1250 pounds, then a second, and immediately after a third; all which, falling upon the sambuca with a dreadful noise, broke its supports, and gave the galleys upon which it stood such a violent shock that they parted, and the machine which Marcellus had raised upon them at a vast trouble and expence was battered to pieces. At the same time, several other machines, which were not visible without the walls, and consequently did not lessen the confidence of the Romans in the assault, played incessantly upon their ships, and overwhelmed them with showers of stones, rafters, and beams pointed with iron; insomuch that Marcellus, being at a loss what to do, retired with all possible haste, and sent orders to his land-forces to do the same; for the attack on the land-side was attended with no better success, the ranks being broken and thrown into the utmost confusion by the stones and darts, which flew with such noise, force, and rapidity, that they struck the Romans with terror, and dashed all to pieces before them.

Marcellus, surprised, though not discouraged, at this artificial storm, which he did not expect, held a council of war, in which it was resolved, the next day before sun-rise, to come up close under the wall, and keep there. They were in hopes by this means to secure themselves against the terrible storm of stones and darts which fell on the ships when at a distance. But Archimedes had prepared engines which were adapted to all distances. When the Romans therefore had brought their ships close under the wall, and thought themselves well covered, they were unexpectedly overwhelmed with a new shower of darts and stones, which fell perpendicularly on their heads, and obliged them to retire with great precipitation. But they were no sooner got at some distance, than a new shower of darts overtook them, which made a dreadful havock of the men, while stones of an immense weight, discharged from other machines, either disabled or broke in pieces most of their galleys. This loss they sustained, without being able to revenge it in the least on the enemy. For Archimedes had placed most of his engines behind the walls, and not only out of the reach, but even out of the sight, of the enemy; so that the Romans were repulsed with a dreadful slaughter, without seeing the hand that occasioned it; as if they had been fighting, to use Plutarch's expression, not with men, but with the gods themselves. What most harassed the Romans in the attack by sea, was a sort of crow with iron claws, fastened to a long chain, which was let down by a kind of lever. The weight of the iron made it fall with great violence, and drove it into the planks of the galleys. Then the besieged, by a great weight of lead at the other end of the lever, weighed it down, and consequently raised up the iron of the crow in proportion, and with it the prow of the galley to which it was fastened, sinking the poop at the same time into the water. After this the crow letting go its hold all of a sudden, the prow of the galley fell with such force into the sea, that the whole vessel was filled with water, and sunk. At other times, the machines, dragging ships to the shore by hooks, dashed them to pieces against the points of the rocks which projected under the walls. Other vessels were quite lifted up into the air, there whirled about with incredible rapidity, and then let fall into the sea, and sunk, with all that were in them. How these stupendous works were effected, few, if any, have hitherto been able to comprehend.

The troops under the command of Appius suffered no less in this second attack than the fleet. In the whole space of ground which the army, when formed, took up, the last files as well as the first were overwhelmed with showers of darts and flints, against which they could not possibly defend themselves. When they had with infinite trouble brought the mantelets and covered galleries, under which they were to work the rams, near the foot of the wall, Archimedes discharged such large beams and stones upon them as crushed them to pieces. If any [illegible] Roman ventured to draw too near the wall, iron hooks w[illegible] let down from above, which, taking hold of his [illegible] some part of his body, lifted him up in the air and dashed out his brains with the fall. Marcellus, though at a loss what to do, could not however forbear expressing himself with pleasantry: Shall we permit, said he to his workmen, in making war upon this Briareus, upon this giant with an hundred hands? But the soldiers were so terrified, that if they saw upon the walls only a small cord, or the least piece of wood, they immediately turned their backs and fled, crying out, that Archimedes was going to discharge some dreadful machine upon them.

The consuls, finding themselves thus defeated in every attempt, turned the siege into a blockade, reduced most of the other places in the island, and defeated the forces which were sent against them; and at last Marcellus made himself master of Syracuse itself, of which the following account is given by Mr Hooke. "He took the opportunity of a festival, when the soldiers and citizens had drunk plentifully, to make a detachment scale the walls of Tyche, in that part of

Left margin notes: 65 Syracuse invested. 66 [illegible] force [illegible] Romans by sea and land. 67 Machine invented by Marcellus. 68 Destroyed by Archimedes. 69 Incredible effects of machines of Archimedes.

Right margin notes: The siege turned to a blockade. Mr Hooke's account of the taking of Syracuse.

Syracuse.

of it which was nearest to Epipolæ, and which was ill guarded. He presently after possessed himself of Epipolæ; whereupon the inhabitants of Neapolis, as well as Tyche, sent deputies to him, and submitted. Marcellus granted life and liberty to all of free condition, but gave up those quarters of the city to be plundered.

"Notwithstanding this, there was a great deal yet to do. Acradina and Ortygia, which were strongly fortified, still held out; Hippocrates and Himilco arrived with their troops to the relief of the besieged; and the Romans were forced to exert all their bravery and skill to maintain the advantages they had gained.

"But now a plague made terrible havock in both armies. At the first breaking out of the pestilence, the Sicilians, who served under Hippocrates and Himilco, disbanded themselves, and returned to their respective homes; but all the Carthaginian soldiers perished, together with those two generals. The Romans suffered less by the infection; because, having been a long time before Syracuse, they were seasoned to the air and water of the country.

"About this time Bomilcar arrived on the coast of Sicily from Carthage, with a fleet of 130 galleys and 700 ships of burden; but was long hindered by contrary winds from doubling the cape of Pachynum. Epicydes, fearing the Carthaginian might sail back to Africa, left the command of Acradina to the generals of the mercenaries, and went to Bomilcar, in order to persuade him to fight the Roman fleet. The admiral would not engage, but sailed away to Tarentum with all his galleys, ordering his ships of burden to return to Africa. Epicydes, thus frustrated of his hopes, and knowing himself unable to defend a city already half taken, retired to Agrigentum; whereupon the Syracusians massacred the commanders appointed by him, chose new prætors to govern in the town, and sent deputies to Marcellus to treat of peace. In the mean time, the deserters, fearing to be given up to the vengeance of the Romans, persuaded the mercenaries that they also would have the same fate. Instantly the soldiers ran to arms, put to death the new prætors, together with many of the Syracusians, and plundered part of the city. After this slaughter they chose six generals, three to command in Acradina, and three in Ortygia. Upon the return of the deputies from Marcellus, the mercenaries finding that their case was different from that of the deserters, and that there was no design against their lives, became perfectly satisfied, and the negotiation went on. During the course of the treaty, Marcellus found means to corrupt Mericus, a Spaniard, one of the six generals chosen by the soldiers, and engaged him to admit the Romans into that part of the city where he commanded. Mericus, the better to accomplish this design, feigned an extraordinary zeal for the preservation of that place; pretended not to like that deputies should have leave to go out and in at pleasure; and proposed, that for the greater security of the town, each general should have a distinct quarter assigned him, and be responsible for any neglect of duty in it. The motion was agreed to; and upon the division, that district of Ortygia which extended from the fountain of Arethusa to the mouth of the great port fell to his care. Marcellus, informed of what was done, took his measures accordingly. He sent a body of troops to that side where Mericus commanded, and the Spaniards admitted them at the gate of Arethusa. At the same time, the proconsul ordered a false attack to be made on Acradina; which drawing almost all the soldiers of the garrison thither, Ortygia was in a manner left defenceless. Foreseeing this, he had detached another party of soldiers to take advantage of it. These entered Ortygia almost without fighting; upon which the deserters made their escape, the Romans giving them way; and the Syracusians in Acradina, thus delivered from the fear of the deserters, immediately opened their gates to Marcellus, who thereby became master of the whole city.

7:
The city plundered, and Archimedes killed.

"And now the conqueror, who is said to have wept during the siege with compassion for the inhabitants, gave up both Ortygia and Acradina to be plundered by his army, after he had secured the late king's treasures for the use of his republic, and the statues, paintings, and principal ornaments of Syracuse to illustrate his triumph. The soldiers had orders to spare the lives of the citizens; but they were cruel in their avarice, slew many of them, and among the rest the incomparable Archimedes. He was very intent on a demonstration in geometry, and calmly drawing his lines, when a soldier entered the room, and clapped a sword to his throat. "Hold! (said Archimedes) one moment, and my demonstration will be finished." But the soldier, equally regardless of his prayer and his demonstration, killed him instantly. There are different accounts of the manner of his death; but all agree that Marcellus regretted it extremely, and showed a singular favour to his relations for his sake."

7
Syracuse destroyed by the Saracens.

The city of Syracuse continued subject to the western empire till its declension, when the island of Sicily, being ravaged by different barbarians, the capital also underwent various revolutions; till at last, in the 9th century, it was so destroyed by the Saracens, that very few traces of its ancient grandeur are now to be seen. "The ancient city of Syracuse was of a triangular form, and consisted of five parts or towns. The circuit, according to Strabo, amounted to 180 stadia, or 22 English miles, and four furlongs. An account (says Mr Swinburne) which I once suspected of exaggeration; but, after spending two days in tracing the ruins, and making reasonable allowances for the encroachments of the sea, I was convinced of the exactness of his measurement.

Travels in the two Sicilies, vol. ii. p. 327, &c.

"At present it is strongly fortified towards the land, and the ditches of the bastions form the communications between the two havens. It is very weak towards the sea, but the shelves render it hazardous to debark on that side. The garrison is one of the best appointed in the kingdom, but the heights of Acradina command the works.

"About eighteen thousand inhabitants are now contained in it. The dwellings are far from being memorials of ancient Syracusan architecture or opulence. In any other situation they might be thought tolerable; but to observers who reflect on the style of those buildings that probably once covered the same ground, the present edifices must have a mean appearance. The ancient temple of Minerva is now turned into a cathedral. The walls of the cella are thrown down, and only as much left in pillars as is necessary to support the roof; the intercolumniations of the peristile are walled up. This temple is built in the old Doric proportions used in the rest of Sicily; its exterior dimensions are 185 feet in length and 75 in breadth. There are also some remains of Diana's temple, but now scarcely discernible. Besides these, there are few ruins in the island; and one is surprised that any should exist in a place which has been so often laid waste by enemies, and so often shaken by earthquakes.

"Every object here imprints a melancholy sensation on the mind, while it draws a comparison between the present humble state of things and their once flourishing condition. The ancients have left pompous descriptions of the traffic carried on in this well situated port, the almost incredible wealth possessed by its citizens, and the splendid edifices upon which they lavished a great part of their riches. I had already viewed (says Mr Swinburne) the desert sites of

of many great ancient cities, and had as often mourned over their remains, but never did I feel the impreſſion of pity and regret ſo ſtrong as in wandering among the ruins of Syracuſe."

SYRIA, a very ancient kingdom of Aſia, lying between the Mediterranean on the weſt, the Euphrates on the eaſt, and Arabia Deſerta, Phœnicia, and Paleſtine, on the ſouth.

In ancient times this country was called *Aram*, from Aram the youngeſt ſon of Shem, who ſettled here; but in proceſs of time the name came to be changed into *Syria*, from one *Syrus*, according to ſome; though others think it is only a contraction of the word *Aſſyria*. At firſt it was undoubtedly parcelled out into ſeveral petty ſtates; all of which ſeem afterwards to have been reduced under ſubjection to the four principal ones, Zobah, Damaſcus, Hamath, and Geſhur. Afterwards the whole country was divided into two parts only, viz. Cœleſyria and Phœnicia; though the Phœnicians, Idumeans, Jews, Gazites, and Azotites, or the whole country of the Philiſtines, was included. After the death of Alexander, Syria, in the great extent of the word, was divided, according to Strabo, into Comagene, Seleucis of Syria, Cœleſyria, Phœnice on the ſea coaſt, and Judea in the midland. Ptolemy, however, ſubdivides theſe; and in the Proper Syria reckons only Comagene, Pieria, Cyrrhiſtica or Cyrrheſtica, Seleucis, Caſſiotis or Caſiotis, Chalybonitis Chalcidice or Chalcidene, Apamene, Laodicene, Phœnicia Mediterranea, Cœleſyria and Palmyrene.

The hiſtory of the ancient Syrians, till the time of their being carried away by the kings of Aſſyria, is totally unknown, excepting a few particulars which may be gathered from Scripture, and which it is needleſs here to repeat. During the continuance of the Aſſyrian, Babylonian, and Perſian monarchies, the hiſtory of this country affords nothing remarkable; but after the death of Alexander, it gave name to a very conſiderable empire, which makes a conſpicuous figure in ancient hiſtory. At this time, however, it was not confined to Syria properly ſo called, but comprehended all theſe vaſt provinces of the Upper Aſia which formed the Perſian empire; being, in its full extent, bounded by the Mediterranean upon one ſide, and the river Indus on the other. The firſt king was Seleucus, one of the generals of Alexander the Great; who, after the death of that conqueror, being made governor of Babylon, was tempted, by the example of Alexander's other captains, to ſet up for himſelf. Eumenes, who had ſincerely at heart the intereſt of Alexander's family, ſolicited his aſſiſtance againſt Antigonus, who had openly revolted; but Seleucus not only refuſed this aſſiſtance, but attempted to deſtroy Eumenes himſelf with his whole army, by cutting the ſluices of the Euphrates, and laying under water the whole plain where they were encamped. Eumenes, however, found means to eſcape the danger without the loſs of a man. Upon this Seleucus endeavoured to gain over his troops: but finding that impoſſible, he made a truce with Eumenes, and granted him a ſafe paſſage through his province; but at the ſame time ſent an expreſs to Antigonus, deſiring him to fall upon him before he was joined by the governors of Upper Aſia. Antigonus did not fail to follow his advice; but having prevailed againſt Eumenes through treachery, he next thought of bringing Seleucus himſelf under ſubjection. On his return to Babylon, therefore, after having been feaſted with his whole army by Seleucus, he demanded of him an account of the revenues of his province. Receiving an unfavourable anſwer to this queſtion, Antigonus was ſo much exaſperated, that Seleucus, not thinking himſelf a match for him at that time, thought proper to fly into Egypt.

By the flight of Seleucus, Antigonus was left maſter of all his provinces; but his ſon Demetrius being afterwards defeated by Ptolemy at Gaza, Seleucus began to think of recovering what he had loſt. Being furniſhed by Ptolemy with 1000 foot and 200 horſe, he ſet out with that ſlender force to attempt the recovery of Babylon. Nothing could have a more deſperate appearance than this undertaking; yet Seleucus was not diſcouraged. On his arrival at Carrhæ in Meſopotamia, partly by force and partly by perſuaſion, he prevailed on the Macedonians who garriſoned that place to revolt from Antigonus and join him. Being thus reinforced, he entered the territories of Babylon, where new ſupplies were continually added to his army; his ancient ſubjects flocking to him from all parts, and declaring themſelves ready to ſtand by him with their lives and fortunes. This happened in conſequence of the lenity with which they had been treated by Seleucus; whereas Antigonus was univerſally deteſted on account of his ſeverity.—As he approached the city, those who favoured Antigonus retired into the citadel, but were ſoon obliged to ſurrender; and in that fortreſs Seleucus found his children, friends, and domeſtics, whom Antigonus had kept priſoners ever ſince his flight into Egypt.

Syria. 5 Attempts the recovery of Babylon with a very ſlender force.

6 Becomes maſter of the city.

Seleucus having thus made himſelf maſter of Babylon, in the year 312 B. C. began to prepare for encountering Antigonus, who he knew would ſoon attack him with all his force. Nicanor, governor of Media under Antigonus, firſt advanced againſt him at the head of 10,000 foot and 7000 horſe; but Seleucus, with only 3000 foot and 400 horſe, having drawn him into an ambuſh, cut off almoſt the whole of his army, and ſuch of the ſoldiers as had eſcaped the ſlaughter willingly enliſted under his banner.

7 Defeats Nicanor, and reduces Media and Suſiana.

The conſequence of this victory was the ſubmiſſion of all Media and Suſiana; which alarming Antigonus, he ſent his ſon Demetrius with an army of 5000 Macedonian foot, 10,000 mercenaries, and 4000 horſe. Seleucus was then in Media; and Patrocles, whom he had left to take care of Babylon, finding his force inadequate to that purpoſe, compelled the inhabitants to leave the city and diſperſe themſelves in the adjacent countries, while he himſelf, with what troops he had, retired into two forts, which he thought could eaſily be defended. When therefore Demetrius entered Babylon, he was ſurpriſed to find it deſerted, upon which he inſtantly attacked the forts. One was quickly reduced; but as the other held out till the expiration of the time which had been allowed him by his father, he left 5000 foot and 1000 horſe under the command of Archelaus to carry on the ſiege. With the reſt he marched away, ſuffering his ſoldiers to live at diſcretion as he went along; which ſo provoked the Babylonians, that they were ever after attached to Seleucus as if he had been their natural prince.

On the return of Seleucus to Babylon, he eaſily drove out the troops left by Antigonus, recovered the caſtle which he had garriſoned, and ſettled his authority on ſuch a firm foundation, that it could never afterwards be moved. Having then marched again into Media, he defeated and killed with his own hand Nicanor or Nicator, whom Antigonus had ſent againſt him; after which, having ſettled the affairs of Media, he reduced all Perſia, Bactria, and Hyrcania, ſubjecting to his new empire theſe and all the other provinces on this ſide the Indus which had been conquered.

8 Nicanor again defeated and killed.

Seleucus being now maſter of all the countries which lie between the Euphrates and the Indus, took the title of king of Babylon and Media. But, not ſatiſfied with theſe poſſeſſions, ample as they were, he croſſed the Indus, in order to conquer thoſe regions which had ſubmitted to Alexander beyond that river. But, during the time that the generals of Alexander had been making war upon his family and up-

Syria.

on one another, one Sandracottus, a native of India, had driven out the Macedonians, and made himself master of the
9 Cedes India to Sandracottus for 500 elephants.
whole country. He opposed Seleucus with an army of 600,000 men, and a prodigious number of elephants; which intimidated the Macedonian so much, that he offered to leave Sandracottus in quiet possession of his dominions, provided he would furnish him with 500 elephants. To this Sandracottus readily assented; upon which Seleucus
10 Defeats Antigonus, and builds many cities.
marched back into the west against Antigonus, and, in conjunction with Lysimachus and Ptolemy, engaged and totally defeated and killed him at Ipsus. After this Seleucus marched into Upper Syria, which he reduced entirely, and built the city of Antioch on the Orontes. In the same country he built several other cities; one of which he called *Seleucia*, from his own name; another *Apamea*, from his wife Apama, the daughter of one Artabazus a Persian; and a third *Laodicea*, from his mother Laodice. He first entered into an alliance with Demetrius, and married Stratonice his daughter; but soon after assisted Lysimachus and Ptolemy to deprive him of the best part of his dominions. Thus Demetrius being reduced so low that he could give him no farther jealousy, Seleucus betook himself to the building of another city, which he called likewise *Seleucia*, and which stood on the place where the city of Bagdad now stands. Besides these, he built a great many others; 16 of which he called *Antioch*, from the name of his brother Antiochus; nine *Seleucia*, from his own name; three *Apamea*, from Apama his first wife; one *Stratonicea*, from his second wife Stratonice; and six *Laodicea*, from his mother Laodice.

In 284 Seleucus entered into a war with Lysimachus, with whom he had hitherto lived in strict amity. Out of 36 general officers left by Alexander the Great, they two only survived, and both were upwards of 70 years old. Nevertheless they were both filled with the ambition and animosity of young men. The two armies met at a place called *Curopedion* in Phrygia, where an obstinate engagement
11 Defeats and kills Lysimachus.
took place. Victory was long doubtful: but at last Lysimachus was run through with a spear, and died on the spot; on which his troops betook themselves to flight, and left Seleucus master of their baggage. This victory added to the possessions of Seleucus all those provinces which had formerly been subject to Lysimachus. The former exulted much in his good fortune; being chiefly pleased that he was now the last of Alexander's captains, and by this victory became, as he styled it, *the conqueror of conquerors*; and on this account he is generally called *Nicator*, or *the conqueror*.
12 Is himself treacherously murdered.
His triumph, however, on this occasion, was but short-lived; for, seven months after, as he was marching towards Macedon to take possession of that kingdom, he was treacherously murdered by Ptolemy Ceraunus, on whom he had conferred innumerable favours. Philetærus prince of Pergamus purchased his body at a great price from Ptolemy, and sent it to his son Antiochus; who, with extraordinary pomp, burned it in Seleucia on the sea-coast, erecting on the place a magnificent chapel, which he called from his surname *Nicatorium*.

13 Antiochus Soter.
Seleucus was succeeded by his son Antiochus Soter, who held the empire 19 years. He resigned to Antigonus Gonatus all pretensions to the crown of Macedon; and having engaged in a war with Eumenes king of Pergamus, he was defeated by him, and obliged to yield up part of his dominions.
14 Antiochus Theos.
He died in 261 B. C. and was succeeded by his son Antiochus Theos; who having engaged in a war with Ptolemy Philadelphus king of Egypt, the Parthians and Bactrians took an opportunity to revolt, and could never afterwards be reduced. In 246 B. C. he was poisoned by his wife Laodice, whom he had divorced for Berenice daughter to Ptolemy, with whom he made peace on the revolt of the Bactrians. On the death of Ptolemy, Antiochus divorced Berenice, and took back Laodice; who, to secure herself against the effects of his fickle disposition, poisoned him, as we have just mentioned, and raised to the throne her own son, named *Seleucus Callinicus*. Not thinking herself 15
safe, however, as long as Berenice lived, Laodice began immediately to concert measures for putting both her and her son to death. Berenice attempted to save herself by retiring to Daphne, where she shut herself up in an asylum built by Seleucus Nicator. There she was closely besieged by the sons of Seleucus; of which the cities of Asia having intelligence, formed a confederacy in her favour. Her brother the king of Egypt also hastened to her relief with a considerable army; but before either of these could come to her assistance, both she and her son were barbarously murdered, with all the Egyptians who attended them.

Ptolemy, on hearing the melancholy news of his sister's 16
death, determined to take the most severe vengeance on her murderers. Joining his forces to those of the Asiatics, he carried every thing before him. Having in the first place put an end to the life of Laodice, he made himself master of all Syria and Cilicia; then passing the Euphrates, he subdued all the country as far as Babylon and the Tigris; and had not the progress of his arms been interrupted by a sedition which obliged him to return to Egypt, it is more than probable that he would have subdued the whole Syrian empire. As soon as he was returned, Seleucus attempted to revenge himself; but his fleet being destroyed by a violent storm, and his land-army defeated by Ptolemy, he concluded a truce for ten years. During all this time the Parthian prince had established himself so firmly on the throne, that it was in vain to think of dispossessing him. However, as soon as his other affairs would permit, Seleucus undertook 17
an expedition against Arsaces the Parthian monarch; by whom he was utterly defeated, taken prisoner, and carried into Parthia, where he died four years after. He was succeeded by his eldest son Seleucus Ceraunus, a weak prince, who was poisoned by a conspiracy of two of his officers, when he had reigned one year; after which his brother Antiochus, surnamed the *Great*, ascended the throne in 225 B. C.

In the very beginning of his reign, two of his generals, 18
Alexander and Molo, rebelled against him. The former had been appointed governor of Persia, and the latter of Media; but they, despising the king's youth, refused to obey. The occasion of this revolt is said to have been their dread of the cruelty of Hermias the king's prime minister; and as they hoped to draw into their schemes Achæus governor of the provinces of Asia Minor, they doubted not of success. In this, however, they failed; but this did not discourage them from proceeding in their rebellion. Epigenes, the commander of the troops about the king's person, advised him to march without delay against the rebels; but as Hermias reproached him with treachery and a design to betray the 19
king into the hands of his enemies, Antiochus sent two of his generals into the east, while he himself undertook an expedition against Ptolemy Philadelphus, with a view of recovering Cœlesyria. In this attempt, however, he was disappointed; and the generals whom he had sent into the east were totally defeated, and their troops cut off: upon which he determined to lay aside for the present his Syrian enterprise, and march in person against the rebels. This was again opposed by Hermias; but as he found it impossible to alter the king's mind, the treacherous minister found means to get Epigenes the author of this project executed, under pretence of holding a correspondence with Molo one of the rebel chiefs. Antiochus in the mean time pursued his

his march against the rebels, whom he defeated in a pitched battle; upon which their chiefs laid violent hands on themselves. On his return he received the submission of the Atropatii, a barbarous people in Media; and put to death his prime minister Hermias, whom he found hatching treacherous designs against him. During his lifetime, however, the traitor, by accusing Achæus of treason, had obliged him to revolt in his own defence; so that the king had still two important wars on his hands, viz. that with Ptolemy king of Egypt, and the other against Achæus. After some deliberation, he resolved to march first against the king of Egypt; and was at first very successful, reducing many cities in Cœlesyria and Palestine, and defeating the Egyptians in a pitched battle: but in the year 217 B. C. being worsted in the battle of Raphia, he was obliged to abandon all his conquests; of which Ptolemy immediately took possession, and Antiochus was obliged to cede them to him, that he might be at leisure to pursue the war against Achæus.

Antiochus having made vast preparations for his expedition, soon reduced Achæus to such distress, that he was obliged to shut himself up in the city of Sardis, which he defended for some time with great bravery; till at last, being betrayed by two Cretans, he was delivered up to the king, and by his order put to death. Antiochus then undertook an expedition against the Parthians, whom he obliged to conclude a peace on very advantageous terms. He then turned his arms against the king of Bactria, whom he also compelled to agree to his terms; one of which was, that he should give him up all his elephants. For the confirmation of the treaty, the king of Bactria sent his son to Antiochus; who being taken with his majestic mien and agreeable conversation, gave him one of his daughters in marriage. He then crossed Mount Caucasus, and entered India; where having renewed his alliance with the king of that country, he received also of his elephants, which increased his stock to 150. From India he marched into Arachosia, Drangiana, and Carmania, establishing order and discipline in all those countries: then passing through Persia, Babylonia, and Mesopotamia, he returned to Antioch, after an absence of seven years.

In the year 204 B. C. Antiochus entered into a league with Philip of Macedon, on purpose to deprive Ptolemy Epiphanes, the infant king of Egypt, of all his dominions. The Egyptians, however, put the young king under the tuition of the Romans; who immediately required the confederate princes to desist from any enterprise against the king of Egypt, under the penalty of incurring the displeasure of the republic. After delivering this message, M. Emilius Lepidus, one of the ambassadors, repaired to Egypt, where he took upon himself the office of regent and guardian to the young king. Having regulated affairs there in the best manner he could, he returned to Rome, after having appointed one Aristomenes, an Acarnanian, to be chief minister to the king. Aristomenes being a man of prudence and fidelity, acquitted himself very well in his new station. Having taken care to recruit his army as well as he could, he sent one Scopas, a man of great authority among the Ætolians, into that country, to raise auxiliaries. Scopas soon raised an army of 6000 Ætolians, at that time reputed the best soldiers in the world; and having joined the Egyptian army, reduced all Judea, put a garrison into the castle at Jerusalem, and, on the approach of winter, returned to Alexandria loaded with booty. These exploits, however, were performed when Antiochus was absent in Asia Minor; and no sooner was he returned, than the face of affairs was changed. Scopas was defeated in a pitched battle, where one half of his men were destroyed. He himself escaped to Sidon, where he shut himself up with 10,000 of his soldiers; but Antiochus having invested the place, Scopas was reduced to the necessity of surrendering at discretion. The king pursued his conquests; recovered all Palestine and Cœlesyria; after which he invaded Asia Minor, in hopes of reducing it also, and restoring the Syrian empire to the same extent it had in the time of Seleucus Nicator. The free cities in Asia Minor immediately had recourse to the Romans, who sent an embassy to Antiochus on the occasion; but as both parties put on those haughty and imperious airs to which they thought the greatness of their power gave them a right, no satisfaction was given. but every thing tended to an open rupture. While matters were in this situation, Hannibal the Great being obliged to leave his own country, fled to Antiochus; from whom he met with a gracious reception. As Hannibal had, while a child, sworn perpetual enmity against the Romans, he used all his eloquence to persuade Antiochus to make war with them; and as the many victories which he had gained over them left no room to doubt of his capacity, Antiochus doubted nothing of being able, by his assistance, to conquer that haughty people. Several embassies passed between the two nations; but chiefly with a design, on the part of Antiochus, to gain time. Hannibal endeavoured to draw his countrymen into the confederacy against Rome, but without effect. Antiochus having strengthened himself by several alliances, at last resolved to begin the war in earnest. To consult on the measures proper to be taken, he called a council of war; but excluded from it the only man whose advice he ought to have followed; namely, Hannibal the Carthaginian. The reason of this was, that he had become jealous of him from the too great intimacy, as he thought, which he had kept with the Roman ambassadors. However, in this council it was agreed that the war should be immediately commenced. The King himself was prevailed upon by the Ætolians to pass over into Greece, and at the same time entirely to reject the advice which Hannibal had formerly given, of sending him with an army into Italy. Here he was made generalissimo of all the Greek forces; but made none of those efforts that had formerly obtained him the title of Great. Indeed it now plainly appeared, not only that he was incapable of carrying on war against such enemies as the Romans, but even of accepting proper advice when it was given him. In another council, into which Hannibal was admitted, that commander advised the king, before he undertook any thing else, to use his utmost endeavours to gain over Philip of Macedon; which, he said, was a step so important, that if it could be gained, they might, without much ado, become masters of all Greece. But if Philip could not be prevailed on to make war on the Romans, he was of opinion that the king should send his son Seleucus into Macedon at the head of an army, and thus prevent Philip from giving the Romans any assistance. But he still maintained, that the only way to defeat the Romans was to send an army into Italy. This advice was again rejected; and the king imprudently became the aggressor, by falling on a body of 500 Romans before war had been declared. He also made king Philip his enemy, by entertaining the regent of Athamania, who was a pretender to the crown of Macedon. To complete all, he himself fell in love, tho' above 50 years of age, with a beautiful young woman of Chalcis, whom he married; and became so great a slave to this passion, that he entirely neglected his affairs; the army gave themselves up entirely to dissipation and debauchery, and every trace of military discipline vanished.

In the year 191 B. C. Antiochus was raised from his lethargy by a declaration of war against him at Rome, and set out for Ætolia. His army at this time amounted to no more than 10,000 foot and 500 horse. He had been made so

Syria.

25 His conquests checked by the Romans.

26 Hannibal flees to him for protection.

27 Antiochus neglects the advice of Hannibal.

28 His infamous behaviour.

29 Is defeated by the Romans at Thermopylæ.

to believe that he would receive a vast reinforcement in Ætolia: but when he came to make the experiment, he soon found his mistake; all the troops he could raise there amounted to no more than 4000 men. With this force, so exceedingly inadequate to the purpose, he was obliged to oppose the Roman army, who were advancing in conjunction with the Macedonians, and had already made surprising progress. Antiochus seized the Straits of Thermopylæ; but was driven from them by the Romans, the king himself being the first that fled. Almost his whole army was destroyed in the battle or in the pursuit, and Antiochus returned with disgrace into Asia.

30 His fleet defeated by that of the Romans.

Soon after his return, Antiochus equipped a fleet of 200 sail; on which he immediately embarked for the Thracian Chersonesus, now Crim Tartary, where he fortified the cities of Lysimachia, Sestus, and Abydos, with others in that neighbourhood, to prevent the Romans from crossing the Hellespont. In the mean time Polyxenidas the Syrian admiral sent intelligence to the king that the Roman fleet had appeared off Delos; upon which he desired him to seek them out and engage them at all events. He did so, and was defeated with the loss of 40 ships taken or sunk in the engagement. This was soon after revenged by the destruction of the Rhodian fleet by the artifice of Polyxenidas; but in the end the king's affairs went everywhere to wreck. Having laid siege to the city of Pergamus, he was obliged to

31 Meets with two other defeats, and becomes like one infatuated.

raise it with loss; the Phœnician fleet commanded by Hannibal was defeated by the Rhodians; and soon after the Syrian fleet under Polyxenidas was utterly defeated by the Romans. Antiochus was so much disheartened by these repeated defeats, that he appeared like one infatuated. Instead of fortifying more strongly those cities which lay on the frontiers of his kingdom, he entirely deserted them: and thus Lysimachia and Abydos, the two keys to Asia, fell into the hands of the Romans without the least resistance.

32 Sues for peace, but is refused.

The arrival of the Romans in Asia struck Antiochus with such terror, that he instantly sued for peace. The terms he offered were indeed very advantageous, but by no means agreeable to the expectations of the Romans. They therefore gave him this final answer: 1. That since he had drawn upon himself the war, he should defray the whole expence of it; 2. That he should restore liberty in general to all the Greek cities in Asia; and, 3. That to prevent future hostilities, he should relinquish all Asia on this side Mount Taurus. These terms, however, still appeared to him so intolerable, that he resolved to continue the war; and determined also to take the most imprudent method of carrying it on, namely, by hazarding all on the event of a general engagement. The king encamped near Magnesia, and strongly fortified his camp. The Romans insulted him in his trenches, and proposed to attack his fortifications if he continued to decline an engagement. At last the king, thinking it would be shameful for him longer to refuse an engagement, being at the head of an army far more numerous than that of the enemy, in a friend's country, and in the midst of his allies, resolved at all events to accept the challenge, and accordingly prepared for a decisive battle.

33 Battle of Magnesia.

The Roman army consisted of four legions, partly Romans and partly Latins, each legion at this time containing 5500 men, and of 7000 auxiliaries sent by the kings of Pergamus and Macedon; but of these 2000 were ordered to guard the camp during the action. The Romans were posted in the centre, and the Latins in the two wings, the left of which extended to the river. On the side of the right wing, to cover and support it, the consul posted the auxiliary troops of Eumenes, a small body of horse, and some Trallians and Cretans lightly armed. Sixteen elephants which the Romans had were placed behind the army by way of corps-de-reserve, the consul not thinking it proper to oppose them to those of the enemy, which were far more numerous, being in all 52, and besides excelled the Roman elephants in strength, height, and courage, the former being brought from India and the latter from Africa. As for the Syrian army, all the nations of the east seemed to be assembled to support the cause of Antiochus. But the main strength of it consisted in 16,000 foot, armed after the Macedonian manner, who composed the phalanx. This body faced every way, was armed with long pikes, and taught to fight in close order, as the soldiers of Alexander the Great had formerly been. Antiochus did not draw up his phalanx as usual, but divided it into 10 companies separated from each other, placing, in the spaces between each of the companies, an elephant loaded with a tower full of armed men. On the right of the phalanx was drawn up in a line part of the cavalry, viz. 1500 Asiatic Gauls, 3000 horse armed cap-a-pee and 1000 more, the flower of the Median cavalry. At some distance from these followed the cavalry of the king's household richly clothed, and wearing bucklers plated over with silver. In the same line 1200 Scythians on horseback, armed with bows and arrows, made a great figure, being all chosen men, and of an extraordinary size. The light-armed troops, to the number of 3000, partly Trallians and partly Cretans, with 1,000 Mysian archers and 4000 men more, partly Cyrtæans armed with slings, partly Persians armed with bows, and partly Arabians mounted on dromedaries, closed the right wing, which was led on by the king in person, surrounded by a body of Syrians and Lydians well mounted, but not heavily armed. The left wing was commanded by Seleucus and Antipater; the former the king's son, and the latter his nephew, and disposed thus: Close to the phalanx were posted 1500 Galatians and 2000 Cappadocians, which king Ariarathes had sent to the assistance of his father-in-law. Next to these were placed 2700 auxiliaries sent from different countries; these were followed by 300 cuirassiers well mounted; and, lastly, in the flank of this wing marched 2000 horse lightly armed. At some distance were placed several small bodies of light-armed troops both foot and horse; among which were 2500 Galatian horse, some Tarentines, Cretans, Carians, Cilicians, &c. The phalanx, which was in the centre, was commanded by three officers of distinction, viz. Minio, Zeuxis, and Philip. A vast number of chariots, armed with hooks and scythes, were drawn up before the first line, as were likewise a great many elephants carrying towers with several floors, all filled with slingers and archers; besides many camels, animals then unknown to the Roman troops, mounted by Arabians armed with swords six feet long, that the riders might from their backs reach the enemy. The Romans had never seen a more numerous army, nor one more finely adorned; nevertheless they never showed so great a contempt for an army as for this which they were now going to attack.

On the day of the battle the weather proved very favourable to the Romans; for a thick fog rising in the morning, the day was almost turned into night, so that the Syrian commanders could not have all the corps under their command in view, on account of their great extent, nor send them proper orders in time; whereas the fog was not thick enough to prevent the Roman generals from seeing their several bodies at the greatest distance, as they took up but little ground. Besides, the damp which was occasioned by the fog slackened the strings of the enemy's bows, so that the Asiatics who used them could shoot their darts and arrows but faintly. The whole dependence of Antiochus in the first attack was on his armed chariots, which were to cut their way into the Roman army. For this purpose they had

had long halberts faſtened to their poles, and ſharp hooks to their axle-trees; the former were about the height of a man's head, and the latter almoſt ſwept the ground, and cut off the legs of all who ſtood in their way. But Eumenes undertook to render them uſeleſs, and even fatal, to the enemy. This brave prince, putting himſelf at the head of the bowmen and ſlingers, ordered them to charge, not in a body, but divided in platoons, and to aim only at the horſes in the chariots. Accordingly, as ſoon as the chariots moved, Eumenes advanced at the head of his men, who pouring on them from every quarter darts, ſtones, and javelins, and at the ſame time ſhouting as loud as they could, ſo frightened the horſes that they could no longer be kept in order, but ſcouring up and down, and turning againſt their own troops, fell on the Arabians who ſupported them, which occaſioned a great confuſion in that quarter. Thoſe in the Syrian army who were at a diſtance, hearing the noiſe and outcries, and not knowing the cauſe of them, were ſtruck with no ſmall terror. After this advantage, the Roman cavalry advanced, and fell on thoſe whom the chariots had put in diſorder. The Syrians being already intimidated, after a faint reſiſtance gave way; and the Romans made a great ſlaughter of their men and horſes, both being borne down with the weight of their heavy armour. Eumenes charged the left-wing, in which Seleucus commanded, with ſuch vigour, that he put it to flight; and the fugitives flying to the phalanx for protection, put that body likewiſe in diſorder: which Domitius obſerving, advanced againſt it at the head of his legionaries, but could not break it till he ordered his men to attack the elephants; which, as before obſerved, were placed in the ſpaces between the companies. The Romans had learned, in their wars with Pyrrhus and Hannibal, not to fear thoſe monſters which were once ſo terrible to them. They attacked them, therefore, with great reſolution; and driving them againſt the phalanx, put that body into diſorder, by means of thoſe very animals which had been poſted there for its defence.

But in the mean time advice was brought that the left wing of the Romans was in great danger. Antiochus, who had obſerved that the flanks of the left wing were quite open and uncovered, the four ſquadrons which covered it having joined the reſt of the cavalry to fall upon the enemy's left wing, had charged it at the head of all his auxiliaries, not only in front but in flank. The Roman infantry, ſeeing themſelves in imminent danger of being ſurrounded and hemmed in on all ſides, fled in great diſorder to their camp, which was guarded by 2000 men under the command of a legionary tribune called *Æmilius*. This man ſeeing the Romans flying towards him, marched out at the head of all his troops to meet them; and after having bitterly reproached them for their cowardice and ignominious flight, ordered his men to draw their ſwords, and cut in pieces ſuch as ſhould advance one ſtep farther, or refuſe to face about againſt the enemy. This order, given ſo ſeaſonably, and put in execution without mercy againſt ſome, had the deſired effect. Thoſe who were flying firſt halted; and then, being both reinforced and encouraged by Æmilius, returned under his conduct to wipe off the diſhonour of their flight. At the ſame time Attalus the brother of Eumenes, having left the right wing on his receiving advice that the left was in danger, arrived very ſeaſonably with 200 horſe. Antiochus obſerving that the troops which had fled were returning to the battle, and that the enemy's right wing was ready to fall upon him, turned his horſe about and fled. This ſerved in a manner as a ſignal for the reſt of the troops, for the whole Syrian army immediately turned their backs. Eumenes alone purſued them at the head of the cavalry, and made a moſt dreadful havock of the fugitives. The Romans walking over heaps of dead bodies, eſpecially where the phalanx ſtood, marched up to the Syrian camp, attacked, and plundered it. The riches they found in it are not to be deſcribed: but the taking of it coſt the Romans a new battle, which proved more fatal to the Syrians than that in the field; for the Romans having, in ſpite of a moſt deſperate reſiſtance, forced the intrenchments, gave no quarter, but put all to the ſword without diſtinction. There fell this day in the battle, in the purſuit, and in the plunder of the camp, 50,000 foot and 4000 horſe; 1500 were taken priſoners, and 15 elephants. In the conſular army there were but 300 foot killed and 25 horſe. Eumenes had only 15 of his men killed; ſo that this victory, as we are told by the ancients, ſeemed a prodigy to all nations both of the eaſt and weſt. Syria.

Antiochus retired to Sardis with as many of his forces that had eſcaped the ſlaughter as he could draw together. From Sardis he ſoon marched to rejoin his ſon Seleucus, who had fled to Apamea. As for the conſul, he took advantage of the king's defeat and flight, making himſelf maſter of all the neighbouring countries. Deputies haſtened to him from all parts; the cities of Thyatira, Magneſia, Trallis, Magneſia in Caria, all Lydia, and Epheſus itſelf, though highly favoured by Antiochus, declared for the Romans. Polyxenidas, upon the news of the king's defeat, left the port of Epheſus, and ſailed to Patara, where he landed with a very ſmall guard, and returned by land into Syria. The conſul took the road to Sardis, which opened its gates to him. As he ſtopped there, his brother Africanus, as ſoon as his health allowed him, came and joined him in that city, and congratulated him on the glory he had ſo lately acquired.

Antiochus finding his affairs in a bad ſituation both by ſea and land, and not daring to appear before the conſular army in the field, ſent Antipater his brother's ſon, and Zeuxis, who had been governor of Lydia and Phrygia, to ſue for a peace. They were ordered to treat chiefly with the elder brother, of whoſe clemency and good nature Antiochus entertained a high opinion. Accordingly, on their arrival at Sardis, where the conſul then was with his brother, they addreſſed the latter, and were by him preſented to the conſul. Their ſpeech was very ſubmiſſive, and ſuch as became a vanquiſhed people.

Hereupon a council was ſummoned, and after long debates the ambaſſadors were called in; and Scipio Africanus being deſired by the conſul to acquaint the deputies with the reſolutions of the aſſembly, is ſaid to have expreſſed himſelf in the following terms: "We are ſenſible that the victory which we have lately gained is owing to the gods, and therefore ſhall treat the vanquiſhed with moderation, demanding little more of them now than we did at our firſt entering into Aſia. Antiochus ſhall obtain a peace upon the following terms: That he give up his pretenſions to Europe, confine his dominions to Aſia beyond Mount Taurus; and that he pay 15,000 Euboec talents for the expences of the war; 500 down, 2500 when the ſenate and people ſhall confirm the articles, and 1000 more every year for 12 years together. We alſo inſiſt upon his ſatisfying king Eumenes, and his paying him the 400 talents he owes him, and what remains due for the corn which his father ſent to the king of Syria. It is likewiſe the pleaſure of the council that you deliver up to us Hannibal the Carthaginian, Thoas the Ætolian, Mneſilochus the Acarnanian, and Philo and Eubulus two Chalcidians; for theſe have been the authors of our diviſions, the incendiaries who kindled the preſent war. Laſtly, the king of Syria, for a further proof of his ſincerity, ſhall give us 20 ſuch hoſtages as we ſhall chooſe, of whom Antiochus his youngeſt ſon ſhall be one."

37 Antiochus obtains peace upon very hard terms.

The

Syria. The ambaſſadors of Antiochus had been ordered to refuſe no terms, and there ore theſe were accepted, and the whole affair concluded. So that the Syrian ambaſſadors now prepared to ſet out for Rome, to get the conditions of peace propoſed by Scipio ratified there. In the mean time, the conſul dividing his army into three bodies, put it into winter-quarters; one part continued at Magneſia, another was ſent to Trallis, and the third to Epheſus, where the Scipios took up their quarters. There they received a new embaſſy from Antiochus, with the hoſtages he had promiſed, the Roman priſoners and deſerters, and the ſtrangers which the conſul had demanded, except Hannibal, who after the king's defeat had fled out of his dominions; and Thoas the Ætolian, who, as ſoon as he heard that a treaty was on foot between Antiochus and the Romans, had returned to Ætolia, where a war was likely to break out between that republic and Rome. L. Aurelius Cotta was ſent with the ambaſſadors to Rome, to acquaint the ſenate with the particulars of the treaty. When they appeared before the conſcript fathers, they ſpoke with great ſubmiſſion, and only deſired them to ratify the articles which the Scipios had offered to their maſter. The ſenate, after examining them, ordered that a treaty of peace ſhould be concluded with Antiochus, and the articles of it engraved on braſs, and fixed up in the Capitol. They only added one clauſe, which was, That the Syrians ſhould change every year all their hoſtages, except the ſon of king Antiochus, who ſhould continue at Rome as long as the republic thought fit. The peace being thus ratified, and all Aſia on this ſide Mount Taurus delivered into the hands of the Romans, the Greek cities were by them reſtored to their liberty, the provinces of Caria and Lydia given to the Rhodians, and all the reſt that had belonged to Antiochus beſtowed upon Eumenes.

58
His death. Antiochus did not long ſurvive his misfortune at Magneſia. Some tell us, that being greatly puzzled how to raiſe the ſum he had engaged to pay to the Romans, he ſeized on the riches which had for many ages been depoſited in a temple of Jupiter Belus in the province of Elymais; upon which the populace roſe in arms, and ſlew him and all his attendants. Others inform us, that he was killed at an entertainment by one of his gueſts.

Antiochus the Great died in 187, and with him the glory of the Syrian empire. The Romans now gave laws to the kings of Syria, inſomuch, that when Antiochus Epiphanes the grandſon of Antiochus the Great heſitated at obeying the commands of the ſenate, one of the ambaſſadors drew a circle round him with a rod on the floor, and told him that

59
Syria becomes a Roman province.

he ſhould not go out of that ſpot before he had told him what he was to do. The moſt remarkable tranſactions of this prince are his wars with the Jews, and perſecutions of them; of which a full account is given under the article Jews. After a variety of uſurpers and tyrants, the kingdom of Syria fell under Tigranes king of Armenia in the year 83 B. C.; and upon his overthrow by the Romans, it became a province of the dominions of the republic. From them it was taken by the Saracens in the reign of the caliph Omar, and is now a province of Turkey in Aſia.

60
Climate, ſoil &c. of the country.

Syria is in ſome meaſure only a chain of mountains, varying in their levels, ſituation, and appearances. The part of the country, however, next the ſea is in general low, and beſides this there are ſeveral extenſive valleys. The climate on the ſea-coaſt and in theſe valleys is very hot, but in the higher parts of the country it bears a good deal of reſemblance to that of France. Syria is exceedingly fertile, and the variety of its productions is very great. Beſides wheat, rye, barley, beans, and the cotton plant, which is cultivated everywhere, Paleſtine abounds in ſeſamum, from which oil is procured, and doura as good as that of Egypt. Maize thrives in the light ſoil of Balbec, and even rice is cultivated with ſucceſs on the borders of the marſhy country of Havula. They have lately begun to plant ſugar-canes in the gardens of Saide and of Bairout, and they find them equal to thoſe of the Delta. Indigo grows without cultivating on the banks of the Jordan, in the country of Biſan, and only requires care to make it of an excellent quality. The hill-ſides of Latakia produce tobacco. Gaza produces dates like Mecca, and pomegranates like Algiers; Tripoli affords oranges equal to thoſe of Malta; Bairout figs like thoſe of Marſeilles, and bananas not inferior to thoſe of St Domingo; Aleppo enjoys the excluſive advantage of producing piſtachios; and Damaſcus juſtly boaſts of poſſeſſing all the fruits known in our provinces. Its ſtony ſoil ſuits equally the apples of Normandy, the plums of Touraine, and the peaches of Paris. Twenty ſorts of apricots are reckoned there, the ſtone of one of which contains a kernel highly valued through all Turkey. The cochineal plant, which grows on all that coaſt, contains perhaps that precious inſect in as high perfection as it is found in Mexico and St Domingo.

Volney's Trav. vol.

The inhabitants may be divided into three principal claſſes: the deſcendants of the Greeks of the Lower Empire; the Arabs, their conquerors; and the Turks, the preſent ruling power: and theſe again, the firſt into three, the ſecond into four, claſſes; beſides three wandering tribes of Turkomen, Curds, and Bedouin Arabs. The ancient inhabitants before the Greeks under Alexander are entirely loſt. The inhabitants are in general of a middling ſtature, and the eyes of the women almoſt everywhere beautiful, and their ſhape correct and well proportioned. The general language is Arabic. Syriac is a dead language.

SYRINGA, the Lilac, in botany: A genus of plants belonging to the claſs of *diandria*, and order of *monogynia*; and in the natural ſyſtem ranging under the 44th order, *Sepiariæ*. The corolla is quadrifid, and the capſule is bilocular. There are three ſpecies, the vulgaris, perſica, and ſuſpenſa. The two firſt are natives of Perſia, and the laſt of Japan.—The *vulgaris*, which is diſtinguiſhed by ovate heart-ſhaped leaves, was cultivated in Britain about the year 1597 by Mr John Gerard.—The *perſica*, which has lanceolate leaves, was cultivated in 1658; but how long both ſpecies might have been introduced into Britain before theſe dates, it is perhaps impoſſible to aſcertain.

SYRINGE, a well-known inſtrument, ſerving to imbibe or ſuck in a quantity of fluid, and to ſquirt or expel the ſame with violence. The word is formed from the Greek συριγξ, or the Latin *ſyrinx* "a pipe."—A ſyringe is only a ſingle pump, and the water aſcends in it on the ſame principle as in the common ſucking-pump. See Hydrostatics, n° 25, *et ſeq.*

SYRUP, in pharmacy, a ſaturated ſolution of ſugar, made in vegetable decoctions or infuſions. See Pharmacy, ch. xxiii.

SYSTEM, in general, denotes an aſſemblage or chain of principles and concluſions, or the whole of any doctrine, the ſeveral parts whereof are bound together, and follow or depend on each other; in which ſenſe we ſay a *ſyſtem of philoſophy*, a *ſyſtem of divinity*, &c. The word is formed from the Greek συστημα "compoſition, compages."

System, in the animal economy, the *vaſcular*, the *nervous*, and the *cellular*. See Anatomy.

System, in muſic, an aſſemblage of the rules for harmony, deduced from ſome common principle by which they are reunited; by which their connection one with another is formed; from whence, as from their genuine ſource, they natively flow; and to which, if we would account for them, we muſt have recourſe. See the articles Chromatic, Dia-

TONIC, ENHARMONIC, HARMONY, INTERVAL, and MUSIC.

SYSTEM, in botany. See BOTANY, page 430.

SYSTEM, in astronomy. See ASTRONOMY.

SYSTOLE, in anatomy, the contraction of the heart, whereby the blood is drawn off its ventricles into the arteries; the opposite state to which is called the *diastole*, or *dilatation of the heart*. See ANATOMY, n° 124.

SYSTYLE, in architecture, that manner of placing columns where the space between the two shafts consists of two diameters or four modules.

SYZYGY, SYZYGIA, in astronomy, a term equally used for the conjunction and opposition of a planet with the sun. The word is formed from the Greek συζυγια, which properly signifies *conjunctio*. On the phenomena and circumstances of the syzygies a great part of the lunar theory depends. See ASTRONOMY.

T.

T or t, the 19th letter and 16th consonant of our alphabet; the sound whereof is formed by a strong expulsion of the breath through the mouth, upon a sudden drawing back of the tongue from the fore-part of the palate, with the lips at the same time open. The proper sound of *t* is expressed in most words beginning or ending with that letter; as in *take*, *tell*, *hot*, *put*. *Ti* before a vowel has the sound of *si*, or rather of *shi*, as in *creation*, except when *s* precedes, as in *question*; and in derivatives from words ending in *ty*, as, *mighty*, *mightier*. *Th* has two sounds; the one soft, as *thou*, *father*; the other hard, as *thing*, *think*. The sound is soft in these words, *then*, *thence*, and *there*, with their derivatives and compounds; and in the words *that*, *this*, *thus*, *thy*, *they*, *though*; and in all words in which *th* comes between two vowels, as, *whether*, *rather*; and between *r* and a vowel, as *burthen*.

In abbreviations, amongst the Roman writers, T. stands for *Titus*, *Titius*, &c.; Tab. for *Tabularius*; Tab. P. H. C. *Tabularius Provinciæ Hispaniæ Citerioris*; Tar. *Tarquinius*; Ti. *Tiberius*; Ti. F. *Tiberii filius*; Ti. L. *Tiberii libertus*; Ti. N. *Tiberii Nepos*; T. J. A. V. P. V. D. *tempore judicem arbitrumve postulat ut det*; T. M. P. *terminum posuit*; T. M. D. D. *terminum dedicavit*; Tr. *trans*, *tribunus*; Tr. M. or Mil. *tribunus militum*; TR. PL. DES. *tribunus plebis designatus*; TR. AER. *tribunus ærarii*; TRV. CAP. *triumviri capitales*; T. P. or TRIB. POT. *tribunicia potestate*; Tul. H. *Tullus Hostilius*.

Amongst the ancients, T. as a numeral, stood for *one hundred and sixty*; and with a dash at top, thus, T̄, it signified *one hundred and sixty thousand*. In music, T stands for *tutti*, "all, or altogether."

TABANUS, the BREEZE-FLY: a genus of insects belonging to the order of *diptera*. The mouth is extended in a fleshy proboscis, terminated by two lips. The rostrum is furnished with two pointed palpi placed on each side of the proboscis, and parallel to it. Gmelin has enumerated 38 species; of which three only are found in Great Britain, the bovinus, pluviatilis, and cœcutiens.

1. The *bovinus*, or great horse fly, has a grey head; the eyes almost of a black brown, occupying the greatest part of it. The thorax is of a grey colour; the abdomen is yellowish, with a triangular white spot on the middle of every ring, which constitutes a longitudinal band of spots, the point of which is directed towards the thorax. The thighs are blackish, and the legs yellow. The wings are somewhat dusky, with brown veins of a deeper dye. This insect is the terror of horned cattle, horses, &c. Its mouth is armed with two sharp hooks which penetrate their hide; while with its proboscis, which is shaped like a sting, it sucks their blood, of which it is very greedy. The puncture of the tabanus is keen and painful. The insect is very common in damp woods and meadows, especially during the great heats, when it is most troublesome. The horned cattle are sometimes so molested by their stings, that they go mad, run down precipices, tear themselves on the stumps of trees, stones, &c.

2. The *pluviatilis* is of an ashen grey colour; its eyes are green, with brown streaks. The thorax is brown, marked with about seven longitudinal grey lines; the wings, which are brown and ash-coloured, are dotted over with small white spots, and have a black spot on the margin; the legs are surrounded with brown and white rings alternately. This species is very common in meadows, and is about four lines in length.

3. The *cæcutiens* has a brown head; eyes green and brown, with black spots; the thorax brown with black spots; the abdomen above, yellow with triangular brown spots; yellow legs, and white wings with black and brown spots. The length is four lines and a half.

TABARCA, a little island lying opposite to a small town of that name, which divides the maritime coasts of Tunis and Algiers, in Africa, two miles from the land, in possession of the noble family of the Lamellini of Genoa, who have here a governor and a garrison of 200 men to protect the coral fishery. N. Lat. 30. 50 E. Long. 9. 16.

TABASHEER, a Persian word, signifying a hard substance found in the cavities of the bamboo or Indian reed, and highly valued as a medicine in the East Indies. Though some account was given of the tabasheer by the Arabian physicians, no accurate knowledge of it was obtained till Dr Russel favoured the public with his observations on it.

According to this gentleman's information, the tabasheer is produced from the female bamboo, which is distinguished from the male by the the largeness of its cavity. It is easy to discover, without opening them, what bamboos contain it, as they make a rattling noise when shaken. Dr Russel having examined a bamboo brought from Vellore, consisting of six joints, found no appearance of tabasheer in two of them: all the rest contained some, but of various quality and quantity; the whole amounting to about 27 grains. The best was of a bluish white resembling small fragments of shells, harder also than the rest, but which might be easily crumbled between the fingers into a gritty powder; and when applied to the tongue and palate, had a slight saline and testaceous taste; the weight not exceeding four grains. The colour of the rest was cineritious, rough on the surface, and more friable; having some particles of a larger size intermixed, but light, spongy, and somewhat resembling pumice stones; which appearance, our author supposes, led the Arabians to think that fire was concerned in the production. The two middle joints were of a pure white colour within, and lined with a thin film. In these the tabasheer was principally found. The other joints, particularly the two upper ones, were discoloured within; and in some parts of the cavity was found a blackish substance in grains or in powder, adhering to the sides, the film being there obliterated.

In two or three of the joints a fmall round hole was found at top and bottom, which feemed to have been perforated by fome infect.

Garzias informs us, that it is not found in all bamboos, nor in all the branches indifcriminately, but only in thofe growing about Bifnagur, Pateeda, and one part of the Malabar coaft. Dr Ruffel was informed by a letter from a medical gentleman attending the embafly to the Nizam, that though tabafheer bears a high price at Hydrabad, it is never brought thither from Bifnagur; and that fome of what is fold in the markets comes from the parts of Atcour in Canoul; and fome from Ennabad, at the diftance of about 80 miles to the north weft; but that the moft part comes from Mafulipatam. That fold in the markets is of two kinds; one the rate of a rupee *per* dram, but the other only half that price; the latter, however, is fuppofed to be factitious, and made up moftly of burnt teeth and bones. Dr Ruffel himfelf alfo, is perfuaded that the tabafheer met with in commerce is greatly adulterated. The abovementioned gentleman likewife informed the doctor that tabafheer was produced in great quantities at Sylhat, where it is fold by the pound, from one rupee to one and an half; forming a confiderable article of trade from Bengal to Perfia and Arabia. There is, however, a third kind, much fuperior to either of the two above defcribed; differing not only in its fuperior whitenefs, but likewife in being much lefs mixed with heterogeneous particles; being likewife much harder, heavier, and fcarcely in any degree friable by the finger.

From the experiments of Dr Ruffel, it appears that the tabafheer is the juice of the bamboo thickened and hardened to a certain degree. Its chemical qualities, as far as we have heard, have not yet been minutely examined. The following obfervations on its medical effects were taken from a Perfian work, intitled the "Tofut ul Monein of Mahommed Monein Hofeiny," by Mr Williams, a furgeon in the fervice of the Eaft India company. The tabafheer puts a ftop to bilious vomitings and to the bloody flux. It is alfo of fervice in cafes of palpitation of the heart, in faintings, and for ftrengthening thofe members of the body that are weakened by heat. It is ufeful alfo for the piles, and for acute or burning fevers, and for puftules in the mouth (thrufh); and, given with oxymel, is of fervice againft reftleffnefs, melancholy, and hypochondriacal affections. The habitual internal ufe of it is prejudicial to the virile powers. It is alfo faid to be prejudicial to the lungs. Its correctives are the gum of the pine and honey. The dofe of it is to the weight of two d'herems, or feven mafhás.

TABBY, in commerce, a kind of rich filk which has undergone the operation of tabbying.

TABBYING, the paffing a filk or ftuff under a calendar, the rolls of which are made of iron or copper varioufly engraven, which bearing unequally on the ftuff renders the furface thereof unequal, fo as to reflect the rays of light differently, making the reprefentation of waves thereon.

TABELLIO, in the Roman law, an officer or fcrivener, much the fame with our notaries-public, who are often called *tabelliones*.

TABERNACLE, among the Hebrews, a kind of building, in the form of a tent, fet up, by exprefs command of God, for the performance of religious worfhip, facrifices, &c. during the journeying of the Ifraelites in the wildernefs: and, after their fettlement in the land of Canaan, made ufe of for the fame purpofe till the building of the temple of Jerufalem. It was divided into two parts; the one covered, and properly called the *tabernacle*; and the other open, called the *court*. The curtains which covered the tabernacle were made of linen, of feveral colours, embroidered. There were ten curtains, twenty eight cubits long and four in breadth. Five curtains faftened together made up two coverings, which covered up all the tabernacle. Over thefe there were two other coverings; the one of goat's hair, the other of fheep's fkins. The holy of holies was parted from the reft of the tabernacle by a curtain made faft to four pillars, ftanding ten cubits from the end. The length of the whole tabernacle was 30 cubits, that is, about 5[illegible] feet; and the breadth 12 cubits, or 19 feet. The court was a fpot of ground 100 cubits long, and 50 in breadth, enclofed by 20 columns, each 20 cubits high and 10 in breadth, covered with filver, and ftanding on copper bafes, five cubits diftant from one another; between which there were curtains drawn, and faftened with hooks. At the eaft end was an entrance, 20 cubits wide, covered with a curtain hanging loofe.

Feaft of TABERNACLES, a folemn feftival of the Hebrews, obferved after harveft, on the 15th day of the month Tifri, inftituted to commemorate the goodnefs of God, who protected the Ifraelites in the wildernefs, and made them dwell in booths, when they came out of Egypt. On the firft day of the feaft, they began to erect booths of the boughs of trees, and in thefe they were obliged to continue feven days. The booths were placed in the open air, and were not to be covered with cloths, nor made too clofe by the thicknefs of the boughs; but fo loofe that the fun and the ftars might be feen, and the rain defcend through them. For further particulars of the celebration of this feftival, fee LEVIT. ch. xxiii.

TABERNÆ (anc geog.) See *TRES Tabernæ*.

TABERNÆMONTANA, in botany: A genus of plants belonging to the clafs of *pentandria*, and order of *monogynia*; and in the natural fyftem arranged under the 30th order, *Contortæ*. There are two horizontal follicles, and the feeds are immerfed in pulp. There are eight fpecies, all of foreign growth.

TABLE, a moveable piece of furniture, ufually made of wood or ftone, and fupported on pillars or the like, for the commodious reception of things placed thereon.

TABLE is alfo ufed for the fare or entertainment ferved up.

TABLE, in mathematics, fyftems of numbers calculated to be ready at hand for the expediting aftronomical, geometrical, and other operations.

TABLE-Book. See WRITING.

TABLE-Mountain, a mountain of Africa, being the moft wefterly cape or promontory in that part of the world, and near the Cape of Good Hope. The bay which is formed thereby is called the *Table-bay*.

Laws of the Twelve TABLES, were the firft fet of laws of the Romans; thus called either becaufe the Romans then wrote with a ftyle on thin wooden tablets covered with wax; or rather, becaufe they were engraved on tables or plates of copper, to be expofed in the moft noted part of the public forum. After the expulfion of the kings, as the Romans were then without any fixed or certain fyftem of law, at leaft had none ample enough to take in the various cafes that might fall between particular perfons, it was refolved to adopt the beft and wifeft laws of the Greeks. One Hermodorus was firft appointed to tranflate them, and the decemviri afterwards compiled and reduced them into ten tables. After a world of care and application, they were at length enacted and confirmed by the fenate and an affembly of the people, in the year of Rome 303. The following year they found fomething wanting therein, which they fupplied from the laws of the former kings of Rome, and from certain cuftoms which long ufe had authorifed: all thefe being engraven on two other tables, made the law of the twelve tables, fo famous in the Roman jurifprudence, the fource and foundation of the civil or Roman law.

Tables of the Law, in Jewiſh antiquity, two tables on which were written the decalogue, or ten commandments, given by God to Moſes on mount Sinai.

TABOO, a word uſed by the South Sea iſlanders, nearly of the ſame import as prohibited or interdicted. It applies equally to perſons and things, and is alſo expreſſive of any thing ſacred, devoted, or eminent.

TABOR, a mountain of Galilee, about 12 miles from the city of Tiberias. It riſes in the form of a ſugar-loaf, in the midſt of an extenſive plain, to the height of 30 ſtadia, according to Joſephus. The aſcent is ſo eaſy, that one may aſcend on horſeback. On the top there is a plain two miles in circumference.

The ſituation of Mount Tabor is moſt delightful. Riſing amidſt the plains of Galilee, it exhibits to the enchanted eye a charming variety of proſpects. On one ſide there are lakes, rivers, and a part of the Mediterranean; and on the other a chain of little hills, with ſmall valleys, ſhaded by natural groves, and enriched by the hands of the huſbandmen with a great number of uſeful productions. Here you behold an immenſity of plains interſperſed with hamlets, fortreſſes, and heaps of ruins; and there the eye delights to wander over the fields of Jezrael or Mageddon, named by the Arabs *Ebn-Aamer*, which ſignifies "the field of the ſons of Aamer." A little farther you diſtinguiſh the mountains of Hermon, Gilboa, Samaria, and Arabia the Stony. In ſhort, you experience all thoſe ſenſations which are produced by a mixture and rapid ſucceſſion of rural, gay, gloomy, and majeſtic objects.

It was upon this enchanting mount that the apoſtle Peter ſaid to Chriſt, "It is good for us to be here: and let us make three tabernacles; one for thee, and one for Moſes, and one for Elias."

Flavian Joſephus, governor of Galilee, cauſed the ſummit of this mountain, for the ſpace of two miles and a half, to be ſurrounded with walls. The inhabitants of Tabor long braved the power of the Roman armies; but being deprived of water in conſequence of the great heats, they were forced to ſurrender at diſcretion to Placidus, the general of Veſpaſian.

Several churches were built upon this mountain by St Helen, who founded here alſo ſome monaſteries. Of the two moſt remarkable, one was dedicated to Moſes, and inhabited by Cenobites of the order of St Benedict, who followed the Latin rites: the other was dedicated to the prophet Elias by monks of the order of St Baſil, attached to the Greek rites. The kings of Hungary erected here alſo a pretty ſpacious convent for ſome monks belonging to that nation, of the order of St Paul the firſt hermit. Tabor was alſo the ſeat of a biſhop, dependant on the patriarchate of Jeruſalem.

When Godfrey of Bouillon ſeized on this mountain, he repaired the ancient churches, which were beginning to fall into ruins. Under Baldwin I. in 1113, the Saracen troops retook Tabor; and their ſanguinary fury gained as many victories as there were prieſts and Cenobites. This mountain again fell into the hands of the Chriſtians; but the Catholic ſtandard was not long diſplayed on it. Saladin pulled it down the year following, and deſtroyed all the churches. The Chriſtians retook it once more in 1253; and their zeal made them rebuild all the ſacred places. At this time Rome being accuſtomed to give away empires, Pope Alexander IV. granted Tabor to the Templars, who fortified it again. At length, in the courſe of the year 1290, the ſultan of Egypt deſtroyed and laid waſte the buildings of this mountain, which could never be repaired afterwards; ſo that at preſent it is uninhabited.

TACAMAHACA, in pharmacy, a ſolid reſin, improperly called a *gum* in the ſhops. It exudes from a ſpecies of poplar; and is in repute for mitigating pain and aches, and is alſo reckoned a vulnerary.

Tacca, Tacitus.

TACCA, in botany: A genus of plants belonging to the claſs of *dodecandria*, and order of *trigynia*. The flower is above. The corolla has ſix petals, and is vaulted. The calyx is hexaphyllous; the fruit a dry, angular, three-celled berry. There is only one ſpecies known, the pinnatifida.

TACITUS (Caius Cornelius), a celebrated Roman hiſtorian, and one of the greateſt men of his time, appears to have been born about the year of Rome 809 or 810, and applied himſelf early to the labours of the bar, in which he gained very conſiderable reputation. Having married the daughter of Agricola, the road to public honours was laid open to him in the reign of Veſpaſian; but during the ſanguinary and capricious tyranny of Domitian, he, as well as his friend Pliny, appears to have retired from the theatre of public affairs. The reign of Nerva reſtored theſe luminaries of Roman literature to the metropolis, and we find Tacitus engaged, in the year 850, to pronounce the funeral oration of the venerable Virginius Rufus, the colleague of the emperor in the conſulſhip, and afterwards ſucceeding him as conſul for the remainder of the year. *Murphy's Tranſlation of Tacitus.*

The time of his death is not mentioned by any ancient author, but it is probable that he died in the reign of Trajan.

His works which ſtill remain are, 1. Five books of his Hiſtory. 2. His Annals. 3. A Treatiſe on the different Nations which in his time inhabited Germany: and, 4. The Life of Agricola his father-in-law. There is alſo attributed to him a Treatiſe on Eloquence, which others have aſcribed to Quintilian. The Treatiſe on the Manners of the Germans was publiſhed in 851.—In the year 853. Pliny and Tacitus were appointed by the ſenate to plead the cauſe of the oppreſſed Africans againſt Marius Priſcus, a corrupt proconſul, who was convicted before the fathers; and the patriot orators were honoured with a declaration that they had executed their truſt to the entire ſatisfaction of the houſe. The exact time when Tacitus publiſhed his hiſtory is uncertain, but it was in ſome period of Trajan's reign, who died ſuddenly, A. U. C. 870, A. D. 117.—The hiſtory compriſes a period of 27 years, from the acceſſion of Galba, 822, to the death of Domitian, 849. The hiſtory being finiſhed, he did not think he had completed the tablature of ſlavery; he went back to the time of Tiberius: and the ſecond work, which, however, comes firſt in the order of chronology, includes a period of 54 years, from the acceſſion of Tiberius, 767, to the death of Nero, 821: this work is his "Annals."

It is remarkable, that princes and politicians have always held the works of Tacitus in the higheſt eſteem; which look as if they either found their account in reading them, or were pleaſed to find courts, and the people who live in them, ſo exactly deſcribed after the life as they are in his writings. Part of what is extant was found in Germany by a receiver of Pope Leo X. and publiſhed by Beroaldus at Rome in 1515. Leo was ſo much charmed with Tacitus, that he gave the receiver a reward of 500 crowns; and promiſed not only indulgences, but money alſo and honour, to any one who ſhould find the other part; which it is ſaid was afterwards brought to him. Pope Paul III. as Muretus relates, wore out his Tacitus by much reading it; and Coſmo de Medicis, who was the firſt great duke of Tuſcany, and formed for governing, accounted the reading of him his greateſt pleaſure. Muretus adds, that ſeveral princes, and privy-counſellors to princes read him with great application, and regarded him as a ſort of oracle in politics. A certain author relates, that Queen Chriſtina of Sweden, *Biographical Dictionary.*

Tacitus.

Baillet Vie de Des Cartes, tom. ii.

Study of History, Letter v.

Sweden, though extremely fond of the Greek tongue, which ſhe made "the diverſion of her leiſure hours, was not reſtrained by that from her ſerious ſtudies; ſo ſhe called among others Tacitus's Hiſtory, ſome pages of which ſhe read conſtantly every day." Laſtly, our late Lord Bolingbroke, an authority ſurely of no mean rank, calls him, "a favourite author," and gives him manifeſtly the preference to all the Greek and Roman hiſtorians.

No author has obtained a more ſplendid reputation than Tacitus. He has been accounted, and with good reaſon, the moſt cultivated genius of antiquity; and we muſt not ſeek for his parallel in modern times. It is impoſſible not to admire and recommend his intimate knowledge of the human heart, the ſpirit of liberty which he breathes, and the force and vivacity with which he perpetually expreſſes himſelf. The reader of taſte is ſtruck by the greatneſs of his thoughts and the dignity of his narration; the philoſopher by the comprehenſive powers of his mind; and the politician by the ſagacity with which he unfolds the ſprings of the moſt ſecret tranſactions. Civil liberty and the rights of mankind never met with a bolder or a more able aſſerter: ſervitude, debaſement, and tyranny, appear not in the writings of any other author in juſter or more odious colours. He has been cenſured as obſcure; and indeed nothing can be more certain than that he did not write for the common maſs of men. But to thoſe who are judges of his compoſitions, it is no matter of regret that his manner is his own, and peculiar. Never were deſcription and ſentiment ſo wonderfully and ſo beautifully blended; and never were the actions and characters of men delineated with ſo much ſtrength and preciſion. He has all the merits of other hiſtorians, without their defects. He poſſeſſes the diſtinctneſs of Xenophon without his uniformity; he is more eloquent than Livy, and is free from his ſuperſtition; and he has more knowledge and judgment than Polybius, without his affectation of reaſoning on every occaſion.

One of the beſt editions of the works of Tacitus was publiſhed at Paris by Brotier, in 4 vols 4to. There have been four tranſlations of his works into Engliſh; the firſt by Greenway and Sir Henry Saville, in the reign of Elizabeth; the ſecond by Dryden and others; the third by Gordon, which is remarkable for affectation of ſtyle, though ſome think it bears a ſtriking reſemblance to the original; and the fourth and beſt by Murphy, in 1793, in 4 vols 4to.

Tack.

TACK, a rope uſed to confine the foremoſt lower corners of the courſes and ſtay-ſails in a fixed poſition, when the wind croſſes the ſhip's courſe obliquely. The ſame name is alſo given to the rope employed to pull out the lower corner of a ſtudding-ſail or driver to the extremity of its boom.

The main-ſail and fore-ſail of a ſhip are furniſhed with a tack on each ſide, which is formed of a thick rope tapering to the end, and having a knot wrought upon the largeſt end, by which it is firmly retained in the clue of the ſail. By this means one tack is always faſtened to windward, at the ſame time that the ſheet extends the ſail to the leeward.

Tack, is alſo applied, by analogy, to that part of any ſail to which the tack is uſually faſtened.

A ſhip is ſaid to be on the ſtarboard or larboard tack, when ſhe is cloſe-hauled, with the wind upon the ſtarboard or larboard ſide; and in this ſenſe the diſtance which ſhe ſails in that poſition is conſidered as the length of the tack; although this is more frequently called *board*. See that article.

To Tack, to change the courſe from one board to another, or turn the ſhip about from the ſtarboard to the larboard tack, in a contrary wind. Thus a ſhip being cloſe-hauled on the larboard tack, and turning her prow ſuddenly to windward, receives the impreſſion of the wind on her head-ſails, by which ſhe falls off upon the line of the ſtarboard-tack. Tacking is alſo uſed in a more enlarged ſenſe, to imply that manœuvre in navigation by which a ſhip makes an oblique progreſſion to the windward, in a zigzag direction. This, however, is more uſually called *beating*, or *turning to windward*. See Navigation, Sailing, and *Naval Tactics*. *Falconer's Marine Dictionary.*

Tack, in Scots law. See Law, n° clxvii.

TACKLE, among ſeamen, denotes all the ropes or cordage of a ſhip uſed in managing the ſails, &c.

TACKSMAN. See Tenure.

TACTICS, in the art of war, is the method of diſpoſing forces to the beſt advantage in order of battle, and of performing the ſeveral military motions and evolutions. See War.

Naval TACTICS;

Or, The Military Operations of Fleets.

1 Definition.

Naval tactics is the art of ranging fleets in ſuch order or diſpoſition, as may be judged moſt convenient, either for attacking, defending, or retreating, to the greateſt advantage; and to regulate their ſeveral movements accordingly. It is not a ſcience eſtabliſhed on principles abſolutely invariable, but founded on ſuch reaſons as the alteration and improvement of arms muſt neceſſarily occaſion in a courſe of time and experience; from which alſo will naturally reſult a difference in the conſtruction of ſhips, in the manner of working them, and, in fine, in the total diſpoſition and regulation of fleets and ſquadrons. We ſhall curſorily run through this ſucceſſion and change of arms, &c. to the preſent improvement of our lines of battle, in order to make us the more ſenſible of the reaſons which have induced the moderns to prefer ſo advantageous a choice as they now follow in the arrangement of their ſhips.

2 History.

The ancient galleys were ſo conſtructed as to carry ſeveral banks of oars, very differently diſpoſed from thoſe in our modern galleys, which, however, vary the leaſt of any others from their ancient model. Advanced by the force of their oars, the galleys ran violently aboard of each other, and by the mutual encounter of their beaks and prows, and ſometimes of their ſterns, endeavoured to daſh in pieces or ſink their enemies.

The prow, for this purpoſe, was commonly armed with a brazen point or trident, nearly as low as the ſurface of the ſea, in order to pierce the enemy's ſhips under the water. Some of the galleys were furniſhed with large turrets, and other acceſſions of building, either for attack or defence. The ſoldiers alſo annoyed their enemies with darts and ſlings, and, on their nearer approach, with ſwords and javelins; and in order that their miſſive weapons might be directed with greater force and certainty, the ſhips were equipped with ſeveral platforms, or elevations above the level of the deck. The ſides of the ſhip were fortified with a thick fence of hides, which ſerved to repel the darts of their adverſaries, and to cover their own ſoldiers, who thereby annoyed the enemy with greater ſecurity.

As the invention of gunpowder has rendered uſeleſs many of the machines employed in the naval wars of the ancients, the great diſtance of time has alſo conſigned many of them to oblivion: ſome few are, nevertheleſs, recorded in ancient authors,

authors, of which we ſhall endeavour to preſent a ſhort deſcription. And firſt,

The Δελφιν was a large and maſſy piece of lead or iron, caſt in the form of a dolphin. This machine being ſuſpended by blocks at their maſt-heads or yard-arms, ready for a proper occaſion, was let down violently from thence into the adverſe ſhips; and either penetrated through their bottom, and opened a paſſage for the entering waters, or by its weight immediately ſunk the veſſel.

The Δρεπανον was an engine of iron crooked like a ſickle, and fixed on the top of a long pole. It was employed to cut aſunder the ſlings of the ſail-yards, and, thereby letting the ſails fall down, to diſable the veſſel from eſcaping, and incommode her greatly during the action. Similar to this was another inſtrument, armed at the head with a broad two-edged blade of iron, wherewith they uſually cut away the ropes that faſtened the rudder to the veſſel.

Δορατα ναυμαχα, a ſort of ſpears or maces of an extraordinary length, ſometimes exceeding 20 cubits, as appears by the 15th Iliad of Homer, by whom they are alſo called μακρα.

Κεραιαι were certain machines uſed to throw large ſtones into the enemy's ſhips.

Vegetius mentions another engine which was ſuſpended to the main-maſt, and reſembled a battering-ram; for it conſiſted of a long beam and an head of iron, and was with great violence puſhed againſt the ſides of the enemy's galleys.

They had alſo a grappling-iron, which was uſually thrown into the adverſe ſhip by means of an engine: this inſtrument facilitated the entrance of the ſoldiers appointed to board, which was done by means of wooden bridges, that were generally kept ready for this purpoſe in the fore-part of the veſſel. See the article CORVUS.

The arms uſed by the ancients rendered the diſpoſition of their fleets very different, according to the time, place, and circumſtances of the engagement. They generally conſidered it an advantage to be to windward, and to have the ſun ſhining directly on the front of their enemy. The order of battle chiefly depended on their power of managing the ſhips, or of drawing them readily into form; and on the ſchemes which their officers had concerted. The fleet being compoſed of rowing veſſels, they lowered their ſails previous to the action; they preſented their prows to the enemy, and advanced againſt each other by the force of their oars. Before they joined battle, the admirals went from ſhip to ſhip, and exhorted their ſoldiers to behave gallantly. All things being in readineſs, the ſignal was diſplayed by hanging out of the admiral's galley a gilded ſhield, or a red garment or banner. During the elevation of this, the action continued; and by its depreſſion, or inclination towards the right or left, the reſt of the ſhips were directed how to attack or retreat from their enemies. To this was added the ſound of trumpets; which began in the admiral's galley, and continued round the whole fleet. The fight was alſo begun by the admiral's galley, by grappling, boarding, and endeavouring to overſet, ſink, or deſtroy the adverſary, as we have above deſcribed. Sometimes, for want of grappling-irons, they fixed their oars in ſuch a manner as to hinder the enemy from retreating. If they could not manage their oars as dexterouſly as their antagoniſt, or fall alongſide ſo as to board him, they penetrated his veſſel with the brazen prow. The veſſels approached each other as well as their circumſtances would permit, and the ſoldiers were obliged to fight hand to hand till the battle was decided: nor indeed could they fight otherwiſe with any certainty, ſince the ſhorteſt diſtance rendered their ſlings and arrows, and almoſt all their offenſive weapons, ineffectual, if not uſeleſs. The ſquadrons were ſometimes ranged in two or three right lines, parallel to each other; being ſeldom drawn up in one line, unleſs when formed into an half-moon. This order indeed appears to be the moſt convenient for rowing veſſels, that engage by advancing with their prows towards the enemy. At the battle of Ecnomus, between the Romans and the Carthaginians, the fleet of the former was ranged into a triangle, or a ſort of wedge in front, and towards the middle of its depth of two right parallel lines. That of the latter was formed into a rectangle, or two ſides of a ſquare, of which one branch extended behind, and as the opening of the other proſecuted the attack, was ready to fall upon the flank of ſuch of the Roman galleys as ſhould attempt to break their line. Ancient hiſtory has preſerved many of theſe orders, of which ſome have been followed in later times. Thus, in a battle A. D. 1340, the Engliſh fleet was formed in two lines, the firſt of which contained the larger ſhips, the ſecond conſiſted of all the ſmaller veſſels, uſed as a reſerve to ſupport the former whenever neceſſary. In 1545, the French fleet under the command of the Mareſchal d'Annebault, in an engagement with the Engliſh in the Channel, was arranged in the form of a creſcent. The whole of it was divided into three bodies, the centre being compoſed of 36 ſhips, and each of the wings of 30. He had alſo many galleys; but theſe fell not into the line, being deſigned to attack the enemy occaſionally. This laſt diſpoſition was continued down to the reigns of James I. and Louis XIII.

Meanwhile, the invention of gunpowder in 1330 gradually introduced the uſe of fire-arms into naval war, without finally ſuperſeding the ancient method of engagement. The Spaniards were armed with cannon in a ſea-fight againſt the Engliſh and the people of Poitou abreaſt of Rochelle in 1372; and this battle is the firſt wherein mention is made of artillery in our navies. Many years elapſed before the marine armaments were ſufficiently provided with fire-arms. So great a revolution in the manner of fighting, and which neceſſarily introduced a total change in the conſtruction of ſhips, could not be ſuddenly effected. In ſhort, the ſquadrons of men of war are no longer formed of rowing veſſels, or compoſed of galleys and ſhips of the line; but entirely of the latter, which engage under ſail, and diſcharge the whole force of their artillery from their ſides. Accordingly, they are now diſpoſed in no other form than that of a right line parallel to the enemy; every ſhip keeping cloſe-hauled upon a wind on the ſame tack. Indeed the difference between the force and manner of fighting of ſhips and galleys, rendered their ſervice in the ſame line incompatible. When we conſider therefore the change introduced, both in the conſtruction and working of the ſhips, occaſioned by the uſe of cannon, it neceſſarily follows, that ſquadrons of men of war muſt appear in the order that is now generally adopted.

The machines which owe their riſe to the invention of gunpowder have now totally ſupplanted the others; ſo that there is ſcarce any but the ſword remaining of all the weapons uſed by the ancients. Our naval battles are therefore almoſt always decided by fire-arms, of which there are ſeveral kinds, known by the general name of *artillery*. In a ſhip of war, fire-arms are diſtinguiſhed into cannon mounted on carriages ſwivel-cannon, grenadoes, and muſquetry. See CANNON, &c. Beſides theſe machines, there are ſeveral others uſed in merchant-ſhips and privateers, as cohorns, carabines, fire-arrows, organs, ſtink pots, &c.

The writers on naval tactics have been but few, indeed, conſidering the importance of the ſubject; and the only countries that have produced writers on this ſubject, ſo far as we know, are France and Britain, particularly the firſt. One would be led to imagine that Britain, from its inſular ſituation, having bred ſo great a number of excellent ſeamen,

History. and having so often been engaged in naval contests, would naturally have produced a number of writers on this, as well as on subjects of much less consequence to it as a nation. The reader will, however, no doubt be surprised to hear, that we have only one scientific treatise on naval tactics, intitled *An Essay on Naval Tactics, &c.* by John Clerk, Esq; of Elden, near Edinburgh; all the other treatises published in Britain on this subject being either translations from the French, or remarks upon the French authors (A). Some of the principal French treatises on naval tactics are the following: 1. *L'Art des Armées Navales, ou Traité des Evolutions Navales*, par Paul L'Hoste, 1 vol. folio, printed at Lyons 1727. This book was translated and published by Christopher O'Bryen, Esq; in 4to, in 1762. 2. *Tactique Navale, ou Traité des Evolutions et des Signaux*, par M. le Viscompte de Morogues, 4to, Paris 1763. 3. *Le Manœuvrier*, par M. Bourdé de Villehuet. 4. *L'Art de Guerre en Mer, ou Tactique Navale, &c.* par M. le Viscompte de Grenier. Translations of the two last have appeared in English in 4to in 1788, under the name of the *Chevalier de Sauseuil*; and a translation of parts of the three last is in the 2d vol. of the Elements and Practice of Rigging and Seamanship, published at London in 1794. Other books on evolutions and tactics are, *Théorie de la Manœuvre des Vaisseaux*, Paris, 1689. *Pitot's Theory of Working Ships applied to Practice* &c. translated by Stone, 1743. *De la Manœuvre des Vaisseaux, ou Traité de Mechanique et de Dynamique, &c.* par M. Bouguer. *The British Mars*, &c. by William Flexney, 1763. *A Sea Manual*, by Sir Alexander Schomberg, 1789. *A View of the Naval Force of Great Britain*, &c. by an Officer of Rank, 1791, &c.

We shall occasionally consult all these works; and as some of them treat largely of the tactics in present use, while in others new systems are proposed, our article will naturally be divided into two parts, keeping the present practice and proposed innovations totally distinct from each other.

PART I. THE PRESENT SYSTEM OF NAVAL TACTICS.

CHAP. I. *Of the Orders of Sailing.*

3
Division of a fleet into three squadrons, the van, centre, and rear.

A FLEET of ships of war is usually divided into three divisions or squadrons, called the *centre*, *van*, and *rear*; and each squadron has a commanding officer. The commander in chief, or admiral of the fleet, is in the centre column; the vice admiral has the command of the van; and the rear admiral, that of the rear. The ships of each squadron are distinguished by the position of their colours. The ships of the first or centre squadron carry their pendants at the main-top-gallant mast head. The ships of the second division carry their pendants at the fore top-gallant mast head, and those of the third division at the mizen-top mast head. Each squadron ought, if possible, to consist of the same number of ships; and also to be of the same force, so that each may be equally able to attack or repulse the enemy; and when in a line, the several parts will be equally strong. When the fleet is very numerous, each squadron is sometimes subdivided in a similar manner into three divisions of centre, van, and rear.

When the fleet is formed in the line or order of battle, each admiral takes his post in the centre of his squadron, the commander in chief being in the middle of the line. If the enemy be not in sight, the store-ships, fire-ships, sloops, &c. are to be to the windward of the fleet, because they can be more easily supported, and can more readily obey the signals that may be made to them. There are frigates to the windward of the van and rear of the convoy, for the purpose of looking out for the enemy, and keeping those vessels in their proper stations. But if the enemy is in sight, then all those ships which are not to be in the line of battle are to be on the other side of the line with respect to the enemy. If the fleet is sailing in three columns, the first or centre squadron is in the middle between the second and third squadrons; one of which, according to circumstances, forms the starboard and the other the larboard column: and each admiral leads his respective division. If the fleet is destined for a certain place at a considerable distance, it is generally formed into squadrons; but if cruising in expectation of meeting the enemy, the admiral naturally keeps his ships in such sailing positions as may be most advantageous to form for action as quickly as possible. These various positions or arrangements are called *orders*; and that they may be better understood, it is necessary to premise the following definitions:

The starboard line of bearing, is that line upon which the ships of a fleet, being ranged, bear from each other upon a close-hauled line, whatever course they may be steering; and so that, upon hauling their wind or tacking together as may be necessary, the ships will be in a line close-hauled upon the starboard tack.

The larboard line of bearing, is that line from which the ships of the fleet, by hauling their wind, or tacking together, may be formed in a line close-hauled on the larboard tack.

A fleet of ships is said to be in the *line a-breast* when the ships keels are parallel to each other, and their mainmasts in the same straight line.

The bow and quarter line, is when the ships are ranged in a straight line cutting their keels obliquely in the same angle: Hence at any intermediate ship, the ships towards one extremity of the line will be on the bow, and those towards the other extremity will be on the quarter, of that ship.

If several ships stand on the same line and steer the same course, but different from that line, they are said it be in *echiquier*, or *chequerwise*.

Manœuvre in succession, is when a fleet, ranged in one of the orders of sailing, and standing on the same line, the same manœuvre is successively performed by each ship as she arrives at the wake of the van ship of the whole fleet, if in one line; or of the van ship of her particular division when divided into squadrons. So that a fleet tacks or veers, bears away or comes to the wind in succession, when all the ships of every line execute, one after another, the same manœuvre on the same point of the wake of the leading ship.

The number of orders of sailing is commonly assumed to be five; and denominated the *first*, *second*, *third*, *fourth*, and *fifth* orders of sailing; besides an order of *battle*, an order of *retreat*, &c.

In

(A) The reason why Britain falls short of the French in this respect, is, that in various sea ports in France there are academies established for the express purpose of educating those intended for the navy in the various branches of naval science; whereas, in Britain, there is only one academy established at the expence of government, namely, the Marine Academy at Portsmouth; and, excepting navigation, scarcely any other branch of naval science is taught in that seminary. It also requires great interest to be admitted. We are, indeed, well aware that there are boys educated for the sea-service in Christ's Hospital, London, and at Greenwich school, &c. The education there is not, however, adapted for officers in the navy, being only writing, arithmetic, a little mathematics necessary to understand navigation, and navigation.

Orders of sailing. 13 Plate cclxiii.

1 First order of sailing.

In the first order of sailing, the fleet is ranged on one of the lines of bearing, and each ship steering the same course. Thus, in fig. 1. let the wind be north, and the fleet ranged on the starboard line of bearing, and let the ships steer any course, as south-west. In this case, the fleet is ready to form the line on the starboard tack by hauling the wind. Again, let the fleet be ranged on the larboard line of bearing, and steering the same course as before, as in fig. 2.; then the fleet is in a position ready to form the line on the larboard tack, by tacking.

In a numerous fleet this method of sailing is defective; as the fleet will be too much extended, and therefore the communication between the van and the rear rendered more difficult than when in a more connected order. It is of use, however, when the enemy is in fight, as then the fleet may be readily formed in order of battle; and in that case only, or in passing through a strait, will it be necessary to range the fleet in this order.

2 Second order of sailing.

In the second order of sailing the fleet is ranged on a line perpendicular to the direction of the wind, and steering any proper course. This order, which is represented in fig. 3. has the same defects as the former; and has also this disadvantage attending it, that the fleet cannot safely tack in succession from this order, as each ship at the time of tacking is in danger of falling on board the ship next astern; and therefore, if the line is close, the ship astern must bear up considerably, in order to avoid being on board the ship ahead, which at that time is in stays.

3 Third order of sailing.

The third order of sailing is that in which the whole fleet is close-hauled, ranged upon the two lines or lines of bearing, and therefore containing an angle of twelve points; the admiral's ship being at the angular point, and the whole fleet steering the same course. Thus, in fig. 4. the wind being supposed north, and the fleet close-hauled on the starboard tack: Then A being the admiral's ship, one part of the fleet bears from him west-north-west, and the other part east-north-east.

This order of sailing is no doubt preferable to either of the former, as the ships are more collected, and can more distinctly perceive and obey the signals; but if the fleet is numerous, it will be too much extended.

4 Fourth order of sailing.

In the fourth order of sailing, the fleet is divided into six or more columns, as may be judged necessary: by which means the fleet is much more connected than in any of the former orders. The commanders, ranged upon the two lines of bearing, have their squadrons astern of them upon two lines parallel to the direction of the wind; the first ships of each column being, with respect to the commander of their squadron, the one on his starboard and the other on his larboard quarter. The distance between the columns should, however, be such, that the fleet may readily reduce itself to the third order of sailing, and from that to the order of battle. This order is adapted for fleets or convoys crossing the ocean, and is represented in fig. 5. But as it requires much time to reduce a fleet from this order to that of battle, it is therefore defective when in presence of an enemy.

5 Fifth order of sailing.

The fifth and last order of sailing is that in which the fleet is divided into three columns close-hauled, and therefore parallel to each other; and also the respective ships abreast of each other. The van commonly forms the weather column; the centre division, the middle column; and the rear division, the lee column. Circumstances may however require the van to be the lee column, and the rear the weather column. If the fleet is very numerous, each division may be divided into two columns; and each admiral is to place himself at a little distance before, and in the direction of the middle of his division. Fig. 6. and 7. represent this order of sailing.

The distance between any ship and that adjacent to it in the same column, and also the interval between the columns, are regulated by the commander in chief according to circumstances. The interval or perpendicular distance between the columns is commonly taken; such as, that the angle contained between the line of the columns and an imaginary line joining one of the extreme ships of that column, and the ship at the other extremity of the adjacent column, may be about two points. The measure of this angle must however depend in part upon the length of the column; and when it is determined upon, the distance between the columns may be found by multiplying the length of one of the columns by the tangent of the above angle to the radius unity: whence, if that angle be taken equal to two points, the length of a column multiplied by the decimal .414 will give the distance between the columns. Thus let a column contain six ships; let the distance between each be 100 fathoms; and the length of each ship from the extremity of the bowsprit to the stern 46 fathoms; then the whole length of the column will be 776 fathoms. Now the above angle being taken equal to two points, the distance between the columns is equal to $776 \times .414 = 321\frac{1}{4}$ fathoms.

Order of sailing. 16 Rule for the distance between the columns.

17 Order of battle.

The order of battle is formed by drawing up the ships of the fleet in a line nearly close-hauled, and under an easy sail; each ship being at a certain assigned distance from that next ahead, as a half or a whole cable's length. The fire-ships, with frigates ahead and astern, form a line parallel to the former, and to the windward of it if the enemy is to the leeward; but to the leeward if the enemy is to the windward. Without this line another is formed, parallel thereto, of the store-ships, &c. with frigates ahead and astern. Fig. 8. represents the order of battle, the fleet being on the starboard tack.

18 Order of retreat.

In retreating from a superior force, it is necessary to draw up the fleet in such an order that it may, with the greatest advantage, oppose or annoy the fast sailing vessels of the enemy: for this purpose, the order of retreat commonly taken is that which is the inverse of the third order of sailing. As the fleet generally runs before the wind, the ships of the line are therefore ranged on the two lines of bearing; hence these lines contain an angle equal to 135 degrees. The admiral is at the angular point, and the frigates, transports, &c. are included within the wings to leeward. In place of running before the wind, the fleet may take any other proper direction; but still the angle contained by the wings is to be 135°. This order of retreat is represented in fig. 9.

19 Order of convoy.

The order of convoy is that in which the ships are all in the wake of one another, steering on the same point of the compass, and forming a right line. If the fleet is numerous, it may be divided into three columns, which are to be ranged parallel to each other, that of the admiral occupying the middle, and all steering the same course.

Having defined the different orders of sailing, we shall now proceed to show the method of getting a fleet under way, and of bringing it to an anchor.

20 To get a fleet under way.

In order to get a fleet under way, the lee column is to get under way first, and bring to all at the same time, just as they find themselves after casting. The centre column is then to perform the same manœuvre, and cast likewise as soon as the other column is brought to; and both columns will remain in that position till the weather column, which is still apeak, having weighed, shall be also under way. The three columns may often be got under way all at once: but to execute this the fleet must all act together, and with equal ardour; for the weather ships must not, at any rate, be under way before the lee ones. If it be necessary to get immediately in order of battle, the weather columns are at once to bear away two points together, that they may take their posts in the line of battle ahead of the lee column.

If

Orders of Sailing.

If the fleet be moored in a line, head to wind, the rear ſhip may get under way firſt, and haul immediately by the wind; the others in ſucceſſion, from the rear to the van, can eaſily take their ſtation in her wake, ſo that the rear ſhip will now become the leader. Or, the fleet may all get under way at the ſame time; but the van ſhip is to bring to, while the reſt, caſting the other way, would ſtand on by the wind on the ſame tack on which they have caſt, and come to tack ſucceſſively in her wake, to form the order of battle.

21 To bring a fleet to an anchor.

To bring a fleet to an anchor, it ought, if conſiderable, to anchor in three parallel lines, on one of the lines of bearing, and at the proper diſtance which the length of the columns require; the diſtance between the adjacent ſhips in the ſame column being about a cable's length. The van and rear of the columns are to correſpond with each other exactly in the direction of the wind, that they may with eaſe get under way, and form the order of battle with facility, ſo as to be able to diſpute the weather-gage with the enemy if he ſhould come in ſight. As this evolution is to be performed in moderate weather, the fleet being in three columns, they are all at the ſame time to bring their ſhip's head to the wind under their topſails, and let go their anchors together, clewing up their topſails with all poſſible diſpatch; putting the foot of the ſails in the tops, and looſening the ſheets before hauling them down; then veering away an equal quantity of cable to preſerve the aſſigned diſtance. When it blows ſo freſh as to require the topſails being reefed, two cables length may be kept between the ſhips, and even three if it be likely to blow hard.

If the fleet do not exceed 20 ſhips, they may anchor on one of the lines of bearing; or parallel to the coaſt, in places where trade-winds are common, provided they blow in the direction of the land; for, in all caſes, they muſt be in a condition to get under way at the firſt ſight of the enemy, whoſe approach is never to be waited for at anchor; becauſe, if it be dangerous for a ſingle ſhip, it muſt be ſtill more ſo for a fleet, the movements of which are interrupted by the difficulty there is in getting with celerity under way ſhips which are moored, and which, in that caſe, are not able mutually to ſupport one another, as is abſolutely requiſite in a fleet.

Chap. II. *The Manner of Forming the ſeveral Orders of Sailing.*

22 To form the firſt order of ſailing.

The firſt order of ſailing is formed as follows: As the fleet is ſuppoſed to be in no particular order, that ſhip which is to lead on the propoſed line of bearing on which the fleet is to ſail, runs to the leeward of the whole or greater part of the fleet, and then hauls her wind, carrying an eaſy ſail: each ſhip then endeavours to get into her proper ſtation, by chaſing the ſhip which is to be next ahead of her: and when in the wake of the leader, muſt take care to preſerve the aſſigned diſtance from the ſhip immediately ahead, by increaſing or diminiſhing the quantity of ſail: and if any of the fleet ſhould happen to be ſo far removed from her ſecond ahead as not to be able to chaſe her without getting out of her way towards the line, in that caſe ſhe muſt take her ſtation diſcretionally in a line with the leaders, and leave a proper interval. The fleet will now be formed in the line of battle; from which the firſt order of ſailing is formed by each ſhip bearing away at the ſame inſtant, and ſteering each the ſame propoſed courſe.

23 To form the ſecond order of ſailing.

To form the ſecond order of ſailing, the leader runs to the leeward of the whole, or of ſo many of the fleet as that each ſhip may eaſily fetch his wake, and then ſteers a courſe eight points from the wind, carrying an eaſy ſail. Each ſhip now gets into her proper ſtation, by chaſing that which is to be ahead of her; and when the whole fleet is formed in a line, which will be perpendicular to the direction of the wind, each ſhip bears away at the ſame inſtant, and the whole ſteer the ſame intended courſe.

24 To form the third order of ſailing.

In the third order of ſailing the admiral is in the middle of his fleet. Now, the fleet being formed in a line, on one of the lines of bearing, as above directed, and the ſhips ſteering in the wakes of each other, or ten points from the wind, the leading or leewardmoſt ſhip firſt hauls her wind; the ſecond ſhip, as ſoon as ſhe is in the wake of the leader, hauls her wind alſo; and in like manner each ſhip until the admirals ſucceſſively haul their wind as ſoon as they have reached the wake of the leading ſhip; and at the ſame inſtant that the admiral's ſhip hauls her wind, the other, or ſternmoſt half of the fleet, do the ſame. The fleet will then be in the third order of ſailing, as repreſented in fig. 4. From this order of ſailing the fleet can be expeditiouſly formed into the line of battle on either tack.

25 To form the fourth order of ſailing.

As the fleet, in the fourth order of ſailing, is divided into ſix columns, and the three commanders ranged on the two lines of bearing, the commander in chief being at the angular point; in order, therefore, to form this order, the admirals range themſelves on the two lines of bearing, at a proper diſtance from each other, and ſteer the proper courſe; the ſhips of the ſeveral columns come each into its reſpective place, forming themſelves into lines in the direction of the wind, and parallel to each other, as in fig. 5.

26 To form the fifth order of ſailing.

In order to form the fifth order of ſailing, the three leading ſhips of the diviſions are to take their poſts abreaſt, and to leeward of each other, keeping their wind under an eaſy ſail. Then the ſhips of each ſquadron making ſail, will range themſelves in their reſpective ſtations, aſtern of their leaders, and keeping the ſame courſe; each ſhip preſerving the appointed diſtance from that next ahead; and the commanders of each diviſion, and each ſecond, third, &c. ſhip, are to keep themſelves mutually abreaſt of each other.

27 To form the order of battle.

To form the order of battle, it has already been obſerved, in the firſt order of ſailing, that the ſhip which is to lead runs to the leeward of the whole, and then hauls her wind upon the tack directed, carrying an eaſy ſail. Each ſhip then makes ſail according to her diſtance, and chaſes the ſhip which is to be immediately ahead of her in the line, and hauls in her wake in the line on which the van ſhip is moving.

28 To form the order of retreat.

The admiral, or ſhip appointed to make the angular point, runs to the leeward of the fleet, and brings to; then each ſhip runs to its reſpective ſtation in one of the lines of bearing, and brings to; one half of the fleet being on one of the lines of bearing, aſtern and in the wake of the admiral, and the other half on the other line of bearing, on the ſtarboard or larboard bow of the admiral. When this is accompliſhed, the whole fleet bears away before the wind: the two wings will now bear from the admiral two points before his beam, and ready to form the line of battle upon either tack; the ſhips on the admiral's ſtarboard bow being in the line of bearing for the larboard tack, and thoſe on his larboard bow in the line of bearing for the ſtarboard tack.

Chap. III. *To Change from the ſeveral Orders of Sailing to the Line of Battle.*

29 To form the line of battle from the firſt order of ſailing.

To form the line from the firſt order of ſailing: If the ſhips be running large on the tack anſwering to the line of bearing on which they are ſailing and the line to be formed on the ſame tack, all the ſhips haul the wind at the ſame time, or at leaſt each ſhip hauls her wind immediately after the next to windward: but if the fleet be on the other tack with

with respect to the line of bearing, all the ships haul their wind and tack together, or all veer together according to circumstances. If the line of battle is to be formed on the other line of bearing, the leewardmost ship either veers or tacks, and hauls her wind: the rest of the fleet veer or tack at the same time, and steer with the wind four points free; and each ship successively, as soon as she gets into the wake of the leader, hauls her wind. Hence the line of battle will be formed from the first order of sailing. See figs. 10. and 11.

Plate cccxcv.

To form the line from the second order of sailing, the fleet running large or before the wind: All the ships of the fleet haul up together on the tack directed, presenting their heads on the line upon which they are ranged, or eight points from the wind. The leading ship then hauls her wind, and is followed in succession by the rest. That the ships may not be too near each other, they make sail as they haul their wind, or their seconds astern shorten sail to open the order. See fig. 12.

To change from the third order of sailing to the line of battle: The ships being supposed going large, that wing which is in the line of bearing for the tack on which the line is to be formed, and the ship at the angular point, haul their wind at the same time; the ships of the other wing haul up together eight points from the wind; then each ship moves in this direction until she reaches the wake of the other wing, where she hauls close up. See fig. 13.

To form the line of battle on the same tack from the fifth order of sailing: Let the weather column form the van, and the lee column the rear. The centre brings to, or only keeps steerage-way; the weather-column bears away two points, and hauls its wind as soon as it is ahead of the centre; the lee-column tacks together, and runs under a press of sail, to gain the wake of the centre, when it retacks together and completes the line (see fig. 14.) This evolution may also be performed as follows: The weather-column brings to; the centre and lee columns tack together, and go away two points free: when the centre-column has gained the wake of the van, it retacks together, and brings to; and when the lee-column has gained the rear-line, it retacks together, and then all stand on: otherwise the lee-column brings to; the centre goes under an easy sail two points free, to get ahead of the rear-squadron; while the van carries a press of sail, also two points free, to get ahead of the centre divisions.

Hitherto the weather-column has uniformly been supposed to form the van, and the lee-column the rear-division: the line may, however, be formed by interchanging these columns in a variety of different ways, some of which are as follow.

33 The centre and weather columns interchanging.

1. Let the weather and centre columns interchange: In this case the centre-column stands on, the weather-column bears away eight points, and as soon as it reaches the wake of the centre-column, which now forms the van, hauls up together: the lee-column tacks together, and goes under a press of sail scarcely two points free, so as just to gain the rear of the line, and then retacks together, as in fig. 15. This evolution may also be performed by the lee-column bringing to; the centre squadron then bears away together one point, and as soon as it has gained the head of the line, hauls its wind; and the weather-column bears away together three points, under an easy sail; and when it has got into the wake of the van, hauls up together, forming the centre division.

34 The centre and lee columns interchanging.

2. Let the centre and lee columns interchange: The lee-column stands on close-hauled, under an easy sail; the weather-column bears away two points under a press of sail, until it reaches the head of the line, and then hauls up: the centre-column bears away eight points; and when in the wake of the lee-column, which is now the centre division, hauls its wind. See fig. 16.

35 The weather and lee columns interchanging.

3. The weather and lee columns interchanging: For this purpose, the lee column stands on close-hauled under a press of sail; the centre-column bears away two points under an easy sail, and hauls up as soon as it has come into the wake of the new van squadron; and the weather-column bears away eight points until it gains the wake of the centre-column, and then hauls up, as in fig. 17.

36 The centre forming the van and the weather the rear.

4. The centre forming the van, and the weather column the rear-division: The lee-column brings to, the centre-column bears away together two points, and forms the line a-head of the new centre squadron; the weather-column veers away together seven points on the other tack, and forms the rear squadron. See fig. 18.

Plate cccxcv.

37 The lee column forming the van and the centre the rear division.

5. The lee-column to form the van, and the centre the rear division: In order to this, the lee-column stands on under a press of sail, the weather-column bears away together three points under an easy sail, and the centre column bears away eight points; and each, when it has gained the wake of the new van, hauls its wind. See fig. 19.

38 To form the line on the other tack, the weather-column forming the van, &c.

To form the line of battle on the other tack from the fifth order of sailing. The weather-column first tacks in succession; the centre and lee columns stand on, the first under an easy sail, and the second under still less sail, according to the length of the columns; and the leaders tack when they gain the wake of the new-formed van, and each ship tacks in succession as it reaches the wake of the above mentioned van (see fig. 20.) Very great care must be taken by the centre and lee columns, lest they draw too near the sternmost ships of the van, and also each other.

39 The centre and weather columns interchanging.

To perform this evolution, the centre and weather columns interchanging: The weather column brings to, the centre column stands on until the leader judges he will be fully able to clear the weather-column, and then the centre-column tacks in succession: when the last ship of this new-formed van has passed the weather-column, that column stands on, and each ship tacks in succession as soon as it reaches the wake of the van. The lee-column stands on, and tacks in succession as the ships attain the wake of the van, and at the same time carrying a moderate sail, that there may be a sufficient interval left for the weather-column to form the centre division. See fig. 21.

40 The centre and lee columns interchanging.

To form the line from the fifth order of sailing on the other tack, the centre and lee columns interchanging. The centre-column brings to; the weather-column tacks in succession under very little sail, and the lee-column stands on under a press of sail: when the leader of the lee-column has gained the wake of the line, he tacks, and is followed in succession by his division. The centre-column is to fill and stand on, when the first ship of that column, and the last ship of the lee-column, bear from each other in a line perpendicular to the direction of the wind. See fig. 22.

41 The weather and lee columns interchanging.

To form the line on the other tack from the fifth order of sailing, the weather and lee columns interchanging: The weather and centre columns bring to; the lee-column stands on under a press of sail, until it can pass ahead of the weather-column, and then tacks in succession; the centre-column fills where its leading ship and the last ship of the lee-column bear from each other, in a line perpendicular to the direction of the wind, and tacks in succession when it has gained the wake of the new van. In like manner, the weather-column fills when its leading ship and the last of the centre bear in a line perpendicular to the wind, and each ship tacks in succession when it has gained the wake of the centre. See fig. 23.

42 The weather-column forming the rear.

To form the line on the other tack, the centre forming the

To change [illegible] line of battle [illegible] Order of Sailing. the van, and the weather the rear division: The weather-column brings to, the other columns make sail and stand on, till they can pass on the other tack ahead of the weather-column, when they tack in succession. When both columns have passed the weather column, it fills, tacks in succession, and forms the rear. See fig. 24.

43 The lee-column passing to the van. To form the line on the other tack from the fifth order of sailing, the lee-column forming the van: The weather and centre columns bring to; the lee-column carries a press of sail, and tacks in succession when it can pass a-head of the weather-column; and when the last ship of this new van has passed to the windward of the former weather-column, the van squadron shortens sail, to give time for the other columns to form: the weather and centre columns fill at the same time, to gain the wake of the van, when they tack in succession. See fig. 25.

44 To form the line from the order of retreat. To form the line from the order of retreat: The leader of the wing, which is to form the head of the line, hauls the wind, and that wing follows in succession; the other wing goes four points free together on the same tack, and thus runs parallel to the wing which first began the evolution; and they haul up together when they arrive in the wake of the line. See fig. 26.

CHAP. IV. *To change from the Line of Battle to the different Orders of Sailing.*

45 To change from the line of battle to the first order of sailing. To change from the line of battle to the first order of sailing on the same tack: All the ships bear away together the number of points directed by the admiral, observing to keep themselves in the line of bearing for the tack they are in. The sternmost ship bears away first, and the rest successively as quickly as possible, to prevent being too near each other.

To change to the first order of sailing in bearing for the line on the other tack: The leader bears away four points to leeward, and is followed in succession by the rest. When the sternmost ship has bore away, the whole haul up, and they will be in bearing for the line on the other tack. See fig. 27.

46 To change to the second order of sailing. To change from the line of battle to the second order of sailing: The whole fleet bears away together ten points; and so proportions the sailing from the van to the rear of the line, that when the headmost ship, which first presses sail, shall come abreast of the second ship, the second ship adapts her sail to keep in this bearing; and so on in succession, each observing to keep the ship that immediately preceded her in the evolution in a line with herself, perpendicular to the direction of the wind; and the whole fleet will now be running before the wind (see fig. 28.) But if it is intended that the fleet shall steer any other given course than that before the wind, the whole fleet may then alter together to the proposed course.

47 To change to the third order of sailing. To change to the third order of sailing from the line of battle: The whole fleet bears away together ten points; the headmost half of the fleet, including the centre ship, carry an equal degree of sail, in order to preserve their line of bearing; each ship of the remainder of the fleet carries less sail in succession, such as will form and preserve on the other line of bearing with respect to that upon which they were ranged before the evolution; and by this means the fleet will be formed in the third order of sailing. See fig. 29.

Plate cccxv.

48 To change to the fifth order of sailing on the same tack. To change from the line of battle to the fifth order of sailing on the same tack: In the treatise of *Naval Tactics*, published in the second volume of *The Elements of Rigging and Seamanship*, there are various rules for performing this evolution, according as the different squadrons in the line of battle are intended to form the weather, the centre, and the lee columns, in the order of sailing. We shall give two of them as examples. To change from [illegible] to the Order of Sailing.

1. When it is intended to change from the line of battle to this order of sailing, so as that the van shall form the weather, and the rear the lee column, and the fleet at the same time keep as much to windward as possible: the van and centre tack together, and run close-hauled in [illegible] quarter-line; the rear moves on in its former course under an easy sail. When each ship of the centre is abreast of its correspondent ship in the rear, the centre retacks: the van stands on until the centre and rear come up, and then retacks, and all the columns regulate their distances. See fig. 30. 49 The van [illegible] weather and the rear the lee column.

50 The van forming the lee and the rear the weather column. 2. When it is intended that the van shall form the lee, and the rear the weather column; the van bears away together under an easy sail, and goes at right angles with the line ahead: the centre at the same time goes away two points free, and each ship steers for that ship of the van respectively which is to be abreast of her when in column. The leader of the van must determine the distance, by not hauling up with his division until his ship and the sternmost ship of the centre-column, which is drawn up with him, are in a line at right angles with the wind: They then both stand on under an easy sail, while the rear crowding sail passes to the windward of both. See fig. 31.

51 To change to the fifth order of sailing from the line of battle on the other tack. To change from the line of battle to the fifth order of sailing on the other tack: This evolution may be performed in as many ways as the former, according to the intended positions of the different columns; but in such a Work as our's, it may be sufficient to observe, that,

52 The van forming the weather and the rear the lee column. 1. When the van is meant to form the weather, and the rear the lee column: The van tacks in succession; the leader of the centre tacks when the leader of the van is passing him exactly to windward, and his division follows him; the rear manœuvres in the same manner with respect to the centre. See fig. 32.

53 The rear forming the weather and the van the lee column. 2. When the rear is to form the weather, and the van the lee column: The van tacks in succession; and when about, either brings to, or shortens sail, to allow the other columns time to form. The centre and rear then carry sail, and tack in succession. The centre tacks when its leader has the centre of the lee-column in a line at right angles with the wind, or when its centre passes astern of the lee-column. When the centre is about, it regulates its rate of sailing by the lee-column, either by bringing to or making equal sail; and thus both wait for the rear to pass to windward. The rear tacks when its leader has the first ship of the lee-column in a line at right angles with the wind, or when its centre ship passes astern of the last ship of the centre-column. See fig. 33.

54 To change to the order of retreat. To change from the line of battle to the order of retreat: The leader bears away four points; and all the fleet following close hauled, they will come to file off in succession at the same point in the van ship's wake, till the centre ship arrives at the angle where the evolution began. Then the order of retreat will be formed, and any course whatever may be steered, since the two wings will be equal and in order on the starboard and larboard lines of bearing, forming consequently between them an angle of 135 degrees. Fig. 34. represents the order of retreat formed from the line of battle, the whole fleet going four points free.

CHAP. V. *To Manœuvre the Line of Battle.*

THE method of forming the line of battle, when the ships are in no previous order, has already been explained. In this place it is intended to point out some of the various evolutions

evolutions that are, or may be, performed by a fleet which is already formed in line of battle.

The fleet being in line of battle, to form the line on the other tack, by tacking in fucceffion: The headmoft fhip of the fleet tacks firft, having previoufly made more fail, or the fecond having fhortened fail, in order to increafe the interval between them; for it often happens that one or two cables length are run over before the fhip ahead has been able to fill her fails on the other tack. When the firft fhip is about, either the fecond makes more fail, or the third fhortens fail; and then the fecond tacks as foon as fhe has gained the wake of the leader, the helm being put down at the inftant fhe opens the weather quarter of the firft fhip, which is already on the other tack. In like manner the third, fourth, &c. fhips tack each at the inftant it has gained the wake of the leader; and thofe fhips already about muft preferve their affigned diftances, by fhortening fail, if neceffary, until the whole fleet is on the other tack. If a fhip miffes ftays, fhe is immediately to fill again on the fame tack, and make fail with all poffible expedition, taking care to keep as clofe as poffible to the wind, and not to fall off to leeward. By this means fhe will get ahead and to windward of thofe which follow her; and they will perform fucceffively their evolutions in the wake of the fhips which are already on the other tack, only ftanding on a little farther than they would have done if the fhip ahead had not miffed ftays. The fhip that miffed ftays will return fooner to her ftation, by making all poffible fail to windward of the line. See fig. 35.

To form the line on the other tack without tacking in fucceffion: The whole fleet veers together: the rear fhip hauls her wind on the other tack, and ftands on, while all the others go two points free on the other tack, and haul up as they fucceffively gain the wake of the leading fhip. Thus the rear of the line on the one tack becomes the van on the other tack. See fig. 36.

The line to veer in fucceffion: The van fhip of the line veers round, and fteers four points free on the other tack; and when fhe is clear of the rear fhip of the line, fhe hauls her wind; the reft follow, and haul up in fucceffion. See fig. 37.

The line to tack and retack together: In tacking together, the fternmoft fhip of the line puts in ftays; then her fecond ahead puts her helm down; and fo on through the whole line, to prevent the fhip ahead from falling on board the fhips aftern. The fleet will then be in bow and quarter line; from which, if tacking together, no fhip muft put in ftays till the fhip on her weather quarter is in the act of tacking.

The line bear away together, preferving their bearing for the line: The rear begins this evolution, the fternmoft fhip bearing away the number of points propofed; and fo on as quickly as poffible, to prevent falling on board of each other.

To turn to windward in line of battle: When the fleet has fea-room, the moft advantageous method of gaining to windward is, that all the fhips of the fleet may go about together; as by this means the whole fleet will gain as much to windward as in the cafe of a fingle fhip. The fleet will be in line of battle on the one board, and in bow and quarter line on the other. This is alfo the moft proper method to get to windward on a coaft when the wind is parallel to the land: But if the fleet is turning to windward in a ftrait or between two fhores, the fleet fhould tack in fucceffion; for if all the fhips tacked together, the van would be foon in with the land on one fide, and foon after the fleet had retacked the rear would be in with the land on the other fide: hence this would occafion a number of fhort boards. In paffing through a ftrait, other circumftances are alfo to be attended to, as tides, &c.

Manœuvre a fleet in the Fifth Order of Sailing.

61 To interchange the van and centre squadrons.

To interchange the van and centre fquadrons: The van bears away a little, and brings to; the centre paffes on to windward, edging a little, to get ahead of the former van on the fame line; the rear, coming on under an eafy fail, edges away likewife, to obtain the wake of the new centre fquadron. See fig. 38.

62 Van and rear fquadrons.

To interchange the van and rear fquadrons: The van and centre fquadrons bear away a little, and then bring to, the van obferving to bear away a little more to the leeward than the centre. The rear ftands on to gain the head of the line; and when abreaft of the former van, the centre fills, and both ftanding on, form ahead of the new rear, by edging down until they are in a line with it. See fig. 39.

63 Centre and rear fquadrons.

To interchange the centre and rear fquadrons: The van ftands on under an eafy fail, while the centre bears away a little and brings to, and the rear at the fame time carries a prefs of fail to pafs the centre to windward and get into the wake of the van. The van and centre then edge away to gain the line with the new rear fquadron, which then fills. See fig. 40.

64 The van to pafs to the rear.

The van to pafs and form the rear: The van fquadron edges away a little and brings to; the other two fquadrons, crowding fail, ftand on till they get ahead of the new rear, and then edge away a little to form in the line; after which the rear fills.

65 The rear to pafs to the van.

The rear to pafs and form the van: The van and centre bear away a little and bring to; the rear makes fail, paffes ahead of both, and then edges away to form on the fame line. Thefe two manœuvres are fo fimple as not to ftand in need of illuftration by figures.

CHAP. VI. *To Manœuvre a Fleet formed in the Fifth Order of Sailing.*

66 To manœuvre the fifth order of failing.

THIS order of failing is very advantageous for a numerous fleet, as it keeps the fhips clofer together, and therefore more connected with each other than either of the three firft orders. The method of forming this order is fhown in Chap. II.: and the method of manœuvring in it, which with very little alteration is alfo applicable to the fourth order, is to be the fubject of this chapter.

67 To tack in fucceffion.

To tack the columns in fucceffion: The fhips of the lee-column having more diftance to run before they can recover their pofition, muft go about firft in fucceffion. When the centre leader finds himfelf abreaft of the leader to leeward of him, or at right angles with the clofe-hauled line on the other tack, upon which the lee leader is now moving, he tacks, and is followed in fucceffion by his divifion. The weather-column paying the fame regard to the centre-column, manœuvres in the fame manner (fee fig. 41.) In this evolution the weather-column ftill continues to windward; and fhould the columns have clofed too much, or be too far afunder, either of which may happen from the inequality in the rate of failing of the different fhips, the order may be recovered either by the lee or windward column bearing away, fo as to make an angle equal to that propofed, as two points, between any column, and a line joining the leader of that column and the fternmoft fhip of the next column.

If this evolution is to be performed in the night, the weather-column muft tack firft. In order to prevent the rifk of one column paffing through the van of the other columns, the next column muft not tack till its leader is fenfible that many fhips of the column immediately to windward are about. When about, the leaders make little fail, while their followers make fucceffively a little more, in order to form their refpective columns. The columns which are

Manœuvre to alter the line of sailing. pletely about should either bring to and wait for the next, or should just keep steerage way; then the leeward weather column should wait for the centre, and both should then wait for the former lee column. In this evolution the weather and lee columns will be interchanged. As some risk may attend the execution of this at night, it is most advisable to tack the columns together, and sail in bow and quarter line; because, should it become necessary to retack, or should the wind change before the completion of this evolution, much confusion might ensue. By tacking together this will be avoided.

68 To tack together. To tack the columns together: The sternmost ships of the three columns put in stays together; and when they are observed to be so, their seconds ahead immediately put their helm down, and so on through the whole fleet. Each column will then be in bow and quarter line. See fig. 42.

69 To veer in succession. To veer the columns in succession: The leader of the lee-column veers round, and steers four points free upon the other tack, followed by the ships of that division; and of which, when he is clear of the sternmost ships, he hauls up. The centre and weather columns perform successively the same evolution, observing to continue standing on till they successively bring the point at which the lee-column began to veer to bear in a right line to leeward of them. They likewise successively spring their luffs when the point at which the lee column hauled its wind bears right to leeward (fig. 43.) Each column having the same distance to run, if the evolution be well executed, the leaders of the windward columns will find themselves, when they spring their luffs, exactly abreast of the leader of the lee-column, and so will all the other ships. But the making or shortening sail will at all events rectify the inequality of sailing.

70 To turn to windward. To turn to windward in the fifth order of sailing: Let the ships of the fleet be so arranged, that the leaders, and also the corresponding ships of the columns, may be in the direction of the wind; as by this means the fleet will gain more to windward, and at the same time be less liable to disorder. Now the van ships of the columns tack at the same instant, and are followed in succession each by the remaining ships of the division, when they reach the wake of their leaders, or the same point when they went about; hence there will always be three ships in stays at the same time until the whole fleet has got on the other tack. The fleet then stands on any assigned distance, and then retacks in the same manner as before. See fig. 44.

Plate CCCXCVII.

71 To interchange the weather and centre columns. To interchange the weather and centre columns: The weather and lee columns lie to, or only keep steerage way. The centre column tacks together; and forming a bow and quarter line, goes close-hauled to gain the wake of the weather-column; it then retacks together, and stands on, while the weather-column bears away to its new station in the centre, and the lee-column fills. See fig. 45.

72 The weather and lee columns. To interchange the weather and lee columns: The centre column brings to; the lee column stands on under a press of sail; and when its sternmost ship can pass to windward of the van of the centre column, which will be when the centre ship of the lee column is in a line perpendicular to the direction of the wind with the van of the centre column, the lee column then tacks together, and stands on close-hauled till it comes in a line with the centre column, when it goes large two points to get into the station which the weather-column left; and then veers together, hauling the wind for the other tack. At the beginning of the evolution, the weather column bears away together under little sail, and goes large six points on the other tack, so as to get into the wake of the centre column; it then hauls to the former tack, going two points large, till it ranges abreast of the centre column, when it brings to, and waits for the new weather column. See fig. 46.

To interchange the centre and lee columns: The centre and weather columns bring to, or keep steerage way, as is most convenient; the lee column tacks together, and presses sail to gain the wake of the centre column; which, when they have effected, they retack together and stand on; the centre column then edges away under an easy sail, steering, if it lay to, eight points from the wind, and if it kept steerage way only two points, until it comes into the station of the lee column, where it hauls to the wind; while the weather column fills and stands on: and the order is re-established by shortening or making sail, according to circumstances.

The weather column to pass to leeward: The weather-column stands on under very little sail, while the centre and lee columns tack together, and carry a press of sail till they reach the wake of the weather-column, when they retack, and crowd sail till they come up with the weather-column; and when they have gained the wake of the weather-column, it bears away two points, to gain its station to leeward, and then hauls to the wind or brings to till the new weather and centre columns come up. See fig. 47.

The lee-column to pass to windward: The weather and centre columns bring to, while the lee column carries sail and tacks in succession as soon as the leading ship can weather the headmost ship of the weather-column; and when arrived upon the line on which the weather-column is formed, it re-tacks in succession, forms on the same line, and either brings to or stands on under very little sail. If it brings to, the other two columns bear away together two points, to put themselves abreast of the column now to windward; but if the new weather-column stood on under an easy sail, they may bear away only one point to gain their proper stations. See fig. 48.

As it is of the utmost importance that each ship be in her respective station, both to preserve order, and that the various evolutions may be more readily performed, the officer of the watch will therefore be ever anxious to preserve the station of his ship. This he may do by his quadrant; but the more ready method for this purpose is by means of the NAVAL SQUARE, which is constructed as follows:

Upon some convenient place at the middle of the quarter-deck, describe the square ABCD (fig. 49.), of which the sides AD and BC are parallel to the keel; through the centre line G draw the line EF parallel to AD or BC, and draw the diagonals AC and BD; bisect the angles EGD, EGC by the straight lines GH, GI, and the naval square will be constructed. Now since the angles FGD, FGC are equal to four points, being each half a right angle; therefore the angles EGD, EGC are each equal to 12 points, and consequently the angles EGH, EGI are each equal to six points. Hence, if a ship is running close-hauled on the starboard tack, in the direction FE, the direction of the wind will be IG, and her close-hauled course on the other tack will be GC: But if she be running in the same direction FE upon the larboard tack, her close-hauled course on the starboard tack will be in the direction GD.

In order now to apply the naval square to the keeping of ships in their respective stations, let the fleet be formed in the fifth order of sailing close-hauled, the corresponding ships of the columns coinciding with the direction of the wind, in order to turn to windward with greater facility. The corresponding ships in the column must be kept in the direction of GH, or GI, according to the direction of the wind and the tack they are upon, while all the ships of the

the ſame column muſt be in the direction of EF. See fig. 50.

Again, let the fleet be in three columns in one of the lines of bearing, the ſhip being cloſe hauled on the other tack. The ſhips of each column will be in the direction of one of the diagonals, while the correſponding ſhips of the other columns will be in the direction of the other diagonal (fig. 51). It will alſo be the ſame if the columns are in one line of bearing, and going four points large on the ſame tack. The application of the naval ſquare in other caſes will be obvious.

Chap. VII. *To reſtore or reform the Order of Battle upon Shifts of the Wind.*

1. Let it be intended to reſtore the order of battle on the ſame tack, the wind coming forward, and ſhifting ahead leſs than ſix points. In this caſe, the whole fleet is to bring to except the leader; who, in order that the ſame diſtances between the ſhips may be preſerved when the line is reformed, ſteers a courſe *ab* (fig. 52.), ſuch as to be at right angles to the middle point between the former and preſent direction of the wind: hence the courſe he muſt ſteer will be known by adding half the number of points the wind has ſhifted to eight points, and applying this ſum to the former cloſe-hauled courſe. As ſoon as the leader has arrived at the new cloſe-hauled line with reſpect to the ſecond ſhip ahead, that ſhip immediately fills, and bears away the ſame number of points as the leader; and when both theſe have reached the cloſe-hauled line with reſpect to the third ſhip, ſhe alſo fills, and bears away. In like manner the remaining part of the fleet bear away in ſucceſſion; and when they have got into the cloſe-hauled line *bc* with the ſternmoſt ſhip, they all haul their wind at the ſame inſtant, and the ſternmoſt ſhip fills and ſtands on cloſe-hauled.

A very expeditious method of performing this evolution is as follows: The whole fleet having fallen off as ſoon as the wind ſhifted the ſame number of points which it changed, the leader bears away eight points from the middle point between the former and preſent directions of the wind; or, if the wind has ſhifted near ſix points, in this caſe the leader muſt bear away eight points from the new direction of the wind; but then the fleet will be cloſer than before, and the leader hauls his wind as ſoon as the ſternmoſt ſhip bears on the cloſe-hauled line from him: The ſecond ſhip bears away when ſhe has reached the wake of the leader, and alſo hauls her wind when ſhe has again gained his wake. In like manner the third, fourth, &c. ſhips bear away, and alſo haul their wind in ſucceſſion, until the ſternmoſt and the whole line is formed again. See fig. 53.

If the wind ſhifts exactly four points ahead, the whole fleet is to veer round till the heads of all the ſhips are directed to the point exactly oppoſite to their former courſe; and the rear ſhip, which has now become the van, is to run four points large upon her new tack, and the reſt of the fleet to follow her in ſucceſſion; and when the laſt ſhip, which was the former leader, is got into the wake of the headmoſt in the line, the whole fleet is to veer together, and the order will be reformed on the former tack.

If the wind ſhifts eight points forward, the ſhips are to veer round altogether till their heads are on the point of the compaſs oppoſite to their former courſe; then the rear ſhip, having become the van, is to haul cloſe by the wind on the ſame board; all the other ſhips are to haul up in ſucceſſion, and range in the wake of the leading ſhip; and when the laſt ſhip is in her ſtation, the order will be reformed on the ſame tack.

82 Twelve points.

If the wind changes 12 points exactly, the fleet muſt veer round together, and haul their wind in ſucceſſion on the firſt tack.

83 To reform the order of battle on the other tack, the wind coming forward leſs than ſix points.

2. The wind coming forward, and the order of battle to be reformed on the other tack.

If the wind ſhifts ahead leſs than ſix points, all the ſhips of the fleet are to veer round, till their heads come to the oppoſite point of the compaſs with reſpect to their former courſe; and then the rear ſhip, which is now become the van, is to haul cloſe by the wind on that tack, and the other ſhips follow her in ſucceſſion. From hence the fleet might paſs to the line of battle on the former tack by veering in ſucceſſion.

84 Between ſix and twelve points.

If the wind comes ahead more than ſix points, but leſs than twelve, the fleet is to manœuvre in the ſame manner as before.

85 Twelve points.

If the wind comes ahead exactly twelve points, the tack is to be changed.

86 The wind coming aft and the order of battle to be reformed on the ſame tack.

3. When the wind ſhifts aft, and the order of battle to be reformed on the ſame tack.

If the wind has ſhifted leſs than two points, the leader hauls his wind, the fleet ſtands on as before, and each ſhip hauls her wind in ſucceſſion as ſhe gains the wake of the leader.

87 On the other tack.

If it is intended to change the tack, the whole fleet tack together, and the ſternmoſt ſhip, which now becomes the leader, hauls up, and the reſt bear down and haul up in ſucceſſion.

88 The wind changing ſixteen points.

If the wind changes ſixteen points, all the ſhips brace about for the other tack immediately, by which means the fleet will be going four points large; then the ſhips tacking or veering inſtantly together, the order of battle will be reſtored or formed again on the ſame tack as they were before the wind changed.

Chap. VIII. *Of the Battle.*

89 Of the line of battle.

In a naval engagement, the preſent mode, as has already been obſerved, is to draw up the fleet in a ſtraight line upon one of the cloſe-hauled lines under an eaſy ſail. The frigates, fire-ſhips, tranſports, &c. are placed at proper diſtances on the other ſide, with reſpect to the enemy (B). The diſtance between two adjacent ſhips in the line is uſually about a cable's length; but the admiral increaſes or diminiſhes this interval according to circumſtances.

90 Its advantages by being cloſe.

The nearer, however, the ſhips are to each other, the ſtronger is the line, and the more difficult to be broken or forced by the enemy; but ſtill there muſt be a ſufficient interval left, ſo that if a ſhip receive conſiderable damage, ſhe may be got out of the line without becoming foul or falling aboard of the ſhip next aſtern, which would be the means of putting the whole line in confuſion.

91 And conſiſts of large ſhips though fewer in number.

The ſtrength of a fleet depends alſo more on the largeneſs of the ſhips, and the weight of the metal, than in their number. The fewer the number of ſhips in a fleet, the more diſtinctly will the ſignals be perceived and anſwered by thoſe near the extremities of the line; the better alſo will the order

(B) Several able officers have been of opinion, that when fleets are ranged in order of battle, inſtead of being cloſe-hauled, they ſhould have the wind two points free, or upon the beam. Some of the reaſons alleged in ſupport of this opinion are, that the ſhips can more eaſily keep their ſtations; and if any ſhip ſhould happen to fall to leeward, ſhe may eaſily regain her ſtation, which would be almoſt impoſſible were the fleet cloſe-hauled.

The Battle.

der of battle be kept, and the fleet more easily manœuvred. A large ship is not so soon disabled as a small one; and in the case of a three-decker, although the upper deck should happen to be crowded with the wreck of broken masts, yards, &c. and hence it being scarcely possible to work the guns on that deck, yet if the weather be not tempestuous, the guns on the other two decks may be worked. If boarding should be deemed practicable, it is evident that the large ship, upon account of the height of her sides, as well as for other reasons, will have greatly the advantage over one of a less size. Large ships are also for the most part more able to encounter a storm than small ones; and in a gale of wind large ships have commonly the advantage in point of sailing. Hence it is obvious, that a fleet composed of large ships may have greatly the advantage over a fleet consisting of less ships, though much more numerous.

As in a naval engagement the two fleets are drawn up close-hauled, on two lines parallel to each other, one of these fleets is therefore to the windward of the other. The windward fleet has several advantages not possessed by the fleet to leeward, and the leeward fleet has also advantages over the weather fleet. The advantages and disadvantages of each of these fleets are as follow:

92 Advantages of the fleet to windward.

The fleet to windward may approach the leeward fleet at pleasure, and can therefore determine the time of commencement of the action. If the weather fleet is more numerous, it may send down a detachment of ships on the rear of the leeward fleet, and thereby put it into confusion. If any of the ships of the fleet to leeward should be disabled, the fleet to windward may with great ease send down their fire-ships upon them, or send a detachment after any part that gives way. The weather fleet may board if the admiral thinks proper; and it is scarcely incommoded with the smoke, which is carried off by the wind to the fleet to leeward.

93 Disadvantages of the fleet to windward.

The disadvantages of the fleet to windward are, an inability to quit the fight when once engaged, without being obliged to pass through the enemy's line, which is extremely dangerous; because the ships being already very much injured before they are obliged to fly, they must expect to be still more so; and as they have it no longer in their power to form the order of retreat, this manœuvre is absolutely a desperate one. If the fleet to windward tack altogether, in order to get off, the line to leeward may do the same, after having raked the weather ships in stays, and follow them on the other tack, with the advantage of having gained the wind of the centre and rear divisions of the flying line. If it blow fresh, it is seldom that weather ships have their lower deck guns sufficiently elevated; whence it results, that the ship being a little inclined on the lee side, the guns often run out again at their ports after being fired, which very much retards the service of the artillery, since the guns are obliged to be bowsed in again every time for loading; and oftentimes they can make no use at all of their lower tier. Again, such of the ships as are so disabled as to be obliged to quit the line, cannot easily do it, because in veering, for want of being able to tack, they fall between the two lines, where they are raked ahead, and by that means completely put in disorder: but should they be fortunate enough to be able to finish their evolution, it is still very difficult for them, disabled as they are, to get to windward of their line, and very often they fall foul of the next ships astern of them, which have it scarcely in their power to prevent the accident on account of the fire and smoke, especially if the line is much contracted; and should these perceive it, and try to avoid being run foul of by falling back on their next ship astern, and so on thus successively, it might happen, that from one to the other a great part of the fleet being obliged to manœuvre, their fire would lessen, and very often cease, by their covering each other; when, if the enemy take the advantage of this critical moment, the disorder increases, and all is lost. But these inconveniences may be partly prevented by having the disabled ships quickly towed out of the line by the boats of the fleet, which for that purpose should always be hoisted out from each ship before the engagement begins. Otherwise, if the ships in the weather line, not being too close, have the necessary space to observe what passes ahead of them, and to manœuvre, they ought to range themselves to leeward of the disabled ship, in order to cover her, and approach nearer to the enemy; all the other ships bearing up also together to preserve the line.

The ships in the line to leeward have the advantage of serving with facility and effect their lower deck guns in all weathers proper for fleets to come to action: they can quit the engagement at pleasure: their disabled ships can without difficulty quit their stations when necessity requires it: they can form the order of retreat with more readiness, or continue the action as long as convenient: in short, the lee line of battle, if superior in number, can also double the enemy, by making some of the ships in the van or rear to tack, and put one of the extremities of the enemy's line between two fires; and if they are formed in time, they may cannonade the enemy while bearing down to the attack.

The disadvantages of the fleet to leeward are, its being very much annoyed by the smoke, and a continued shower of fire from the wads falling on board, repelled by the wind, which if not attended to may be productive of dreadful consequences. The ships of the line to leeward cannot attempt to board those of the other whatever may be their inclination for it; they can hardly do more than accept the battle, without being able to determine either time or distance: it is even with great difficulty that they can avoid being boarded, or prevent their line from being broken, if the weather ships are bent upon doing it; and their fire-ships are very seldom of use.

A general rule for the adoption of either the weather or lee gage cannot be laid down. Sometimes the one is preferable, and sometimes the other; and very often the commander in chief has it not in his power to make an option.

Having proceeded so far with respect to the line of battle, it may not be improper to introduce in this place an account of a naval engagement, with the conduct to be observed previous to, and during the time of, its continuance.

The engagement will not begin till the admiral makes the signal, unless an action is insensibly brought on by some unavoidable circumstances in the line, or position of the van or rear of both fleets in forming or approaching each other. The admiral in such case will make the proper signal for the van or rear, by the distinguishing flag of either of these divisions, which will undoubtedly regulate the necessary manœuvres of the rest of the fleet throughout the whole line.

During the time of an engagement the greatest silence is to be observed in each ship; no one must quit his post upon pain of death; and should any one happen to refuse obeying an officer, he shall be put to death on the spot; the same also shall be done to any one who shall hide himself, or feign to be wounded. The wounded must be carried or conducted to the surgeon by those who have been appointed by the captain for that purpose. Should any one discover an advantage to be taken, he shall inform the officer who stands nearest him. No kind of rigging whatever is to be touched without an order. Should any dangerous shot be received at the water line of the ship, such of the calkers, or carpenters, or any other person who perceives it, shall inform in private the captain with it, without saying a word of the same to any one else upon pain of death,

unless it be a superior officer; the same precaution shall also be observed about any part of the ship catching fire.

Whilst the fleets are engaged, the admiral carries but little sail: in this however, he must conduct himself by the motions of the enemy, the ships always observing to keep close in the line; and if any ship happen to get out of the line, the ship which immediately follows is to pay no regard to her, but endeavour to keep her station in the line.

A captain must not quit his post in the line upon any pretence whatever, unless his ship should be so greatly damaged as to render her incapable of continuing the action. The little sail a fleet is under at such a time may in general give the ships, though damaged in their rigging, &c. time enough to repair their defects, without causing an unnecessary interruption in the line, by withdrawing out of action when their service might perhaps be of the utmost importance to the rest of the fleet.

A captain, through too impetuous a desire of distinguishing himself, ought never to break the order of the line, however inviting the advantage of an attack might then appear to him to secure success: he must wait with patience the signal of the admiral or commanding officer of his division, because it is always more essential to preserve and support a close line in action, as it constitutes the principal strength of a fleet in general, than to attend to a particular attack between two ships, which commonly decides but little with regard to the whole, however glorious in appearance, unless with a view at the same time of taking or destroying a flag-ship of the enemy's, and where success alone, even then, can justify the attempt.

The two immediate seconds to the admiral ought to direct part of their fire against the enemy's flag-ship, or any other that may attack their admiral; so that their chief attention should be employed more in his defence than in that of their own proper ship, as they must sacrifice every other consideration to the honour of their flag.

The same attention must likewise be paid to any other ship that may find herself engaged with one of the enemy's flag-ships; the next to her ahead and astern should serve in that respect as seconds, by dividing part of their fire against such flag-officer, in order to make him strike the sooner.

If any flag-officer stand in need of being assisted, he will of course make a signal for the corps de reserve; or if there should be none, he will signify the same to his division; on which his two seconds, with those nearest him, will close in to cover him, and continue the action. The frigates of his squadron will likewise be ready to give him the necessary assistance; and if he should still continue the attack, he will in a particular manner be supported by his whole division.

Those ships which happen to be most exposed to danger will naturally make the ordinary signals upon the occasion if they should receive any hurt or damage, in order to be supported by such of the line as are nearest to them.

When a fleet is so far superior in number as to be able to extend itself both ahead and astern considerably beyond the enemy's line, the admiral generally forms the excess into a body of reserve, drawn up in a line on the other side of the fleet with respect to the enemy. If the body of reserve is to windward, the ships composing it are to be drawn up in a line with the frigates nearest abreast of the centre; but if to leeward, a little ahead of them; being careful at the same time to keep within reach of observing distinctly all the signals and motions of the fleet, and to be ready to replace such of the ships as may happen to be dismasted or driven out of the line, where all intervals must be properly strengthened, and carefully filled up again without loss of time. The body of reserve is usually formed at the same time with the line, to prevent any irregularity that may happen on leaving any intervals or openings; yet the admiral may draw ships out of the line to form a body of reserve, according to the time and circumstances of his situation.

106 The oldest captain except the commander to relieve the first disabled ship.

The oldest captain, after the senior officer who commands the body of reserve, ought to relieve the first, or take that part of the line which the disabled ship has been obliged to quit; and so on successively of the rest.

107 The whole body of reserve not to be detached unless in case of emergency.

The commanding officer of the body of reserve will not be detached with the whole corps, unless on some pressing occasion, to fortify the line, where such reinforcement is absolutely necessary. If to second one of the flag officers of the three squadrons, he will be followed by the next senior officer of the reserve who was not before detached, in order to place themselves as seconds, the first ahead and the other astern of the flag they are to support, without any diminution of the honour of his own proper seconds at the same time, as they are only called in through necessity on that emergency, being not engaged before, and consequently better able to assist and support the admiral; their duty being likewise to exert their utmost efforts in attacking, or, if possible, in boarding, the enemy's flag-ship, to force him to yield, except they are particularly ordered off to some other quarter or part of the line.

108 The admiral may order the whole body to reinforce either of the squadrons.

The admiral will sometimes order the whole body of reserve to reinforce one of the three squadrons of the fleet, as he may see occasion; which, when he does, the body must make all the sail it can, that each ship may place herself successively, the first in the first interval, the second in the second interval, and so on throughout. If a part only of the body of reserve is wanted, the proper signal will be made accordingly.

109 The body of reserve to rejoin the line.

When the admiral has no further occasion for the body of reserve, he will make the proper signal for the ships composing it to resume their respective posts in the line, and these ships will repeat the signals.

110 In case a captain should think boarding practicable.

If any captain in the fleet think he can board with success one of the enemy's ships, he will signify the same to the admiral by hoisting the boarding flag, together with his particular pendant, to be more plainly distinguished: the admiral in return will make the proper signal of approbation, or otherwise if he disapprove of the attempt, by letting fly that ship's particular pendant that she may observe the signal the better. Before the captain make the signal, he ought to consider well the ill consequences that might attend such an enterprise if he should fail of success; for the breaking of the order or disposition of the line, by quitting his post, may be of much greater disadvantage to the whole, than any advantage arising from his victory, except that over a flag-ship.

111 The fire-ships to prepare when the signal is made to engage.

When the admiral makes the signal for his fleet to prepare for action, the fire-ships will at the same time get ready their grappling-irons, fire-engines, &c. for boarding, and will likewise dispose all their combustibles into their proper channels of communication, &c. as soon as possible after the action begins: all which, when ready, they will take care to make known by signal to the particular division or squadron they belong to, and they of course will repeat the same to the admirals.

112 To be out of the reach of the enemy's guns.

The fire-ships must be particularly careful in placing themselves out of the reach of the enemy's guns, which they may do abreast and under shelter of their own ships in the line, and not in the openings between the ships, unless to prevent any of the enemy's ships that should attempt to force through their line, when they must in such cases use their utmost efforts to prevent them. They ought always to

The battle — to be very attentive to the admiral's signals, as well as those of the commanding officer of the particular squadron they belong to, that they may lose no time when the signal is made for them to act, which they must quickly answer by a signal in return.

113 The fire-ship in her way to the enemy to be assisted by the ship ahead of which she passes.

Although no ship in the line should be particularly appointed to lead down or protect the fire-ships, besides the frigates already ordered for that particular purpose; yet the ship ahead of which the fire-ship passes in her way to the enemy, whatever division she may belong to, is to escort her, and must assist her with a boat well manned and armed, as well as any other succour she may stand in need of: The two next ships to her must likewise give her all necessary assistance. The captain of a fire-ship is to consider, in short, that he is answerable for the event, in proportion as he expects to be honourably rewarded if he succeed in so daring and hazardous an enterprise.

114 Particular description of a naval engagement between two ships.

Since a general engagement of fleets or squadrons of men of war is nothing else than a variety of particular actions of single ships with each other, in a line of battle, it may not be improper to begin by describing the latter, and then proceed to represent the usual manner of conducting the former.

115 Divided into preparation, action, and repair.

The whole economy of a naval engagement may be arranged under the following heads; namely, the *preparation*, the *action*, and the *repair* or *refitting* for the purposes of navigation.

116 The preparation.

The *preparation* is begun by issuing the orders to clear the ship for action, which is repeated by the boatswain and his mates at all the hatchways or staircases leading to the different batteries. As the management of the artillery, in a vessel of war, requires a considerable number of men, it is evident that the officers and sailors must be restrained to a narrow space in their usual habitations, in order to preserve the internal regularity of the ship. Hence the hammocs, or hanging beds, of the latter are crowded together as close as possible between the decks, each of them being limited to the breadth of 14 inches. They are hung parallel to each other, in rows stretching from one side of the ship to the other, nearly throughout her whole length, so as to admit of no passage but by stooping under them. As the cannon therefore cannot be worked while the hammocs are suspended in this situation, it becomes necessary to remove them as quickly as possible. By this circumstance a double advantage is obtained: the batteries of cannon are immediately cleared of an encumbrance, and the hammocs are converted into a sort of parapet, to prevent the execution of small shot on the quarter-deck, tops, and forecastle. At the summons of the boatswain, *Up all hammocs!* every sailor repairs to his own, and, having stowed his bedding properly, he cords it up firmly with a lashing or line provided for that purpose. He then carries it to the quarter-deck, poop, or forecastle, or wherever it may be necessary. As each side of the quarter-deck and poop is furnished with a double net-work, supported by iron cranes fixed immediately above the gunnel or top of the ship's side, the hammocs thus corded are firmly stowed by the quarter-master between the two parts of the netting, so as to form an excellent barrier. The tops, waiste, and forecastle, are then fenced in the same manner.

Whilst these offices are performed below, the boatswain and his mates are employed in securing the sailyards, to prevent them from tumbling down when the ship is cannonaded, as she might thereby be disabled and rendered incapable of attack, retreat, or pursuit. The yards are now likewise secured by strong chains or ropes, additional to those by which they are usually suspended. The boatswain also provides the necessary materials to repair the rigging, wherever it may be damaged by the shot of the enemy, and to supply whatever parts of it may be entirely destroyed. The carpenter and his mates, in the meanwhile, prepare shot-plugs and mauls, to close up any dangerous breaches that may be made near the surface of the water; and provide the iron-work necessary to refit the chain-pumps, in case their machinery should be wounded in the engagement. The gunner with his mates and quarter-gunners is busied in examining the cannon of the different batteries, to see that their charges are thoroughly dry and fit for execution; to have every thing ready for furnishing the great guns and small arms with powder as soon as the action begins; and to keep a sufficient number of cartridges continually filled, to supply the place of those expended in battle. The master and his mates are attentive to have the sails properly trimmed, according to the situation of the ship; and to reduce or multiply them, as occasion requires, with all possible expedition. The lieutenants visit the different decks, to see that they are effectually cleared of all encumbrance, so that nothing may retard the execution of the artillery; and to enjoin the other officers to diligence and alertness, in making the necessary dispositions for the expected engagement, so that every thing may be in readiness at a moment's warning.

The B. e. —

When the hostile ships have approached each other to a competent nearness, the drums beat to arms: The boatswain and his mates pipe, *All hands to quarters!* at every hatchway: All the persons appointed to manage the great guns immediately repair to their respective stations: The crows, handspikes, rammers, spunges, powder-horns, matches, and train tackles, are placed in order by the side of every cannon: The hatches are immediately laid, to prevent any one from deserting his post by escaping into the lower apartments: The marines are drawn up in rank and file on the quarter-deck, poop, and forecastle: The lashings of the great guns are cast loose, and the tompions withdrawn: The whole artillery, above and below, is run out at the ports, and levelled to the point blank range, ready for firing.

The com- and

The necessary preparations being completed, and the officers and crew ready at their respective stations to obey the order, the commencement of the action is determined by the mutual distance and situation of the adverse ships, or by the signal from the commander in chief of the fleet or squadron. The cannon being levelled in parallel rows projecting from the ship's side, the most natural order of battle is evidently to range the ships abreast of each other, especially if the engagement is general. The most convenient distance is properly within the point-blank range of a musket, so that all the artillery may do effectual execution.

The combat usually begins by a vigorous cannonade, accompanied with the whole efforts of the swivel-guns and the small arms. The method of firing in platoons, or volleys of cannon at once, appears inconvenient in the sea-service, and perhaps should never be attempted unless in the battering of a fortification. The sides and decks of the ship, although sufficiently strong for all the purposes of war, would be too much shaken by so violent an explosion and recoil. The general rule observed on this occasion throughout the ship, is to load, fire, and spunge the guns with all possible expedition, yet without confusion or precipitation. The captain of each gun is particularly enjoined to fire only when the piece is properly directed to its object, that the shot may not be fruitlessly expended. The lieutenants, who command the different batteries, traverse the deck to see that the battle is prosecuted with vivacity; and to exhort the men to their duty. The midshipmen second these injunctions, and give the necessary assistance, wherever it may be required, at the guns committed to their charge. The

gunner should be particularly attentive that all the artillery is sufficiently supplied with powder, and that the cartridges are carefully conveyed along the decks in covered boxes. The havock produced by a continuation of this mutual assault may be readily conjectured by the reader's imagination: battering, penetrating, and splintering the sides and decks; shattering or dismounting the cannon; mangling and destroying the rigging; cutting asunder or carrying away the masts and yards; piercing and tearing the sails so as to render them useless; and wounding, disabling, or killing the ship's company! The comparative vigour and resolution of the assailants to effect these pernicious consequences in each other, generally determine their success or defeat: we say generally, because the fate of the combat may sometimes be decided by an unforeseen incident, equally fortunate for the one and fatal to the other. The defeated ship having acknowledged the victory by striking her colours, is immediately taken possession of by the conqueror, who secures her officers and crew as prisoners in his own ship; and invests his principal officer with the command of the prize until a captain is appointed by the commander in chief.

8
The engagement being concluded, they begin to repair: the cannon are secured by their breechings and tackles with all convenient expedition. Whatever sails have been rendered unserviceable are unbent; and the wounded masts and yards struck upon deck, and fished or replaced by others. The standing rigging is knotted, and the running-rigging spliced wherever necessary. Proper sails are bent in the room of those which have been displaced as useless. The carpenter and his mates are employed in repairing the breaches made in the ship's hull, by shot-plugs, pieces of plank, and sheet-lead. The gunner and his assistants are busied in replenishing the allotted number of charged cartridges, to supply the place of those which have been expended, and in refitting whatever furniture of the cannon may have been damaged by the action.

Such is the usual process and consequence of an engagement between two ships of war, which may be considered as an epitome of a general battle between fleets or squadrons. The latter, however, involves a greater variety of incidents, and necessarily requires more comprehensive skill and judgement in the commanding officer. A short account of which also we shall next proceed to lay before our readers.

9
When the admiral or commander in chief of a naval armament has discovered an enemy's fleet, his principal concern is usually to approach it, and endeavour to come to action as soon as possible. Every inferior consideration must be sacrificed to this important object, and every rule of action should tend to hasten and prepare for so material an event. The state of the wind, and the situation of his adversary, will in some measure dictate the conduct necessary to be pursued with regard to the disposition of his ships on this occasion. To facilitate the execution of the admiral's orders, the whole fleet is ranged into three squadrons, each of which is classed into three divisions, under the command of different officers. Before the action begins, the adverse fleets are drawn up in two lines, as formerly described. As soon as the admiral displays the signal for the line of battle, the several divisions separate from the columns, in which they were disposed in the usual order of sailing, and every ship crowds sail to get into its station in the wake of the next ahead; and a proper distance from each other is regularly observed from the van to the rear. The admiral, however, will occasionally contract or extend his line, so as to conform to the length of that of his adversary, whose neglect or inferior skill on this occasion he will naturally convert to his own advantage, as well as to prevent his own line from being doubled; a circumstance which might throw his van and rear into confusion.

When the adverse fleets approach each other, the courses are commonly hauled up in the brails, and the topgallant-sails and stay-sails furled. The movement of each ship is chiefly regulated by the main and foretop sails and the jib; the mizen topsail being reserved to hasten or retard the course of the ship; and, in fine, by filling or backing, hoisting or lowering it, to determine her velocity.

The signal for a general engagement is usually displayed when the opposite fleets are sufficiently within the range of point blank shot, so that they may level the artillery with certainty of execution, which is near enough for a line of battle. The action is begun and carried on throughout the fleet in the manner we have already described between single ships. The various exigencies of the combat call forth the skill and resources of the admiral to keep his line as complete as possible when it has been unequally attacked; by ordering ships from those in reserve to supply the place of others which have suffered greatly by the action; by directing his fire-ships at a convenient time to fall aboard the enemy; by detaching ships from one part of the line or wing which is stronger to another which is greatly pressed by superior force, and requires assistance. His vigilance is ever necessary to review the situation of the enemy from van to rear; every motion of whom he should, if possible, anticipate and frustrate. He should seize the favourable moments of occasion, which are rapid in their progress, and never return. Far from being disconcerted by any unforeseen incident, he should endeavour, if possible, to make it subservient to his design. His experience and reflection will naturally furnish him with every method of intelligence to discover the state of his different squadrons and divisions. Signals of inquiry and answers, of request and assent, of command and obedience, will be displayed and repeated on this occasion. Tenders and boats will also continually be detached between the admiral and the commanders of the several squadrons or divisions.

As the danger presses on him, he ought to be fortified by resolution and presence of mind; because the whole fleet is committed to his charge, and the conduct of his officers may in a great degree be influenced by his intrepidity and perseverance. In short, his renown or infamy may depend on the fate of the day.

CHAP. IX. *Manœuvres performed by adverse Fleets when in sight of each other.*

10
To dispute the weather-gage with the enemy.—When the enemy is to windward, and it is wished to gain the weather-gage of him, the fleet to leeward should avoid extending itself the length of the enemy's line, in order to oblige them to edge down upon theirs, if they intend to attack them; which will be a mean, if they still persist in doing so, of losing the advantage of the wind.

It is impossible for a fleet to leeward to gain to windward so long as the enemy keep their wind, unless a change happens in their favour: therefore all that a fleet to leeward can do, must be to wait with patience for such a change; which they will undoubtedly avail themselves of, as well as any mistake or inadvertency the enemy may commit in the mean time. And as long as the fleet to leeward does not extend its line the length of the enemy's, it will be impossible for the latter to bring them to action without running the hazard, by bearing down, of losing the advantage of the wind, which both fleets will be so desirous of preserving.

Manœuvres performed by adverſe Fleets when in ſight of each other.

Hence, that an admiral may benefit by the ſhifts of the wind that frequently happen, he muſt in a manner force them; which will not appear ſo extraordinary to officers of any experience, who know what winds reign moſt on the coaſt, or off the head-lands, where they may expect an enemy; and though an admiral may be ſometimes out in his conjecture, he alſo as often ſucceeds ſo happily as to gain the advantage of his enemy. The diſpoſition of projecting head lands, and the ſetting of tides or currents, alſo contribute greatly towards gaining the wind of the enemy.

Again, the fleet to windward ought to keep that to leeward as much as poſſible always abreaſt of it; becauſe, by doing ſo, they will preſerve the advantage they have, unleſs the wind changes much againſt them. They ſhould force them likewiſe to keep their wind, unleſs they think it more prudent not to engage; but when that is the caſe, they ſhould keep entirely out of ſight.

The following obſervations, with reſpect to the ſhifting of the wind, are given by M. Bourdé de Villehuet: 1. If the weather fleet be in order of battle, and the wind draw ahead, the lee fleet, if they be ahead and in order of battle, ought to box off on the ſame tack as before, in order to tack in ſucceſſion in the wake of one another, to reſtore the order of battle; drawing at the ſame time a great deal to windward. This manœuvre may even be the means of weathering the enemy, if the wind ſhould ſhift much; for they have no other method to regain the order of battle, without loſing much ground: though they will always loſe a great deal with reſpect to the poſition of the enemy to leeward.

Elements of [illegible] Seamanſhip, vol ii. p. 384.

2. If the lee fleet be aſtern, and the wind ſhifts aft while they are on the contrary tack with the enemy in order of ſailing on one line, the lee fleet ought to tack or veer altogether, and at the ſame inſtant; becauſe this ſhift of wind will be ahead for all the ſhips in reſpect to their tacks then on board, and aſtern in reſpect to the order of battle. When the van ſhip is full on the other tack, as well as all the reſt in their former order of battle, ſhe ſhall haul by the wind, while the reſt of the fleet run large on their firſt line of battle as many points as the wind has ſhifted aft, to get into her wake ſucceſſively, and reſtore the order of battle while approaching the enemy; by which they gain the wind of him, or elſe double him if the ſhift has been great; for the only means they have of reſtoring the line of battle is by the van ſhip hauling by the wind, and the reſt coming into her wake in ſucceſſion. If the ſhift of the wind was four points, the fleet to leeward would be obliged ſtill to perform the ſame manœuvre, that they might go about, after a certain time, ſucceſſively to windward of the enemy, who could only in the mean time have tacked all together, to bring their fleet ſuddenly in a line of battle on the other board.

If, when the wind ſhifts aft, the lee fleet is aſtern in order of battle, and the enemy be on the other tack in the order of ſailing, the leading ſhip muſt haul cloſe to the wind immediately, while the other veſſels will, in ſucceſſion, bear away as many points as the wind has ſhifted, in order to perform the ſame manœuvre and reſtore the line of battle. By obſerving this mode of manœuvring, you will approach the enemy, and gain as much to windward of him as poſſible, or get even the weather-gage of him entirely, if the wind has ſhifted conſiderably. The rear ſhip of the fleet to leeward may immediately keep cloſe to this new wind on the ſame board, while all the reſt of the fleet, after having tacked together and at the ſame time, will come and place themſelves cloſe by the wind in her wake, where they are again to tack ſucceſſively, in order to follow their rear ſhip, which is now become the leader, and which may break the enemy's line, or at leaſt gain the wind of him. But, to be able to go through this evolution, you muſt have nothing to fear from the enemy; for the fleet will be obliged to go about twice before the order of battle can be reſtored. The weather fleet ought to keep their wind as cloſe as poſſible, holding the enemy always exactly to leeward of them, by keeping on the ſame tack as he; and if the wind ſhifts a little, and becomes favourable to the enemy which is to leeward, the weather ſhips are then to keep exactly their wind, without caring for the preſervation of the line, unleſs the two fleets be very near one another.

To force the enemy to action.

To force the enemy to action when he is to windward.

1. When the enemy has the weather-gage.—When two adverſe fleets are in ſight of each other, an engagement is almoſt unavoidable: For ſince it may be preſumed that the faſteſt ſailing ſhips of the one fleet will ſail faſter than the ſloweſt ſailing veſſels of the other fleet, hence the fleet that is in purſuit will gain upon the other. The lee fleet, which is willing to bring on an engagement, muſt therefore keep always on the ſame tack with the weather fleet; and taking care to keep them ſo exactly abreaſt as to prevent the leaſt danger of loſing ſight of them, and hence be ready to take the advantage of the firſt favourable ſhift of wind to make the attack. Night is certainly the time when an alteration of the courſe may be beſt attempted. But the lee fleet is to have frigates on the look-out; which, by ſignals, will continually give notice of the manœuvre and courſe of the retreating fleet to windward; which, by theſe means, is always expoſed to be purſued without being able to get off unſeen, and muſt ſooner or later be compelled to come to action, unleſs they can get into ſome port, or a gale of wind ſhould come to reſcue them by diſperſing both fleets, and thus furniſh the means of retreating in a ſtorm.

Ibid. p. 384.

When is to leeward.

2. When the enemy is to leeward.—If the lee fleet keep cloſe to the wind in the order of battle, the fleet to windward is to ſtand on in the ſame manner till it is abreaſt of the enemy, ſhip to ſhip, when they are all together, and at the ſame time, to bear away, and ſteer exactly ſo as to bring their reſpective opponents, in the adverſe line, on the ſame point of the compaſs with them; obſerving the principles of chaſing, which are to be obſerved by every chaſer to windward. Thus the fleets will be near enough to begin the action, in preſenting the bow of each ſhip to her opponent in the order of ſailing, which will be eaſily changed for the line of battle, by all the ſhips hauling cloſe to the wind together, in the moment which precedes the beginning of the action.

Ibid. Manœuverer, p. 27.

If the fleet to leeward be inclined to engage, it might bring to, to prevent loſing time; as, by this manœuvre, leſs time will be requiſite for the weather fleet to join them: then they will fill as ſoon as the action begins, becauſe it is more favourable to a lee line to be advancing ahead; ſince, if a ſhip be diſabled in the weather line (which is obliged to follow with the topſails full), ſhe will infallibly drop, and run foul of the next veſſel aſtern of her, covered with fire and ſmoke, which may be productive of great diſorder.

As the lee fleet fills and ſtands on cloſe by the wind, it is neceſſary that the weather-line ſhould be abreaſt and parallel to the other before they bear away to come within the requiſite diſtance for action, in order that the van ſhip of the weather fleet ſhould always keep to windward of the leading ſhip of the lee line, and be guarded againſt ſuch a ſhift of wind as might come ahead; which would not be the caſe if they were aſtern of the van ſhip in the lee fleet; which, as well as the reſt of the line, would be able then to double them to windward, by tacking in ſucceſſion.

Another reaſon for the weather line being right abreaſt of the enemy to leeward, and for every ſhip ſteering on the ſame point in approaching her opponent in the leeward line of

of battle, is, that the fleets may be placed exactly parallel to each other; for, as the weather line muſt not be aſtern, becauſe of the riſk of the wind coming more forward, neither muſt they be ahead of the line to leeward, in caſe the wind ſhould come aft; for then the lee fleet, keeping cloſe by the wind in the wake of their leading ſhip, might, by this ſhift, be as far to windward as the oppoſing fleet, or even get the weather gage of them. But if the weather fleet keep exactly abreaſt of the other, they will always be in a ſituation to preſerve their advantage without expoſing themſelves. It is, notwithſtanding, that thoſe ſhips keeping more away than the line to leeward will find themſelves, when come within gun-ſhot, in a very diſagreeable ſituation with reſpect to the enemy's ſhips, which will have it then in their power to rake them as they bear down. This may occaſion much diſorder among the ſhips of the weather line, which, for that moment, have it not in their power to fire their whole broadſide at the enemy, who has the advantage of beginning the action.

If the lee fleet bear away four points to move their order of battle on the other tack and avoid the action, filing off in ſucceſſion in the wake of the van ſhip, the weather line, by bearing away all together eight points, cannot fail, as both fleets are ſuppoſed to ſail equally, to paſs through the middle of their line, and force them to fight with diſadvantage, if their extent be double the diſtance between the two fleets. If the extent of the fleet be leſs than the above limitation, then the weather fleet will divide the lee fleet more unequally; and if the diſtance between the fleets be conſiderable, the weather fleet will not be able to break through the line.

If the lee fleet bear away four points all together, being of equal extent with the fleet to windward, and their diſtance from each other equal to half the length of one of the lines; ſhould the weather fleet bear away at the ſame time eight points, they will approach very near the ſternmoſt of the retreating fleet; but they will not have it in their power to cut off any part of that fleet, even with an equality of ſailing: ſo that the only advantage gained by this manœuvre will be an ability of attacking the rear, and bringing it to action.

If the van ſhip and the reſt of the weather fleet had a ſufficient velocity to keep the centre ſhip of the lee line on the ſame point of bearing; in that caſe the leading ſhip may break through the enemy's line about the middle ſhip of the centre diviſion: for, ſuppoſing the fleets in order of battle, on the ſtarboard tack, ſteering eaſt, with the wind at ſouth-ſouth eaſt, being at two leagues diſtance from each other, both the lines being four leagues in extent; then the lee line bearing away all together four points, will run north-eaſt, while the fleet to windward, bearing away all together eight points, will ſteer north; the van ſhip of which will keep the centre diviſion of the lee line on the point of bearing north-weſt. As ſhe is ſuppoſed to be able to continue in this poſition, it follows, that the van of the weather line muſt cloſe the centre of the flying line to leeward, after having run four leagues. The time and diſtance neceſſary to cut off a retreating fleet may always be known according to the laſt ſuppoſition. Should the lee fleet get upon the other tack and run large, ſtill preſerving the order of battle, they will be ſtill ſooner cloſed and forced to action by the weather fleet, who have only to keep away from eight to nine points on the ſame tack, or run right before the wind.

The weather fleet can always force the lee one to action, whatever movements they make; for, if they run with the wind right aſt in order of battle, they cannot, ſuppoſing an equality of ſailing, avoid being cloſed or broken nearly about the centre by the weather line, which has only to ſteer two points on each tack nearer the wind than the retreating fleet. So that the rear of the weather fleet having bore away no more than eight points, will be found at the end of a certain time to have approached extremely near the centre of the retreating fleet; and, in a ſhort time more, will be able to bring their rear to action. The weather fleet have yet another advantage; becauſe, as their ſhips have the wind on the quarter, they ſail with greater celerity than thoſe of the lee fleet, which run before the wind. The lee fleet being abſolutely determined to fly, has therefore no other expedient left to prolong time but to continue in the order of retreat right before the wind, or on the ſame courſe as the purſuing fleet; for other advantages are not to be relied on, if purſued by a victorious foe.

If, from all that has been ſaid, it reſults that it is not poſſible for a fleet of equal force to avoid an action, how then muſt it be with one much inferior? The more numerous has nothing to do but to form a detachment of ſuperior ſailers, which will gain upon the lee fleet and begin the action, while ſome others approach to finiſh it. Whence we may conclude, that when in preſence of too powerful an enemy, it will never be poſſible to avoid an action if he is determined to come to one.

To avoid coming to Action. 123

1. When the enemy is to windward.—The lee fleet, which is wiſhing as much as poſſible to avoid an engagement, ought to form the order of retreat to fly from the enemy if they are in view of him, and run on the ſame tack as their chaſer. But if he is yet out of ſight, and they have intelligence of his approach by their frigates which are looking out, they may run large from the hoſtile fleet, without confining themſelves to keep the wind exactly aft, unleſs they be in the order of retreat. There are, however, circumſtances when the lee fleet may run with the wind aft, without aſſuming the order of retreat; as, for example, when they wiſh to gain time, or reſolved to engage the enemy, if they ſtill continue to purſue them. But except on ſuch extraordinary occaſions, a fleet ſhould not fly before the enemy without being in the order of retreat, as the rear is then in the beſt ſituation to extricate themſelves in caſe of accident.

To avoid an action, the enemy being to windward,

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2. When the enemy is to leeward.—The weather fleet can ſcarcely ever be forced to engage; becauſe it can always continue on that tack which increaſes its diſtance from the enemy, by ſtanding on one tack, while the enemy continues upon the other. If the wind was to remain on the ſame point of the compaſs for any conſiderable ſpace of time, it would be very eaſy for the fleet to windward to keep in ſight of the enemy, without being under any apprehenſions of being forced to come to action; but the inconſtancy of the wind obliges the moſt experienced admiral to avoid meeting the enemy when he thinks it improper to engage him.

The enemy being to leeward.

To double the Enemy, or to bring a Part of his Fleet between two Fires. 125

1. When the enemy has the weather-gage.—The fleet which attempts to double an enemy ought always to be ſuperior to him in number of ſhips. The lee fleet ought to endeavour to range exactly abreaſt of, and parallel to, the weather fleet, ſo that the van or rear may extend beyond their line, in order to over-reach them, by tacking in ſucceſſion to double to windward their van or rear, and bring them between two fires. Provided this manœuvre be properly executed, it will be impoſſible for the ſhips in the weather line, thus preſſed, to continue long in their poſts; for there is no veſſel cloſely attacked by two others of equal force which can long reſiſt being overcome, ſince it is always in the power of one of them to get into ſuch a poſition

To double the enemy when he has the weather-gage.

Elements of Rigging and Seamanſhip, vol. ii. p. 386.

tion as to be able, without much danger on her side, to destroy the enemy in a very short time. But whether the most advantageous evolution is to double the van or the rear, is necessary to be considered; for there is so considerable an advantage attending each of these evolutions, that either of them may in a very little time determine the fate of the battle.

As, in the present case, the enemy is supposed to be to windward, either their van or rear may be doubled; but the van may with the greatest facility, because, if they are engaged by the ships abreast of them, those which are advanced ahead will be able, by making all sail, to get on the perpendicular to the direction of the wind with the van of the enemy, and tack in succession to gain the wind of them on the other board, thus keeping them to leeward; and when they are come sufficiently to windward, they are again to go about, in order to keep the two headmost ships of the enemy's line continually under their fire. If there be two or three ships to tack in succession and gain the wind of the enemy, they may edge down on the van of the weather line at pleasure, keeping themselves a little to windward of it; and as that van is already engaged by the other ships abreast on the other side, she must necessarily be soon disabled. If they bear away, they must drop upon the line with which they are engaged to leeward, while the ships to windward still continue to cannonade them. If they attempt going about, in order to attack more closely the ships to windward, they will be raked, while in stays, by their opponents to leeward and to windward, who enfilading them with whole broadsides, which they cannot return, must absolutely complete their disorder. If they make sail, in order to frustrate the design of the ships inclined to double, those with which they are engaged abreast to leeward have only to perform the same manœuvre, and keep them under their fire; while the others, after having harassed them as much as possible, will do their best to perform the same manœuvre on the succeeding ships.

The captains destined to double the enemy ought to be men of known ability, as well as of approved courage. They should not be ordered upon that service but in weather fit for sailing at the rate of three knots an hour at least; and, for the greater promptitude and certainty of success, none but the best going ships are to be employed.

If any of the ships in the van of the weather line happen to be disabled in their masts or yards, as will most probably be the case after having been between two fires, they will drop astern and run foul of the next which follows, and these again of their subsequent comrades; at last, disorder will become prevalent, by ships running foul of each other, or manœuvring to avoid the same accident: so that the order of battle will be broken; while, on the other hand, the line to leeward is preserved with all the advantage possible. The ships which have gained the wind of the enemy will, by continuing their manœuvre, augment the confusion; engaging, however, no more than they like; and if, by chance or misfortune, they should be crippled, it will not certainly be an easy matter for them to extricate themselves. But as they may, on the other tack, drop astern to windward of the enemy's line, or veer again like him, they must extricate themselves as well as they can, and always advantageously enough if, by doubling the van, they are able to throw it into disorder.

If the rear of the lee fleet be extended beyond the sternmost ship of the weather line, they will be obliged, if they want to double the rear of the enemy to windward, to make sail and tack in succession; in which manœuvre the headmost ship of those destined for this service is to go about first; then, continuing to keep up a brisk cannonade as they come to the wind, they will go and heave about again a little to windward of the rear of the enemy, in order to bring their stern ships between two fires: and should they have the good fortune to oblige them to bear away, they must go on successively from one ship to another, as long as they find they succeed in forcing them to give way. Should disorder take place in the rear of the weather fleet, it will not be near so prejudicial to the enemy as if it had happened in the van; on the contrary, it may turn out to be of some advantage to them. But the vessels combating to windward can easily withdraw from the fight, by backing astern when they find themselves too hard pressed.

2. When an enemy is to leeward.—The ships of the weather-line having extended their van beyond that of the lee-line, are to veer, in order to bring the head-most ships of the enemy's line between two fires. But, let them do as they will, there never can result so much advantage from this manœuvre as when doubling a fleet to windward, because the disabled ships can always veer with facility. True it is, they cannot fail becoming at the same time the prey of the enemy; for both those which have doubled them, and those with which they are engaged abreast in the weather-line, will always have it in their power jointly to press as close as they think proper.

If the ships which have doubled the van of the lee fleet, with which they are engaged, be disabled, they will be obliged, as they cannot make sail, to pass along the lee line; and they cannot escape being totally destroyed if they do not bear away before the wind, to get out of gun-shot; during which manœuvre they cannot avoid being still in a very disagreeable situation.

Should the sternmost ships of the weather fleet be disabled in doubling the enemy's rear, they have only, if they want to extricate themselves, to drop astern, and let the two fleets advance ahead; and after having refitted themselves, they will reassume their ports.

To avoid being doubled.

1. The enemy being to windward.—For this purpose, it has been proposed to extend the line, by leaving a greater interval between the ships towards the centre than in the van or rear; but in this case the line runs the risk of being divided, unless prevented by a corps de reserve, consisting of a few ships of the line and fire-ships. It has also been proposed as a general rule, that the flag-officers of the lee fleet should oppose themselves to those of the enemy; by which means several of the enemy's ships will be rendered useless in the intervals. This method has, however, its inconveniences; as sometimes the van and rear of each division may be exposed to the fire of two ships at the same time: nor is the last division out of danger of being doubled. In order to remedy these defects, the larger ships ought to be placed in the van and rear of each division; and the whole fleet must regulate its sailing in such a manner that the rear of the enemy may not be astern of the rear of the last division.

Other methods have been proposed to avoid being doubled; as, that each squadron of the lee fleet should attack its corresponding squadron in the weather fleet; each division of the lee fleet, however, extending its line far enough to prevent the enemy from leaving any ships astern of it, but rather ahead. It has also been proposed, that the lee fleet should extend its line as long as the enemy's line. This method will be advantageous for the lee fleet, provided it is composed of ships of superior force, though fewer in number, than the enemy. In other cases, it is probably the worst method that can be followed by the lee fleet, as it gives the enemy's fleet all the advantage it can desire of exerting its whole force upon the inferior line.

2. When the enemy is to leeward.—The weather fleet is to keep astern of the enemy, so that the van of the weather fleet may be opposed to and attack the enemy's centre: hence

hence the enemy's van will become uſeleſs for ſome time; and if it ſhould attempt to tack and double upon the weather fleet, much time will be loſt in performing that evolution; and it alſo runs the riſk of being ſeparated by the calm which generally happens in the courſe of a ſea-engagement in conſequence of the continual diſcharge of cannon. A conſiderable interval might alſo be left between the centre and van, provided the neceſſary precautions be taken to prevent the van from being cut off.

To force the enemy's line.

This is a manœuvre which the lee fleet may execute to gain the advantage of the wind. It is performed by the van ſhip, if within gun ſhot, tacking when ſhe and the centre ſhip of the weather line are on a perpendicular to the direction of the wind; then all the lee fleet tack in ſucceſſion, and thus may paſs through the enemy's line, or perhaps a little more towards the enemy's van, and go about again in ſucceſſion to windward of him. But as he will not be long, without doubt, before he performs the ſame manœuvre, he will thus be able to regain the wind, if he be not forced to give way before his evolution is finiſhed. The enemy to windward may even cauſe his van ſhip to tack, as well as the reſt of the van ſquadron to follow in ſucceſſion, as ſoon as the leading ſhip of the lee fleet ſhall have paſſed through his line and be ready to go about; by which means he will bring them between two fires. This manœuvre, well executed, might perhaps give no little trouble to the ſhip attempting to force the line.

This evolution may be performed with advantage, if, by ſome accident or fault in the manœuvring, the centre diviſion of the weather-line be ſeparated from their van or rear. For example, when the centre diviſion to windward is encumbered with diſabled ſhips, then the ſhips of the centre diviſion of the fleet to leeward, having all ſails ſet, are to tack in ſucceſſion, and force with promptitude through the weather fleet, leaving their own van diviſion to engage that of the enemy on the other tack.

To prevent the line being forced.

When the ſhips of the fleet go about in ſucceſſion, in order to force the weather line, the whole line to windward is to tack together, and at the ſame time to get upon the ſame board as the lee fleet; then that fleet will neither be able to traverſe nor join them. To perform this evolution with advantage, it will be requiſite to permit ſome of the van ſhips of the lee fleet to paſs to windward; then the weather fleet muſt go all about rapidly, in order to put and keep them between two fires: thus may theſe ſhips be deſtroyed without their own fleet being able to give them any effectual aſſiſtance.

It is eaſy to perceive, from what has been ſaid, that there is little occaſion to fear being traverſed, as ſuch a manœuvre may turn out to be more prejudicial than advantageous to thoſe who perform it. Nevertheleſs, it may and ought to be put in practice when the weather fleet leave ſuch vacancies between their diviſions as to allow ſome ſhips of the lee fleet to be inactive. In this caſe, the ſhips which are without opponents abreaſt of them are made to tack, with all ſails ſet, in ſucceſſion, and paſs through theſe intervals in the weather line, in order to double the centre diviſion, or any other part of it, and bring it between two fires.

CHAP. X. *Of Chaſing.*

Of Chaſing.

1. IN the caſe of ſingle ſhips.—It is ſcarcely neceſſary to obſerve, that the ſhip which gives chaſe is uſually called the *chaſer*, and that which is purſued is called the *chaſe*. Unleſs the chaſer be the faſteſt ſailing veſſel of the two, it is generally ſuppoſed that ſhe will ſeldom or never come up with the chaſe: but we have heard experienced officers ſay, that a chaſing ſhip, ſailing equally faſt, in other circumſtances, will gain on her chaſe; becauſe ſhe has an object to ſteer by, whereas the chaſe cannot ſteer ſo nicely by the compaſs. In what follows, however, we ſhall ſuppoſe the chaſer to be the faſteſt ſailer.

132 The chaſe being to windward.

When the chaſe is to windward, it is evident that as ſoon as ſhe perceives a ſtrange ſhip which ſhe takes for an enemy, ſhe will haul her wind, in order to prolong the chaſe, as otherwiſe her retreat would be ſoon cut off. The chaſer then ſtands on alſo nearly cloſe-hauled until he has the chaſe on his beam; he then tacks, and ſtands on cloſe-hauled until the chaſe is again on his beam, and then retacks. In this manner he continues tacking every time he brings the chaſe perpendicular to his courſe on either board; and by manœuvring in this manner, it is very certain that the chaſer will, by the ſuperiority only of his ſailing, join the other in the ſhorteſt time. For ſince the chaſer tacks always as ſoon as the chaſe is perpendicular to his courſe, ſhe is then at the ſhorteſt diſtance poſſible on that board; and ſince the chaſer is ſuppoſed to be the faſteſt ſailer, theſe ſhorteſt diſtances will decreaſe every time the chaſer tacks. It is therefore of advantage to the chaſe to keep conſtantly on the ſame courſe, without loſing her time in going about; as tacking cannot be ſo favourable to her as to her adverſary, whoſe ſailing is ſuperior. If the chaſer ſhould ſo little underſtand his profeſſion as to ſtand on a long way, and tack in the wake of the chaſe, the beſt thing ſhe can do is to heave in ſtays, and paſs to windward of him on the other tack, unleſs ſhe would have a ſuperiority in going large; for if the chaſer perſiſts in tacking in the wake of the other ſhip, it is an unqueſtionable fact that the chaſe will be very much prolonged.

133 The chaſe being to leeward.

The chaſe being to leeward, the chaſer is to ſteer that courſe by which he thinks he will gain moſt upon her. If, after having run a ſhort time, the chaſe is found to draw more aft, the chaſer is then to bear away a little more; but if the chaſe draws ahead, the purſuer is to haul up a little, and by this means the courſe may be ſo regulated that the chaſe may always bear on the ſame point of the compaſs, and then the chaſer will get up with the chaſe in the ſhorteſt time poſſible; for were any other courſe ſteered than that which keeps the chaſe always on the ſame point, the chaſer would then be either too far ahead, or too far aſtern; and hence the chaſe would be prolonged.

The chaſe ought to run upon that courſe which will carry her directly from the chaſer; and, in general, to conſult which is her beſt trim with reſpect to the wind, that ſhe may move with the greateſt rapidity poſſible from the ſhip which purſues her; for ſome veſſels have more advantage in going large than others, ſome with the wind right aft, and others again are to be found that ſail beſt cloſe-hauled; ſo that attention ſhould be paid by the officer to the known qualities of his ſhip, in order to take the moſt advantageous direction capable to effect a retreat.

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Another method has alſo been propoſed for chaſing a ſhip to leeward, that is, by conſtantly ſteering directly for the chaſe: In this caſe, the tract the purſuer deſcribes through the water is called the line or *curve of purſuit*. In order to illuſtrate this, let A (fig. 54.) repreſent the purſuer, and B the chaſe directly to leeward of it, and running with leſs velocity than the purſuer, in the direction BC, perpendicular to that of the wind. Now, to conſtruct this curve, let B*b* be the diſtance run by the chaſe in any ſhort interval of time; join A*b*, and make A 1 equal to the diſtance run by the purſuer in the ſame time. Again, make *bc*, *cd*, *de*, *ef*, &c. each equal to B*b*; join 1*c*, and make 1 2 equal to A 1; join 2*d*, and make 23 equal to A1; in like manner proceed

ceed until the two distances carried forward meet as at C, and a curve described through the points A, 1, 2, 3, &c. will represent nearly the curve of pursuit; and the less the interval A1 is taken, the more accurate will the curve be formed. In this particular case the length of the distance BC may be found as follows, provided the distance AB and the proportional velocities of the two ships be known.

Let the velocity of the chase be expressed by a fraction, that of the chaser being unity. Multiply the given distance AB by this fraction, and divide the product by the complement of the square of the same fraction, and the quotient will be the distance run by the chase B. Let AB, the distance of the chase directly to the leeward of the pursuer, be 12 miles, and the velocity of the chase three-fourths of that of the chaser; the distance to be run by the chase before she is overtaken is required?

Now $\frac{12 \times \frac{3}{4}}{1 - \frac{9}{16}} = \frac{9}{\frac{7}{16}} = 9 \times \frac{16}{7} = 20\frac{4}{7}$ miles; and since the velocity of the pursuer to that of the chase is as 4 to 3: hence the distance run by the chaser will be $= 20\frac{4}{7} \times \frac{4}{3} = 27\frac{3}{7}$ miles.

As the pursuer alters his course at every point, and since it is presumed his ship will sail better with the wind in one direction, with respect to her course, than in another, her velocity will therefore be different at different points of the course. Thus suppose her to sail faster when the wind is upon the quarter, her velocity will constantly increase until she has attained a certain point, and then it will decrease: hence in real practice this curve will not be precisely the same as above, and of course the measure of BC will differ a little from the preceding determination. The investigation of the foregoing rule is in Simpson's Fluxions, p. 516.; and the application of the curve of pursuit in Sir George Pococke's engagement in the East Indies in the year 1758, is given in Clerk's Essay on Naval Tactics, p. 160. It must be confessed, however, that Mr Simpson's investigation, though a pretty specimen of mathematical investigation, proceeds on certain physical assumptions, which are by no means sanctioned by experience. See what has been said of these assumptions and principles in the articles *Resistance of Fluids*, and Seamanship.

Hitherto we have considered chasing in the case of single ships only; the same rules are also applicable to fleets: we shall, however, subjoin the following remarks with respect to chasing as practised by fleets.

If the whole fleet is to give chase, the admiral will make the proper signal; and then each ship will instantly make all the sail possible. If the retreating fleet is not much inferior to the other, a few of the fastest sailing vessels only are to be detached from the victorious fleet, in order to pick up any stragglers or those ships which may have fallen astern; and the remaining part of the fleet will keep in the same line or order of sailing as the retreating fleet, so that they may, if possible, force them to action. But if the retreating fleet is much inferior, the admiral of the superior fleet will make the signal for a general chase; and then each ship will immediately crowd all the sail possible after the retreating fleet; or, if the chase be still less numerous, the admiral will detach one of the squadrons of his fleet, by hoisting the proper signal for that purpose, and he will follow with the remainder of the fleet. The squadron that chases, or the cruisers detached from the fleet, should be very careful not to engage too far in the chase for fear of being overpowered; but at the same time to endeavour to satisfy themselves as much as may be in their power with regard to the object of their chase. They must pay great attention to the admiral's signals at all times; and in order to prevent separation, they should collect themselves before night, especially if there be any appearance of thick or foggy weather coming on, and endeavour to join the fleet again. The ships are diligently to observe when the admiral makes the signal to give over chase; that each regarding the admiral's ship as a fixed point, is to work back or make sail into her station, to form the order or line again as expeditiously as the nature of the chase and the distance will permit.

When a fleet is obliged to run from an enemy who is in sight, it is usual to draw up the ships in that form or order, called the *order of retreat*, which has been already described; and the admiral, when hard pursued, without any probability of escaping, ought, if practicable, to run his ships ashore, rather than suffer them to be taken afloat, and thereby transfer additional strength to the enemy. In short, nothing should be neglected that may contribute to the preservation of his fleet, or prevent any part of it from falling into the hands of the conqueror.

Part II. NEW SYSTEM of NAVAL TACTICS.

We have now laid before our readers as comprehensive a view as the limits prescribed to such articles will permit of the various evolutions usually practised by fleets in naval war. Though we have transcribed liberally from the most approved writers on the subject, we doubt not but the scientific officer will perceive that we have compiled aukwardly and unskilfully: but we are not seamen ourselves; and the generosity of British officers will pardon the blunders into which mere literary landsmen could hardly avoid falling. The young seaman, who has the noble ambition to excel in his profession, will consult the authors whom we have mentioned in our introduction, in whose works he will find our deficiencies amply supplied; but that the present article may be as complete as *we* can make it, a view must be given of the system of tactics proposed by the Viscount de Grenier and our countryman Mr Clerk; because, whether these systems shall ever be adopted or not, they are the offspring of ingenuity, and as such merit attention.

Chap. I. *View of De Grenier's Tactics.*

Of all the orders, that of battle is the most important in naval tactics; but the order of battle which was first formed in the last century by the Duke of York, and has been continued in use to the present day, the Viscount de Grenier thinks extremely defective. Various causes may conspire to render the task of breaking it not difficult. Its great extent must make it no easy matter for the admiral to judge what orders are proper to be issued to the ships stationed in its extremities; whilst his signals, however distinctly made, are liable to be mistaken by the commanders of those ships. The extremities of a long line are necessarily defenceless, especially if it be to leeward; because, after it is formed, the enemy may throw himself with a superior number on its van or rear, and put that squadron to flight before assistance can be sent to it from the other squadrons. These defects the Viscount de Grenier thinks may be remedied by never

never presenting to the enemy any part of a fleet without its being flanked; so that were the commander of the adverse fleet to attack those parts which hitherto have been reckoned weakest, he might find himself defeated when he looked for conquest. With this view he proposes a new order of battle; in which the fleet, composed of three divisions, instead of being drawn up in one line as usual, shall be ranged on the three sides of a regular lozenge, formed by the intersecting of the two close-hauled lines. It is obvious that one of the divisions of a fleet ranged in this manner will always be formed in the order of battle; whilst the two others, resting upon the first ship ahead and the last astern of that division, will be formed on the close-hauled line opposite, and will stand on checquerwise on the same tack with the ships which are in the line of battle, serving to cover the headmost and sternmost of those ships, and thereby prevent the enemy from penetrating the line or doubling the rear.

Our author thinks it a great mistake, though very generally fallen into, that the weather-gage is of any advantage to a fleet equal in force to its enemy and willing to engage. To him the great art of war at sea appears to consist in drawing or keeping to *windward a part of the adverse fleet*, and collecting all one's forces against that part; and it is chiefly to effect this purpose that he proposes his new system of tactics. The reader, who would understand his principles, must never lose sight of this evident truth, that each ship of a fleet necessarily occupies at all times the centre of an horizon; which the author divides into two unequal parts, calling the greater the *direct and graduated space*, and the less the *indirect, crossed, and ungraduated space*. The reason of these appellations is, that on the greater segment of the horizontal circle there are twenty different points, which may be marked by degrees from one of the close-hauled lines to the other, and to which a ship may sail from the centre by so many direct courses without tacking; whereas to the other twelve points, including that from which the wind blows, she cannot arrive but by steering cross courses, which must necessarily delay her progress.

Suppose now a fleet to leeward, so disposed as that only a part of it can fight with another equally numerous, and ranged to windward in a single line; and let the lee fleet be ranged on the three sides of a lozenge *a b*, *c d*, *e f* (fig. 55.). The squadron *a b*, which is most to windward, being drawn up in line of battle, cannot be fought but by an equal number AB of the weather fleet AB, CD, F. All the rest of that fleet therefore must remain inactive, unless the ships which are not engaged should try to pass to leeward of the fleet *a b*, *c d*, *e f*. But should the ships of the weather fleet, which are placed between B and F, bear away as they appear in the figure between C *i* and F *i*, it is evident that the ships between A and B, which are fighting to windward, cannot bear away with them. Suppose now that, after the ships between C *i* and F *i* have passed to leeward, the squadrons *c d*, *e f*, which are ranged according to the new system, and have not yet been engaged, should come to windward and join with their friends *a b* against that squadron of the enemy AB which is still to windward and engaged; it seems almost inevitable but that the squadron AB must be destroyed by so great a superiority, before it could receive any assistance from the ships to leeward between C *i* and F *i*. No doubt those ships would endeavour to succour their friends; but with respect to them, the squadron AB must be considered as placed in that part of the horizon which our author calls *crossed and indirect*, and to which they would not be able to repair but by steering alternately the two close-hauled lines; and assistance brought by so tedious a course would come too late to be of essential service. It is from this apparently well supported conclusion that the viscount de Grenier deduces the propriety of his proposed orders of sailing and order of battle.

Of orders of sailing, he thinks, there can be no occasion for more than three; one, when a fleet is to pass a strait; another, when it steers in an open sea, either looking for the enemy or trying to avoid him; and the third, when it has an extensive cruise to perform, in which the ships should be so disposed as not to be surprised or cut off by the enemy. His first order of sailing differs not from that in common use. It is and must be observed (says he) in any narrow road, whatever may be the occasion of its narrowness, whether rocks or sands.

142 In the second order of sailing, when the fleet is looking for the enemy or trying to avoid him, the columns *a b*, *c d*, *e f*, are to be formed on three sides of a regular lozenge, and ranged on the two close-hauled lines. The ships of the two divisions *c d*, *e f*, sometimes to windward (as in fig. 56.), and sometimes to leeward (as in fig. 57.), of the third division *a b*, are to be formed on two parallels of one of the close-hauled lines in the wakes of their respective headmost ships; and the third division *a b* is to be ranged ahead or astern of the two others on the other close-hauled line, and nevertheless to steer chequerwise the same course as the two divisions *c d* and *e f*. When *a b* is to windward of *c d* and *e f* (fig. 57.), the viscount calls that the *primitive* windward order of sailing; and when to leeward (fig. 56.), the fleet is in the *leeward primitive* order of sailing. The position of the three divisions in the windward primitive order of sailing is the same for the order of battle natural; for the order of retreat; and for the order of circumvallation, when the object is to separate from the hostile fleet a part of its ships in order to engage the remainder with more advantage. The position of the three divisions in the leeward primitive order of sailing is also the same for the order of battle inverted; for the order of chasing; and for the order of convoy; so that in no possible case, when looking for the enemy or wishing to avoid him, need the admiral perplex himself with more than these two positions on the one or the other tack, whatever movements he may wish the fleet to make.

143 In the third order of sailing, the divisions *c d* and *e f*, instead of bearing on the headmost and sternmost ships of the division *a b*, may be very conveniently placed at considerable distances from that division, without the smallest danger of being surprised by the enemy, provided the ships of each of the divisions keep always their respective positions in the two lines of bearing. For if we suppose the three divisions to be in such positions that *a b* and *e f* are at the distance of six leagues from each other (fig. 58), and that the two divisions *c d* and *e f* rest on the extremities of the base of the triangle STV, while the centre ship of the division *a b* rests on its summit T; none of the divisions could be cut off by an enemy, however formidable, seen from its centre ship at the distance of six leagues. For if, upon the proper signal being thrown out, the division *a b* should steer from T towards X, on the course opposite to the close-hauled line it steered before, and the two divisions *c d* and *e f* steer from V and S towards X likewise; it is plain that each of these three divisions would have only three leagues to run in order to join the other two in the windward primitive order of sailing, which is the same with the order of battle natural; whilst the enemy, which was first perceived at the distance of six leagues, must necessarily run nine before he could come up with the nearest of these squadrons. And if frigates were placed ahead, and in the intervals between the divisions, at the points *y y y* to windward and leeward of the fleet, the enemy might be seen at a still greater distance, and the danger of surprise be still so much less.

Second order. Plate CCCCXCVIII. Third order.

View of De Grenier's Tactics.

We have ſaid, that the poſition of the three diviſions in the primitive orders of ſailing is the ſame with our author's propoſed order of battle; but there is this difference between them, that in the order of battle only the ſhips of one

144 Order of battle.

of the three diviſions ſtand in the wakes one of another, and that thoſe of the two other diviſions are ranged on two parallel lines, and ſteer chequerwiſe. So that if it be wanted to change a fleet from the windward primitive order of ſailing to this new order of battle on the other tack, the movement will be infinitely quicker than thoſe which, in former known tactics, are commonly preſcribed, to paſs from all the orders of ſailing either in one line, or on the obtuſe angle of chaſing or retreating, or in three or ſix diviſions, to the uſual order of battle. For it will be ſufficient for the ſhips of the three diviſions, ranged in the windward primitive order of ſailing, to heave in ſtays all together, and get on the other tack in the oppoſite line of bearing, and they will inſtantly find themſelves in this new propoſed order of battle (fig. 59.); and ſhould the fleet be in the leeward primitive order of ſailing, it would be ſufficient for the ſhips of the three diviſions all together to haul their wind on the ſame tack as they ſteer, and they would find themſelves in order of battle (fig. 60).

145 Natural and inverted.

When the two columns *c d*, *e f*, are to leeward of the third diviſion *a b*, ranged in order of battle, our author calls *that* the order of battle *natural;* and when *c d* and *e f* are to windward of *a b*, the fleet is in the order of battle *inverted.* The former of theſe orders is calculated for a fleet combating to leeward, and the latter for a fleet which muſt combat to windward.

146 Advantages of theſe orders of ſailing and of battle.

That we may form ſome notion of the advantages which our author expects from drawing up a fleet for battle in the form of a lozenge, let us ſuppoſe the line AB, CD, EF (fig. 61.) to repreſent the fleet of an enemy to windward in the ordinary order of battle on the cloſe-hauled line of bearing, and on the ſtarboard tack. Then the leeward line *a b* will repreſent one of the diviſions, in order of battle on the ſtarboard tack, of the fleet ranged according to the new natural order, which the enemy wiſhes to attack, and to which he believes himſelf ſuperior, becauſe that diviſion offers a front much inferior to his own. The two lines *c d*, *e f*, will repreſent the two other diviſions ſtanding on chequerwiſe on the ſame tack as the line of battle, and formed on the oppoſite cloſe-hauled line. On this ſuppoſition, if the diviſions AB, EF, of the hoſtile fleet, which have it not in their power to attack the ſhips of the line *a b*, wiſh to fall on the headmoſt ſhip *a* or the ſternmoſt *b* of that line, they will be obliged to bear away in order to attack the two ſhips *a* and *b*. To prevent this, each of the diviſions *c d*, *e f*, of the fleet ranged according to the new order, ſhould make the following evolutions, according to their reſpective ſituations and to the manœuvres of the enemy.

147 Evolutions to be performed when engaging, and

1ſt, The ſhips of the diviſion *a b* are to ſlacken as much as poſſible their headway, and form a very cloſe line, till the enemy makes a movement to attack the headmoſt or ſternmoſt ſhip of that diviſion.

2dly, The ſhips of the diviſion *c d* are to make ſail till they come under the ſecond or third ſhip of the rear of the line of battle *a b*, when they will take the ſame ſail as the ſhips of that diviſion, to preſerve that poſition until the hoſtile ſhips make their evolution to attack the rear ſhips of that diviſion. In this ſituation the ſhips of the diviſion *c d* will be able to obſerve the manœuvres of the enemy, in order to change tack and form themſelves in order of battle on the oppoſite board as ſoon as the hoſtile ſhips ſhall have, after their bearing away, run over a certain ſpace: becauſe the ſhips of the diviſion *c d*, ſteering afterwards cloſe-hauled in the wake of the ſternmoſt ſhip of the diviſion *a b*, will be able to cover the rear ſhips of that diviſion, and get the weather-gage of the hoſtile diviſions which are bearing away; rake their ſhips; run alongſide of them; double their rear-guard, and put it between two fires, if thoſe hoſtile ſhips are following in the wake of each other (c); divide it if they bear away chequerwiſe, or gain to windward, and put between two fires the enemy's diviſion CD, while it is engaged with the diviſion *a b*.

3dly, The ſhips of the diviſion *e f* may abandon their poſt and run chequerwiſe under a preſs of ſail, in the ſame courſe and in the ſame order they were formed, as ſoon as they perceive that the enemy falls ahead of the diviſion *a b*; in order that if the diviſion AB of that enemy makes any manœuvre to bear away and fall on the diviſion *e f*, or on the van of the diviſion *a b*, they may, by going about, ſteer in order of battle cloſe-hauled on the oppoſite line of bearing, and cover the headmoſt ſhip of the diviſion *a b*, double the hoſtile diviſion CD ahead, or divide the other hoſtile diviſion AB, which is running chequerwiſe on the oppoſite tack.

The two diviſions *c d*, *e f*, might again manœuvre another way, in caſe the ſhips of the enemy were ranged in one ſingle line, not well formed, or ſhould be in diſorder and leave too great a diſtance between them while they are engaged very cloſe with the diviſion *a b* (fig. 62). 148 When the enemy in a ſingle line not well formed.

1ſt, By putting about the ſhips of the diviſion *e f*, and likewiſe the ſhip *a* headmoſt of the diviſion *a b*. 2dly, By making at the ſame time the ſhips of the diviſion *c d* tack, and likewiſe the ſhip *b* of the diviſion *a b*, to keep by the wind on the oppoſite cloſe-hauled line. 3dly, By making all the ſhips of the diviſion *a b* (which ſtood between the headmoſt *a* and the ſternmoſt *b*) bear away four points at the ſame time, and making them alſo take the ſame tack as the ſhips of the other two diviſions when they are on the beam of the ſternmoſt ſhips of thoſe two diviſions; becauſe, in that poſition, the ſhips of the two diviſions *c d*, *e f*, getting to windward on two parallels in order of battle, in the wake of the two headmoſt *a* and *b*, might put between two fires a part of the enemy's ſhips, which then would be obliged to take the ſame tack as theſe two diviſions, becauſe the ſhips of the diviſion *a b* (which are on the ſame tack as thoſe two diviſions) might prevent the ſhips of the enemy ſteering the courſe oppoſite to that tack.

From this ſuccinct expoſition it may be obſerved, that, in the firſt ſuppoſition, the way of thus diſpoſing the forces of a fleet is ſo much the more ſuitable to the defence of the headmoſt and ſternmoſt ſhips of a line of battle, as the ſhips of the diviſion *c d*, being covered by that line of battle, are able to manœuvre without any one ſhip of that diviſion being expoſed to the fire of the enemy; that the diviſion *e f*, the headmoſt ſhip of which is *e*, always preſents the ſide to the

(c) If the hoſtile ſhips which are not engaged with any of thoſe of the diviſion *a b* bear away in ſucceſſion in the wake of their headmoſt, in order to paſs to leeward of the diviſion *a b*, and to put it between two fires; then the ſhips of the diviſion *e f* muſt neceſſarily take the weather-gage of them, ſince the headmoſt of that diviſion *e f* is by her very ſituation already to windward of the headmoſt of the adverſe ſhips which are bearing away, and ſhe has the opportunity to come as cloſe as poſſible to the ſternmoſt ſhip *b* of the line of battle *a b*.

ew of Grenier's Tactics

the enemy, without any one ſhip of that diviſion being expoſed to receive the fire of the enemy either ahead or aſtern, becauſe they are not to range in a line of battle unleſs the enemy runs large or before the wind; and that, in the ſecond ſuppoſition, the only ſhips which are liable to be raked aſtern, while they change tack, are the headmoſt and ſternmoſt of the diviſion in line of battle which cover the ſhips of the other two diviſions.

49 ... on ... tack ... fleet ... be ... ed.

As it is of the utmoſt advantage to know, at firſt ſight of the enemy, whether it be to windward or leeward of the fleet ranged lozenge-like, on what tack, and on what ſide the fleet muſt be formed, in order to defend itſelf or attack the enemy with advantage, it is to be obſerved, that in both the windward and leeward primitive orders of ſailing the direction of the wind always traverſes both the weathermoſt and leewardmoſt ſhips of the fleet (figs. 57. and 56.); that this leewardmoſt ſhip is always placed in the centre of an horizon, which is to be conſidered as the horizon of the whole fleet; and that it is from that ſhip you are to judge, by means of the rules which are known and practiſed in ſuch caſes, whether the lozenge-like fleet be to windward or to leeward of that of the enemy.

If you want to know, at ſight of the enemy, ſeen either to windward or to leeward, on what ſide the line of battle is to be formed in order to be able to ſend one of the diviſions on that ſide of the lozenge where there is none, it is the poſition of the enemy, with reſpect to the direction of the wind, which is to determine it; becauſe, if the enemy is to windward of the fleet ranged in the windward primitive order of ſailing, and if it bears down on that fleet, with the wind large or right aft, it belongs to its weathermoſt ſhip to obſerve what follows. If that ſhip, by ſetting the enemy, finds him to ſtarboard of the direction of the wind, the diviſion which is ſtarboard of that direction of the wind is to take the ſtarboard tack, and range in order of battle before the enemy is arrived within gunſhot: if, on the contrary, the above-mentioned ſhip finds the enemy to larboard, it belongs to the larboard diviſion to aſſume the order of battle, and to take that tack, before the enemy can come to action. The old rule for chooſing the proper tack is to be obſerved by a fleet in the leeward primitive order of ſailing; obſerving, that it is the buſineſs of that fleet's leewardmoſt ſhip to determine it; and the point of the horizon which is oppoſite to that whence the wind blows, is the point towards which the obſerver is to be turned to judge on what ſide, whether ſtarboard or larboard, the line of battle is to be formed; becauſe, in that poſition, the ſtarboard ſide muſt always be on his right hand and the larboard on his left.

By following this general rule, the line of battle will never be expoſed to be too much lengthened either to windward or to leeward, in order to oppoſe all the ſhips of the adverſe fleet formed in one ſingle line, nor even to be ſurpriſed in diſorder by that fleet while you are forming in orders of battle natural or inverted.

150 ...e orders ...chaſing, ...reat, and ...voy.

Our author's orders of CHASING, of RETREAT, and of CONVOY, are very eaſily formed. We have already ſaid what they are; and the ſeaman, or even the landſman, who has any tolerable conception of his orders of SAILING and of BATTLE, will not ſtand in need of any farther deſcription of them. It muſt, however, be obſerved, that in the order of chaſing, the fleet in the lozenge-like poſition preſents the obtuſe angle of chaſing, as when ranged according to the ordinary tactics; with this difference, that, in order to form themſelves in order of battle, it is enough that, in this lozenge-like poſition, the ſhips of the ſecond diviſion ſhould all keep the wind on the ſame board they were ſtanding on, becauſe they would afterwards find themſelves in a line in the wake one of another; but, according to the uſual tactics, the ſhips have a long ſpace to run before they can execute the ſame evolution.

View of ... 's Tactics.

151 How the admiral's ſhip, the ... ought to be placed.

We ſhall conclude this ſhort view of the Viſcount de Grenier's tactics, with his directions for the moſt advantageous placing of the admiral's ſhip, the frigates and tranſports, belonging to a lozenge-like fleet, whether it be ranged in the order of ſailing or of battle, &c.

In the order of ſailing, the admiral A is to be placed ... ahead of the fleet, at a ſhort diſtance from the headmoſt of the ſecond diviſion, and in the direction of the wind with the headmoſt of the firſt diviſion (fig. 63.). Two of the frigates *ff* are to obſerve the ſame rule and the ſame poſition, with reſpect to the van ſhip of the third diviſion and the ſternmoſt of the firſt. In the order of battle, on the contrary, the admiral is to be in the centre of the lozenge, and two of the frigates on the fourth ſide of the lozenge, (fig. 64). As for the tranſports and ſtore-ſhips, when there are any, their ſtation is to be in one line on the ſide oppoſite to that of the enemy, when ranged in order of battle; and, if in order of ſailing or convoy, they may occupy the ſpace circumſcribed by the lozenge. In any other circumſtances theſe ſhips are to occupy the different ſtations appointed for them, that they may diſtinguiſh the ſignals and execute the commands of the admiral. Laſtly, when the fleet ſhall paſs from the order of battle to any other order whatever, or from any order to the order of battle, the admiral's ſhip is to bring to, and not to take any of the poſitions above mentioned till after the complete execution of the movement.

CHAP. II. *View of Mr Clerk's Tactics.*

WHETHER the Viſcount de Grenier's order of battle and of ſailing would be attended with all the advantages which he hopes from them, experienced ſeamen alone can judge; but we are now to introduce to our readers part of a ſyſtem which has met with very great approbation from ſome of the ableſt officers in the Britiſh navy, and which to us appears to be founded on principles ſelf-evident. Mr Clerk, in the introduction to his Eſſay, informs us, that upon conſidering the great ſuperiority diſplayed in the three laſt wars by the Britiſh ſeamen over their enemies, when engaged in ſingle ſhips, and comparing it with the very little that, previous to Lord Rodney's glorious action, they had atchieved when engaged in fleets drawn up in line of battle, he was led to conclude, that there muſt be ſomething wrong in our mode of making the attack. He turned his thoughts to the ſubject, and in 1790 publiſhed part of a large work, comprehending, 1. *A Theory of Attack from Windward;* 2. *A Theory of Attack from Leeward;* and, 3. *An Hiſtorical Sketch of Naval Tactics.* We think it not much to the honour of our countrymen, that he has not yet had encouragement to publiſh more than the firſt part; but in hopes of exciting their curioſity, we ſhall lay before them a diſtinct view of that part, beginning, as he begins, with

OBSERVATIONS ON THE PRESENT METHOD OF BRINGING SHIPS TO ACTION.

152 Diſadvantages of bearing down directly on the enemy.

It has often, if not generally, been the practice, in the caſe of ſingle ſhips, as well as in that of fleets, for the weather ſhip or fleet, when it is wiſhed to bring the other to action, to ſteer directly down upon that ſhip or fleet, without reflecting that, by doing ſo, it gives the enemy an opportunity of completely diſabling it, before it can attain its wiſhed for ſtation. For each ſhip in the lee line can uſe all the guns upon one ſide; whereas the ſhips in the weather-line,

View of Mr Clerk's Tactics.

ther-line, bearing directly down, have it only in their power to uſe their bow-chaces. This method of attack appears, therefore, to be the worſt poſſible for the weather-fleet, and the moſt advantageous for the lee fleet. For ſuppoſe a ſingle ſhip of 80 guns to windward at B (fig. 65.), diſcovering an enemy's ſhip of equal force to leeward at F, to bear directly down upon her endwiſe, the receiving ſhip F, by lying to as in fig. 66. would preſent a broadſide of 40 heavy guns bearing upon B during a courſe of two miles, in which every ſhot might take effect; while B, in this poſition, would have it in her power to bring only the two light guns of her forecaſtle or bow-chaſe to bear on F; a diſadvantage greatly exceeding twenty to one. Beſides, the receiving ſhip F, by lying broadſide to, will have all her maſts and rigging more open, and conſequently will allow ſhot to paſs with leſs effect than the ſhip B, which, coming endwiſe, is liable to be raked by every ſhot from ſtem to ſtern. The conſequence of which muſt be, that B would be diſabled in her rigging, &c. long before ſhe could arrive at a proper poſition for annoying F; and when ſhe had attained that poſition, F, by being entire in her rigging, would have it in her power to fight in any poſition, or to make off at pleaſure.

153 Proper method of attack.

The method then is, B having the wind, ſhould run down aſtern, as *per* dotted line, and getting into the courſe, or near the wake of F, or a poſition that will bring her parallel to the courſe of F, at a proper diſtance, ſhe ſhould then run up cloſe alongſide of F, upon equal terms, as in fig. 67; or otherwiſe, on ſhooting ahead, ſhe may veer, and run down on the weather-bow of F, as in fig. 68. till ſhe ſhall force F to bear away to leeward, keeping cloſe by F on equal terms; but during the courſe, in both caſes, carefully watching that F may not have it in her power to bring her broadſide to bear upon B without retaliation.

154 Modes of attack by the Britiſh and French.

It having been often ſaid that the French have made it a rule to throw the whole effect of their ſhot more particularly into the rigging of their enemy, and that the Britiſh, on the other hand, have been as attentive to point the force of their fire againſt the hull of the ſhip; it may be proper here to ſtate the two caſes, and compare the effect.

Let us ſuppoſe a ſhip of 80 guns wiſhing to avoid the effects of a cloſe engagement, but at the ſame time lying to as at F (fig. 63.), intending to receive, with every advantage, an enemy B of equal force, coming down with an intention to fight her; and let us ſuppoſe that F, by aiming her fire at the rigging of B, ſhall have carried away any of the principal ſtays, eight or ten windward ſhrouds, or a foretopmaſt, or any other rigging, though of much leſs conſequence, but, at the ſame time, without having wounded a ſingle man of the ſhip B; and ſuppoſe a ſecond ſhip, conſort to F, receiving ſuch another ſhip as B, and by firing at her hull only, ſhall, without other damage, have killed 30 or 40 of her men: In this critical juncture, when F and her conſort are deſirous of avoiding a cloſe engagement, it is evident that the ſhip at B, which has loſt part of her rigging, is more completely diſabled from cloſing with them than the other ſhip, whoſe rigging is entire, though ſhe may have loſt 100 of her men.

155 No ſhip in the line of battle can be expoſed to the fire of many at once.

It has been often ſaid, that ſome particular ſhip has been expoſed in battle to the cannonade of three, four, or even five ſhips, all extended in the enemy's line, and all bearing upon her at one and the ſame time; but this can never have been the caſe, but when the ſhip ſo expoſed was at a very great diſtance. Let I, H, F, H, I, (fig. 70.) repreſent five ſhips extended in line of battle ahead at the diſtance of one cable's length, or 240 yards, from each other; let the length of each ſhip be 40 yards, ſo that the whole ſpace between head and head of any two adjacent ſhips is 280 yards; and let the perpendicular line FK, proceeding right out from the beam of the middle ſhip F, to the diſtance of ſix cable's length or 1440 yards, be divided into ſix equal parts: It is evident, from inſpection, that a ſhip ſtationed at the point E of the line FK, 720 yards diſtant, cannot for any length of time be expoſed to the fire of more than the centre ſhip F of the fleet I, H, F, H, I. For ſuppoſing the ſhips H, K, ahead and aſtern of F, to be able to bring their broadſides to bear on E (a ſuppoſition which, if the line be cloſe hauled, cannot be made of the headmoſt of thoſe ſhips), it is evident, that by putting themſelves in poſitions proper for that purpoſe, the ſhips H, H, will not only diſorder their own line, but alſo leave, the one her head, and the other her ſtern, expoſed to a raking fire from their oppoſites B, B, in the enemy's line.

But if the opponent ſhip cannot well be expoſed to the fire of the two ſhips H, H, at the point E, ſhe muſt be ſtill leſs expoſed at the point C, 480 yards diſtant; and it will be almoſt impoſſible for the ſhips H, H, to touch her at the point G, 240 yards, or one cable's length, diſtant.

But one cable's length aſunder is too ſmall an allowance for accidents that may happen by the ſhips I, H, F, H, I, extended in line of battle ahead. Therefore let us ſuppoſe the three ſhips, which are ſaid to be at once upon a ſingle opponent, to be ſtationed at I, F, I, at the diſtance of two cable's length or 480 yards from each other. Then it is evident that the opponent ſhip cannot now be more expoſed at the point K, at the diſtance of 1440 yards, than ſhe was, on the former ſuppoſition, at the point E, 720 yards diſtant; and if we ſuppoſe the line of battle to be formed at one and an half cable's length aſunder, ſhe muſt be at L, diſtant 1080 yards, before ſhe can be annoyed even to this degree by the three hoſtile ſhips at once. Hence we may fairly conclude, that if one ſhip has any time been expoſed at once to the fire of five, four, or even three ſhips of the enemy's line, ſuch ſhip muſt have been at a very great diſtance, and in no great danger.

156 Principles neceſſary for bringing fleets to action.

Having finiſhed the above obſervations, our author proceeds to the principles neceſſary to be known for enabling us to judge of the different modes of bringing great fleets to action. For this purpoſe he ſuppoſes a fleet of 10, 20, or more ſhips, of 80 guns each, extended in line of battle to leeward, and lying to at F (fig. 71.), with the intention of avoiding an attack; whilſt another fleet at B, of equal number and force of ſhips, alſo extended in line of battle, three or four miles to windward, is deſirous of making an attack, and coming to cloſe action on equal terms with the fleet F. In this diſpoſition of the two fleets, ſhould that to windward run down headlong ſhip for ſhip on its opponent, as in figs. 66. and 69. it is evident, from what has been ſaid in the beginning of this chapter, that each individual ſhip of the weather-fleet might be completely diſabled before it could poſſibly come to cloſe action with the fleet to leeward. But let it be ſuppoſed that the commander of the weather fleet B, though his ſhips have been much diſabled in their rigging during their courſe *a a a* from windward (fig. 72.), has made them bring to at a great diſtance, from whence he can hurt F; is it to be expected that F, whoſe deſire has always been to avoid a cloſe engagement, and who has already diſabled the ſhips of B, will patiently lie ſtill, or wait until B ſhall have time to diſable him in his turn? No ſurely. While enveloped in his own ſmoke, as well as that of his enemy, he will bear away unhurt to a new ſtation G, and there remain out of the reach of B's cannon-ſhot, who muſt repair his rigging before he can attempt a ſecond attack

Again, ſuppoſe that B, in place of going headlong and endwiſe down, were to run down in an angular courſe, or

laſking

of *laſking* as it has been called; it is evident from fig. 73. that ſhould any ſhip in this angular line come to be crippled, her way being ſtopped, might of conſequence occaſion a confuſion amongſt the ſhips next aſtern to her, ſome running to leeward and others to windward of the diſabled ſhip; and thus the time be loſt for affording the neceſſary ſupport to the ſhips ahead, and now ſo far ſeparated from their companions. Should it be ſaid, that a ſtoppage of one ſhip ahead will not neceſſarily produce a ſtoppage of every ſhip aſtern, becauſe they may go to leeward of the diſabled ſhip; we anſwer, that the ſhips ahead in the van A (fig. 74. n° 1.) may be now engaged, and of conſequence not having much headway, may be ſaid to be ſtationary; therefore every ſhip aſtern, if ſhe ſhall attempt to bear down, as at D, D, from being confined to a determined courſe, muſt be brought into the poſition of being raked when coming down before the wind, as in figs 76. and 69. and conſequently of being completely diſabled long before ſhe can get cloſe enough alongſide of the enemy.

Again, the headmoſt ſhips, or van of B, having attained their ſtation at A, that is, abreaſt of the van of F (fig. 74. n° 1.), and having begun the cannonade, may we not ſuppoſe that F, whoſe conduct or deſire has always been to ſave his ſhips, has inſtructed the commanders of thoſe in the van of his fleet to withdraw from danger as ſoon as they begin to feel the effects of a cannonade? and if ſo, may not thoſe ſhips, as ſoon as they have thrown in their fire upon the van of B, bear away in ſucceſſion as at H, followed indeed by the whole ſhips of F's fleet, which, having poured in their fire upon the van of B, may form a new line of battle two or three miles to leeward at H (fig. 74. n° 2.), and there be in readineſs to receive a ſecond attack, if B ſhall be ſo imprudent as to attempt it? And is it not farther evident, that if any one or more ſhips of the ſquadron of F ſhall be crippled, they will have it in their power to quit their ſtation, being covered with ſmoke, at any time, and to fall to leeward as at G, where they will be in ſafety?

In order to illuſtrate this ſtill farther, let B (fig. 75.) repreſent a fleet putting before the wind, each ſhip with an intent, when brought to at a determined diſtance at A, to take up her particular antagoniſt in the line of the enemy F to leeward; and, for argument's ſake, let F be ſuppoſed at reſt, without any motion ahead. There ſeems to be no difficulty in conceiving, that while the alternate ſhips of F's line, under cover of the ſmoke, withdraw from battle to GGG, the intermediate ſhips left behind them in the line will be ſufficient to amuſe even the whole of B's fleet, till the ſhips G ſhall form a new line HH as a ſupport from the leeward. In ſuch caſe B, after being diſabled, as he muſt be, and not having foreſeen the manœuvre, will neither be able to prevent the intermediate ſhips with which he is engaged from bearing away to join their friends, nor, were he able, would it be adviſable to follow them; for the ſame manœuvre with equal ſucceſs can again and again be repeated.

In order to ſhow the relative motion of both fleets, let F (fig. 76.) be a fleet conſiſting of twelve ſhips, drawn up in line of battle, at one cable's length or 120 fathoms aſunder; and let the length of each ſhip from the end of the jibboom to the ſtern be $36\frac{2}{3}$d fathoms; the whole fleet will then occupy a ſpace of two Engliſh miles; alſo, let its rate of ſailing be four knots an hour in the direction FG, ſo that in the ſpace of an hour it may have moved from F to G four miles diſtant from its former poſition.

Let B be the opponent fleet, conſiſting alſo of twelve ſhips, and four miles to windward; and let the point A be 440 yards, or one quarter of a mile, right to windward of the point G. Then if B, by bearing away in the direction BA, ſhall arrive at the point A at the ſame inſtant that F, the fleet to leeward, has arrived at the point G, the motion of the fleet B will have been at the rate of 5½ miles nearly per hour; and the angle contained between the direction of its line of bearing and preſent courſe 43° 9′, or nearly 4 points. For in the right-angled triangle ABM are given BM = 4 miles, and AM = 3¾ miles. Now BM = 4 m. : AM = 3¾ m. : : R : tan. ABM = 43° 9′, and R : ſec. ABM 43° 9′ : : BM = 4 m. : AB = 5.483 m.

View of Mr Clerk's Tactics.

Again, if F, as in fig. 77. by carrying more ſail, ſhall move at the rate of ſix miles an hour, that is, from F to G; then B, having his courſe made thereby the more ſlanting, will have juſt ſo much the greater difficulty of keeping his ſhips in line abreaſt while coming down to the attack: For the leading ſhip meeting with no obſtruction in her courſe, will puſh on; whereas every accident of obſtruction accumulating, as it happens to each ſhip progreſſively, the rear, being affected in the greateſt degree, will for that reaſon be left the farther aſtern. But, from the very form of this ſlanting courſe, every ſhip aſtern will be apt to get into the wake of the ſhip ahead. Therefore the whole fleet of B, van and rear, will not arrive in the ſame time at the line AD, ſo as to be in a perfect line abreaſt, and parallel with the fleet to leeward; but will have aſſumed the laſking form, as repreſented at the points M, N, and O, in the different parts of the courſe. In this caſe, the diſtance run by the van of B, from B to A, is 7,075 miles, or 7 miles and 132 yards, and the angle contained between the line of bearing and the diſtance BA is 32° 0′.

And again, as in fig. 78. if the fleet to leeward ſhall lie up one point higher, as FG, then the rears of the two fleets will thereby be removed at a much greater diſtance, and the van A of conſequence muſt be ſooner up with the enemy's van, and evidently ſo much the farther from ſupport; while F, by bringing up his ſhips in ſucceſſion, will have it in his power to diſable the van of A, and will afterwards bear away, as at H, unhurt and at pleaſure; while B, at this time, by the ſuppoſition, being crippled, or having his rear D obſtructed, and at a diſtance, will be unable to prevent him. And in all the three caſes, it is evident that the fleet B, ſo ſoon as he ſhall approach within reach of gun ſhot, muſt be expoſed to the fire of F's whole line; for he will be abreaſt of B continually in every part of his courſe. But the difficulty of bringing the rear of the windward fleet to action will ſtill be more increaſed, if the ſternmoſt ſhips of the fleet to leeward, in place of keeping their wind, ſhall bear away occaſionally as at ML. All which being admitted, the difficulty of bringing adverſe fleets to cloſe engagement may be accounted for, without being obliged to have recourſe to that ſuppoſed inferiority in point of ſailing, imputed to our ſhips, compared to thoſe of the French our enemy.

Hence it appears, that a fleet B to windward, by extending his line of battle, with a deſign to ſtop and attack a whole line of enemy's ſhips to leeward, muſt do it at a great diſadvantage, and without hope of ſucceſs; for the receiving fleet F to leeward unqueſtionably will have the four following advantages over him: 1. The ſuperiority of a fire above 20 to 1 over the fleet B, while coming down to attack. 2. That when the ſhips of B are brought to at their reſpective ſtation, if it blows hard, the ſhot from F, by the lying along of the ſhips, will be thrown up into the air, and will have an effect at a much greater diſtance; whereas, on the other hand, the ſhot from B, from the ſame cauſe, will be thrown into the water, and the effect loſt. 3. That F will have the power of directing and applying at pleaſure the fire of his whole line againſt the van of B, who is now unable

View of Mr Clerk's Tactics.

unable to prevent it, his ships being disabled, separated, and therefore unsupported. 4. That F will also have a greater facility of withdrawing from battle the whole or any one of the disabled ships of his line.

If then, after a proper examination of the late (D) sea-engagements or rencounters, it shall be found that the French admirals have never once shown a willingness to risk the making of the attack, but invariably have made choice of, and carefully courted, a leeward position; if invariably, upon seeing the British fleet disabled, they have made sail, and demolished the van in passing; if invariably, upon feeling the effect of the British fire, they have withdrawn at pleasure either a part or the whole of their fleet, and have formed a new line of battle to leeward; if the French repeatedly have done this upon every occasion;—and, on the other hand, if it shall be found that the British, from an irresistible desire of making the attack, as constantly and uniformly have courted the windward position; if, uniformly and repeatedly, they have had their ships so disabled and separated, by making the attack, that they have not once been able to bring them to close with, to follow up, or even to detain one ship of the enemy for a moment—shall we not have reason to believe, that the French have adopted and put in execution some system which, if the British have discovered, they have not yet profited by the discovery?

Our author therefore, instead of the usual mode of attack, which, by being made principally on the van, seems to be the result of a groundless expectation of being able to *take*, *destroy*, or *disable* the whole of the enemy's line, proposes

A NEW MODE OF ATTACK FROM THE WINDWARD UPON THE REAR OF THE ENEMY.

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Mr Clerk's mode of attack upon the rear of the enemy.

Suppose, says he, a fleet of ten, twenty, or more ships, extended in line of battle at F (fig. 79.), endeavouring to avoid a close engagement, but at the same time keeping under an easy sail, with the intention of receiving the usual attack from another fleet of equal number, three or four miles to windward at B, sailing in any form, but let it be in three lines or divisions; it is required by what method shall B make the attack on F with advantage?

The improbability, or rather impossibility, of attacking and carrying the enemy's whole line of ships, having been demonstrated by every action which has been fought at sea, the next consideration will be, how many ships may be attacked and carried with advantage? Let it be supposed that the three sternmost ships only, and not exceeding the fourth, are possible to be *carried;* let a sufficient strength A be sent down to force an attack upon these three ships, disposed and supported according to the judgment of the admiral, while in the mean time he keeps to windward with the rest of his fleet, formed into such divisions as may best enable him to attend to the motions of the enemy and the effect of his attack; being himself so far disengaged from action, as to be able to make his observations, and give his orders, with some degree of tranquillity.

By placing the fleet B in such divisions as represented in the figure, when the attacking squadron comes up with the reer of the enemy, the whole will be so disposed, and so connected together, as to be able to give the support and attention that may be required to any ship, or any part of the fleet, and in preference to a long extended line of six or seven miles in length, where it must be impracticable to give the necessary support to such ships as may be disabled. The ships of the fleet F may, in general, be better sailers than the ships of the fleet B; but it is not conceivable but that the swiftest ships of B must come up alongside of the sternmost and dullest sailing ships of the enemy F; while, at the same time, F, by attempting to outsail B, must be thrown into the disorder of a downright flight: Therefore, of course, it must be admitted, that if the enemy F continues going off in line of battle, and endeavouring to avoid a close engagement, it will be impossible to prevent the fleet making the attack from getting into the position B A. But by this position, it is evident that the three ships at I of the fleet F will be in the power of the admiral of B; for, by keeping so many ships to windward, he will be enabled to send down fresh ships from time to time, either for the support, or to supply the station, of any of those that may be disabled in making the attack, while it may be imagined that the three ships in question, by being disabled, or being deprived of the wind now taken out of their sails by the ships to windward, will be prevented from following their friends. Hence the enemy ahead must either abandon his three sternmost ships, or he must double back to support them; which must be done either by tacking or veering. But let it be first examined what is naturally to be done by tacking; and for the greater satisfaction, let every possible case that can happen be examined separately.

First, let us suppose that the enemy at F, fig. 80. has continued to protract his course in line of battle upon the same tack, and that the headmost ship H, with the three next astern of her, have tacked to windward, and that the whole remaining ships intend to tack the same way, but in succession; is it not evident that F has then left his three sternmost ships at I in the power of the ships at A; that he must also leave exposed his fourth and fifth ship G to another attack from another division of B at C, which will also be on equal terms as with his three sternmost at I; and lastly, if he prosecutes his intention of supporting his three ships, he will be obliged to begin a disadvantageous attack upon the admiral, with the main body of the fleet lying ready to receive him? The consequence of all which must be, that he will not only lose his three sternmost ships, but in all probability the fourth and fifth also, as at G; and will be forced to begin an attack, and close and mix ship with ship on equal terms; a situation which he at all times, with the greatest anxiety, hath avoided, and which B with equal anxiety has always courted.

Again, suppose that his three sternmost ships have been attacked, and that he has ordered his fleet to tack all at one time, as in fig. 81. The consequences will then be, that this movement, having required some time and some length of course, will have produced a considerable distance between his main body and his three ships; or, in other words, that these three ships have been deserted; for it will not be in their power to tack with the rest of their friends. He must also, in bringing his ships heads round, expose the ships nearest his enemy to be raked by a dreadful cannonade; besides running the risk of having his fleet thrown into a general disorder, by many of his ships missing stays, veering, and running to leeward. Lastly, upon a supposition that his ships have all tacked, and none of them missed stays, still he

(D) This was written during the American war, and before Lord Rodney's decisive victory on the 12th of April 1782. That action, as well as the still more brilliant one of Lord Howe on the 1st of June 1794, we have heard the author distinguish from those battles which, with great propriety, he calls *sea-rencounters*, and do ample justice to the scientific manœuvres of both the noble admirals.

of he must of necessity begin the attack, mix his ships, and come to a close engagement, as in the former case.

Having shown the consequences of an attempt to succour the three sternmost ships by tacking, let us also examine what may be expected from an attempt to do it by veering the fleet. Suppose the two fleets in the same position as in fig. 79. that is, the main body of the enemy extended in line of battle to leeward, his three sternmost ships entangled with the fleet B, whose admiral, with the main body, keeps to windward to observe, with a rigid attention, the motions of the enemy. At the same time suppose that the admiral F has ordered his sternmost ship G to veer (fig. 82.), and afterwards the whole line; and that he is now running upon a contrary tack to leeward, as at H, wishing to support or bring off his three ships. From inspection, it will be evident that this attempt may be more dangerous than the attempt to windward; for it will expose a number of his ships to a raking fire while in the act of veering; and the squadron, by getting so far to leeward, will be unable to give the proper support to the three ships. It will open a gap for the fleet of B (who will immediately veer also and follow him) to break in, as at A, and cut off the three ships without hope of recovery. And if F shall still persist in the endeavour to recover his three ships, he will be obliged to begin the attack under all the usual disadvantages.

Again, upon another supposition, that the headmost ship of the enemy H (fig. 83.), with the four or five next astern, have wore, and are running upon a contrary tack, wishing, as before, to support or bring off the three ships, the rest of the fleet intending to weer also, and follow in succession; it is evident that this movement, being more unseaman-like, will be worse than the last: It will expose an additional number of ships, particularly the last two, as at G; and will at the same time make an opening for the main body of B's fleet to fall in and cut off the three ships, as in the former case.

Again, should the enemy F veer and bear away with his whole ships at one and the same time, it is evident that this movement must have the consequence of a downright flight, with the certainty of losing the three ships.

From what has been said, it will appear, that a fleet B, keeping connected in a body to windward, may come up with and entangle the three sternmost ships of an enemy F, extended in line of battle and going off to leeward, and at the same time be able to overawe the remaining main body of their fleet; and that, having forced the position, the whole consequences, as already described, must follow; that is, F must submit to the loss of three ships.

What has been hitherto said proceeds upon a supposition that the fleet F has kept on his course till the fleet B has come up with his rear. Let it then be examined what other attempts the enemy F can make to avoid coming to close engagement upon equal terms.

Suppose a fleet of ships of the enemy standing on the larboard tack to leeward, and going off as before at F, and a fleet of ships in a collected state or position to windward, as at B (fig. 79.); and suppose that the enemy F, perceiving the fleet B pointing an attack against his rear, in place of keeping on his course upon the same tack, should veer, and endeavour to pass on contrary tacks to leeward (for it will not be admitted that he can get to windward); what will then be the effect?

Is it not evident, that the headmost ships of F must be forced to leeward by the fleet B obstructing his line of direction, or the line of his course? that they must be forced to begin an attack at any distance B may choose? that they may receive such damage as will stop their way? that their way being stopped, will of course be an obstruction to the next astern; or that these subsequent ships, to prevent this stop, must bear away to leeward of their crippled ships, as at G (fig. 84.), which will not only prevent these ships from damaging the headmost ships of B, but will give time and opportunity to B to bring down his windward ships to fall in either ahead or astern, that is, to the right or left of his headmost ships A, and oppose ship for ship of the enemy upon equal terms? But should none of the headmost ships of the squadron F be crippled, that is, should F pass B without reach of cannon-shot, which undoubtedly he will do if he can; still, while bearing away, he may be forced to suffer a distant cannonade, ship with ship on equal terms, whether he veers and gets back upon his former tack, as at G in fig. 85. or continues to run before the wind, as at P in fig. 86. But if F persists to pass on a contrary tack to leeward, and without reach of cannon-shot, it is evident, whether he put right before the wind, or run off ship by ship as he best can, that B must at some time or other come up with his rear. — View of Mr Clerk's Tactics.

162 So far the attack has proceeded with the wind fixed in one and the same quarter. To make the propriety of it the more apparent, it will be necessary to inquire, What might be the effect produced by a change of wind, should that take place during the action? For this purpose, let the opponent fleets be placed in some one of the preceding positions, representing the attack upon the three sternmost ships of the enemy, as in fig. 87.; in which the fleet desirous of making the attack is represented in four divisions, as at B, B, B, A, and F the fleet desirous of avoiding the attack, at the hazard of abandoning his three sternmost ships at G. — Effect produced by a change of wind during the action.

163 In the commencement of the attack, let us suppose the wind to be N. and the ships going two points free on the larboard tack, or standing E.; and soon after the commencement let the wind be supposed to veer round to the W.; then it is evident, by the disposition of the two fleets, that the fleet F, by such a change, will have acquired no advantage whatever; on the contrary, it will thereby be thrown just so much the farther to leeward. — The wind shifting 8 degrees and coming aft.

164 Again, if the wind, by taking an opposite course, shall shift ahead and come round by the eastern quarter to L, the admiral of the fleet F will not have it in his power to avail himself of this circumstance, provided the commander of B, continuing carefully to watch his motions, and feeling the impulse of the veering wind, shall stretch his ships, as at OO, to the windward of the three ships at G, separated from F's fleet, and at the same time to the leeward of the main body of that fleet. This will be apparent from figures 88. and 89. which exhibit the two fleets, after this manœuvre, both on the larboard and starboard tack. — The wind shifting 8 degrees round ahead.

165 Let the wind be supposed to wear round gradually from the E. towards the S. and from thence to the W. and then quite round the compass. Then F being supposed to have gained the wind, it will be in his power to maintain it, and make a circular course to windward of B; but as he can be attended all the while by the fleet B, who will cut him off to leeward, he never will be able to recover his three ships, supposed to be cut off. This is evident without the illustration of a figure. — The wind continuing to veer round the compass.

166 Lastly, if the wind in changing shall in one instant shift in direct opposition where it was when the attack began, that is, from north to south; then and in that case, before it can be judged whether such change shall be favourable for F or not, it will be necessary that the relative situation of the two fleets should be determined, such as it was when the change took place. For example, if the headmost ships of the fleet F, that is, if his van and centre shall have separated at any considerable distance from his rear, and shall, in con- — The wind shifting instantly to the opposite point.

commencement of the proposed attack, have changed to a position as represented by fig. [illegible]; it is evident that F, though by this change he will have got to windward, will yet not be able to avail himself of this seeming advantage, the fleet B having it still in their power to cut him off from his three ships.

On the other hand, if this instantaneous change of wind, in direct opposition, shall have taken place more early in the action, that is, when the positions of the two fleets shall be such as represented in fig. 87. (the fleet B in the position of four divisions E, B, P, and A, and the enemy in the positions F and G); then F, who before was to leeward, by this instantaneous change of wind from the north to the south, having now got to windward of every division of the fleet B, is it not evident that it may be practicable for him to carry assistance to his three ships at G in the rear, and perhaps even to cut off some of B's ships at A, if they do not with all convenient speed bear away to put themselves under the protection of their friends B to leeward? But whether F shall attempt to effect this manœuvre, by veering his ships in the line, or, what seems most eligible, by making his ships tack, as it is to be presumed that his three ships, which have been some time engaged, must be considerably crippled, and not able to make sufficient sail; while endeavouring to bring them off, it will be difficult for him to prevent being drawn into a general and close engagement, which, by the supposition, he has all along endeavoured to avoid.

CHAP. III. *Of Partial Breezes of Wind.*

It often happens at sea, that when two ships are in sight of each other, one of them will be sailing at a considerable rate, being favoured with a breeze of wind; while the other at the same time is lying becalmed, having no other motion than what she receives from the tide or a current, if any, or from the swell of the sea. As this may be the case with respect to two adverse fleets when in sight of each other, that fleet which has the advantage of the wind will evidently use every possible method to prosecute the advantage that may result from it. Thus if the fleet desirous of making the attack be favoured with a breeze of wind, while the other fleet at the same time is lying becalmed, it is evident that the commander of this fleet will endeavour to get as near the opponent fleet as possible; whereas, if the fleet wishing to avoid an engagement be favoured with the wind, the other lying becalmed, then that fleet will avail themselves of this opportunity of making their escape.

167 The fleet pursued being favoured with a partial breeze after the attack upon his three sternmost ships is commenced.

If the attack upon the three sternmost ships shall have commenced before this partial breeze in favour of the fleet pursued has taken place; then the variety of positions in which the two fleets may be affected is so great, and the resulting consequences so numerous, that it would be an endless task to give a separate description of each. In the mean time, therefore, as it is imagined nothing in such investigation will be found that can materially affect the general issue; and since no breeze whatever can favour the fleet F, so as to enable it to sail round and round the fleet B, which all the while is supposed to be lying becalmed, it will not be too much to say, that *this partial breeze in favour of the fleet F, taking place after the attack began, although it may facilitate the escape of his van and centre, will not avail him much in the recovery of the three ships in his rear*—perhaps not in any case as yet exhibited, excepting this one, where the wind in one instant had changed in direct opposition.

168 Of little advantage.

Now let, as formerly, the attack be commenced before the partial breeze in favour of the fleet pursued has taken place, but that the wind has instantaneously shifted in direct opposition; then, even in this case, the same breeze which would favour F (fig. 87.) in the attempt to bring off his three ships, would at the same time favour the escape of the ships of B at A, as formerly described. That this partial breeze would require to be of considerable duration, otherwise F, in thus attempting to bring off his three ships, crippled as they will be, must hazard a general engagement, in like manner as already described.

Mr Clerk employs a section of his book to show the propriety of his proposed attack from windward, in places where the hostile fleets are liable to encounter winds blowing in contrary directions at the same instant; but as this is a case which does not surely often happen, we shall refer our readers to the work itself, and conclude this article with some other methods of attack, which have been suggested as improvements of that which is commonly followed.

1st, It has been proposed that the attack should be made with the greater part bearing down before the wind upon the six sternmost ships of the enemy. It is, however, evident, that ships by making the attack in this manner must be exposed, without a possibility of return, to as many broadsides from each of these six ships as can be got ready during a course of two miles. Hence, as the ships making the attack will assuredly be disabled before they can have it in their power to hurt the enemy, this mode of attack cannot be proper.

2d, It has also been imagined, that some part of the force chosen to make the attack should be sent to leeward as well as to windward of the three ships determined to be attacked. But the danger supposed, of shot passing over the enemy's ships, and striking those of friends, may be an objection to this mode.

3d, Others have been of opinion, that the headmost ship chosen to make the attack should come close up alongside of the sternmost of the enemy, and having delivered her fire, push along the line as far as possible, which may be supposed to be the sixth ship of the enemy; and as it is evident that this first ship may have received six broadsides, that is, a broadside from every one of the six ships of the enemy during her course in passing them, it has been thought possible that the other five ships, by following close after her, may attain their stations, each abreast of her opposite, without having received a greater number of broadsides than they have had it in their power to return; and therefore that by this mode the number of ships to be attacked will be determined: For as many ships as the leading ship will be able to reach, as many will the attacking fleet be able to carry.

4th, Again, let it be supposed, as in the former case, that the fleet making the attack has been brought up to action in a collected manner, but subdivided only so far as the service may require, and that the leeward division shall be more particularly destined for the immediate attack, while, at the same time, the body of the fleet keeping to windward shall be supposed attentive to give the necessary support where required; then let it be supposed, that the headmost ship making the attack having been soon crippled, shall not have been able to push farther than the third or fourth ship of the enemy's line—is it not easy to conceive, it is asked, that some one or more of the ships to windward, attentive to support and supply her place, may bear down on the fourth ship of the enemy, under cover of the smoke, throw in her fire, and push on to the fifth or sixth ship, or perhaps farther; and that so far as this fresh ship, or a second fresh ship, may be able to push, so many ships of the enemy may be expected to be carried? For whatever ships of the enemy can

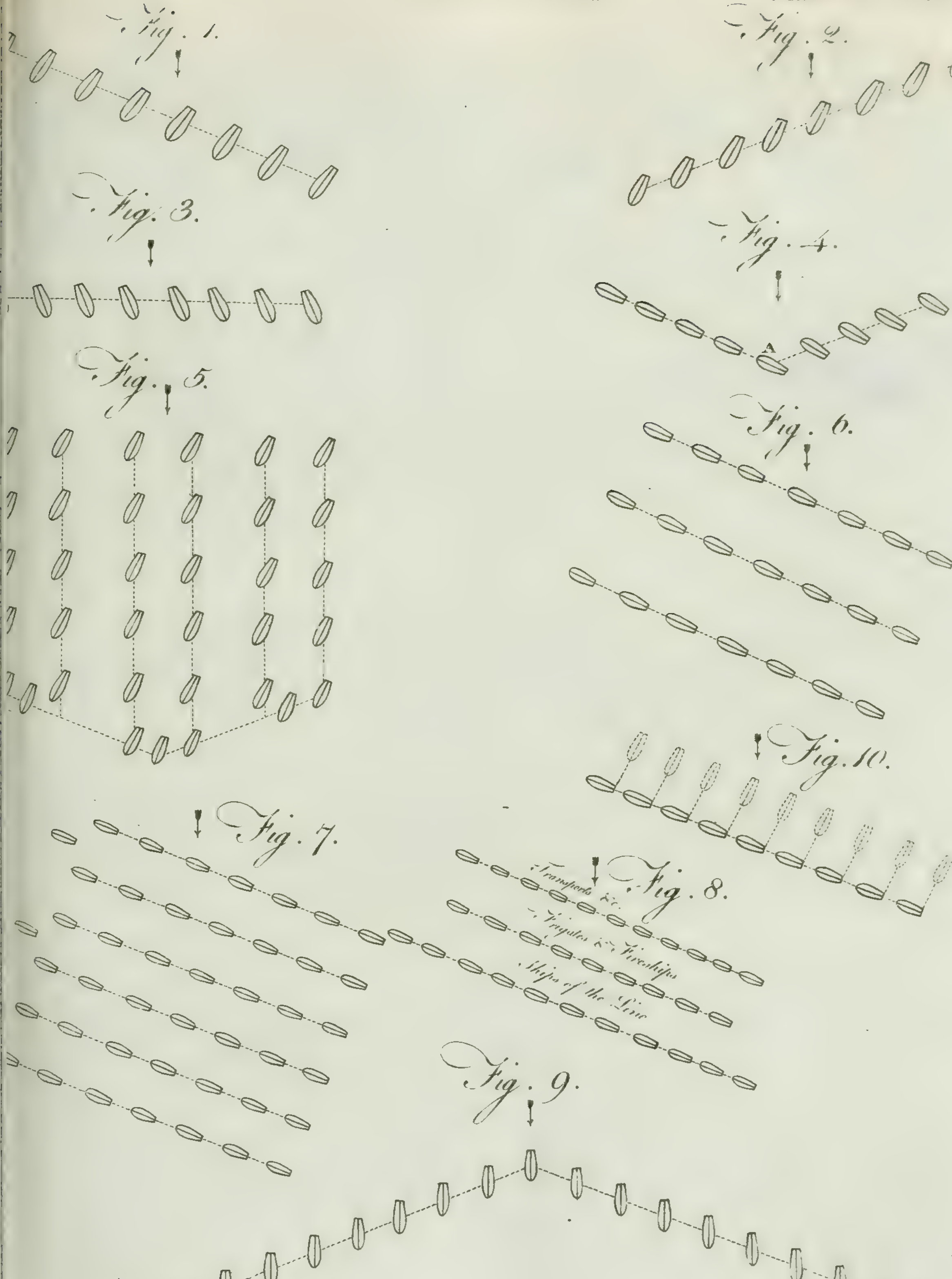
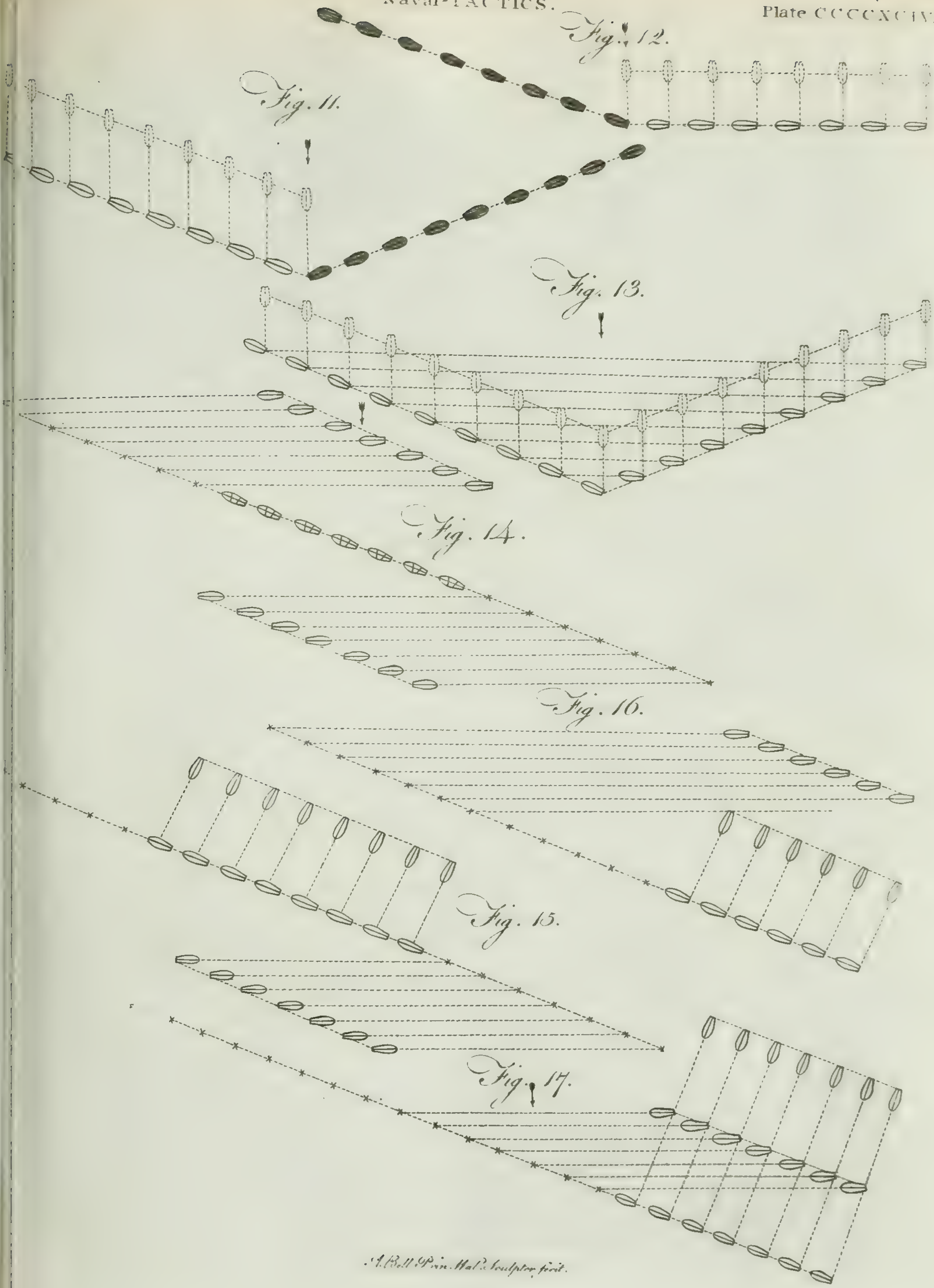


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
A
Fig. 5.
Fig. 6.
Fig. 10.
Fig. 7.
Fig. 8.
Transports &c.
Frigates & Fireships
Ships of the Line
Fig. 9.
A. Bell Prin. Wal. Sculpt.



A. Bell Prin. Wal. Sculptor fecit.

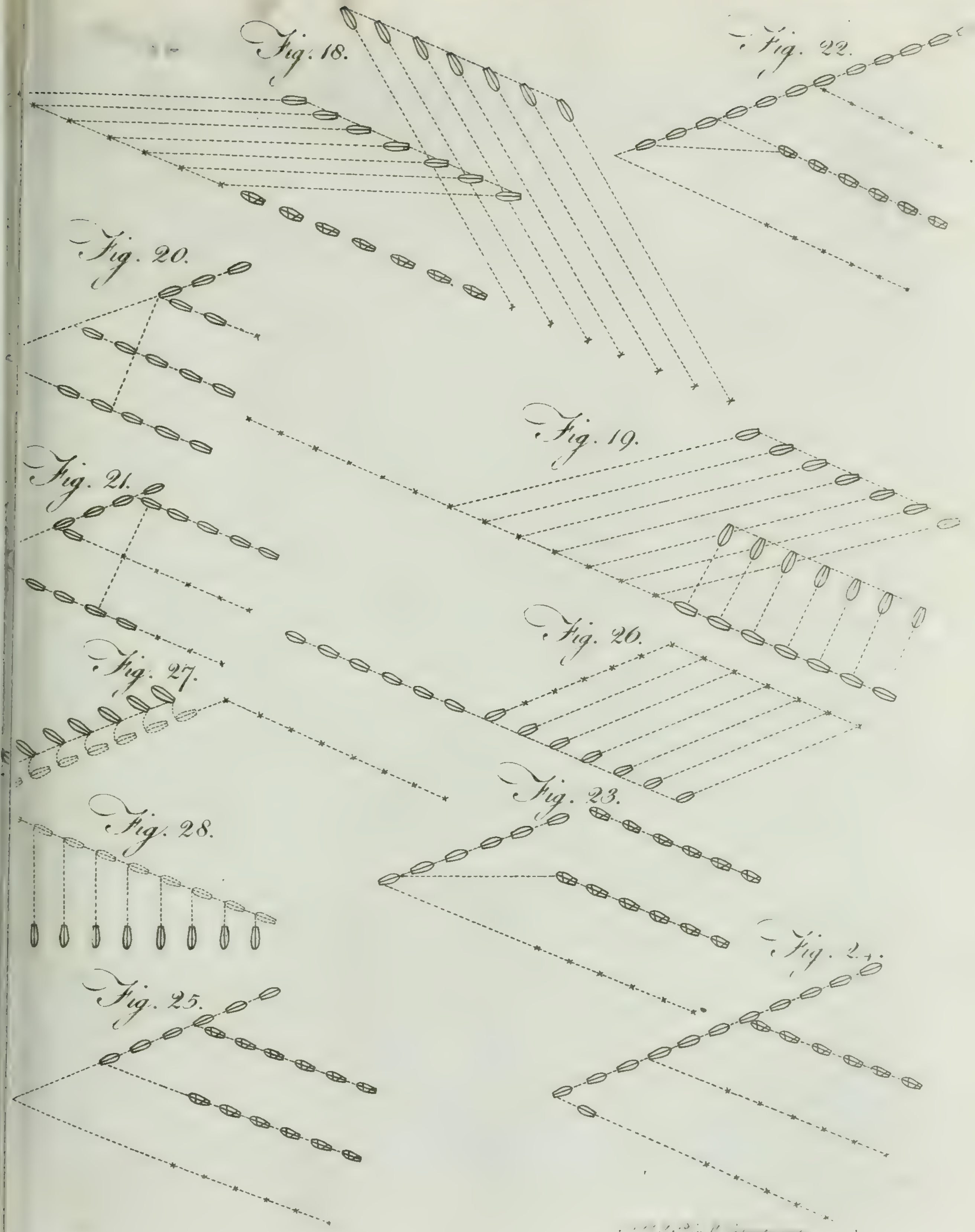


Fig. 18.
Fig. 22.
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Fig. 25.

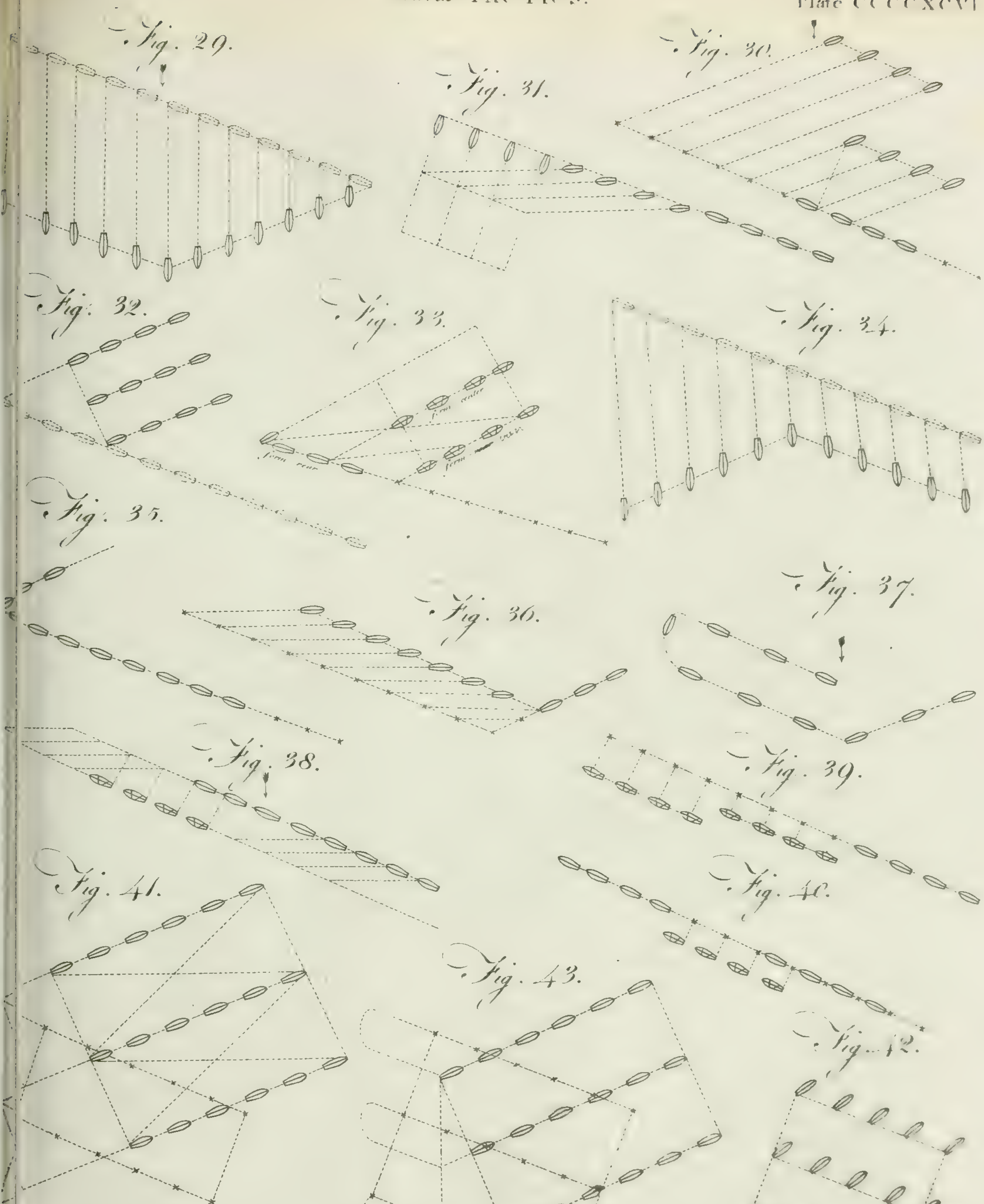
Fig. 29.
Fig. 30.
Fig. 31.
Fig. 32.
Fig. 33.
form rear
form centre
form van
Fig. 34.
Fig. 35.
Fig. 36.
Fig. 37.
Fig. 38.
Fig. 39.
Fig. 40.
Fig. 41.
Fig. 42.
Fig. 43.

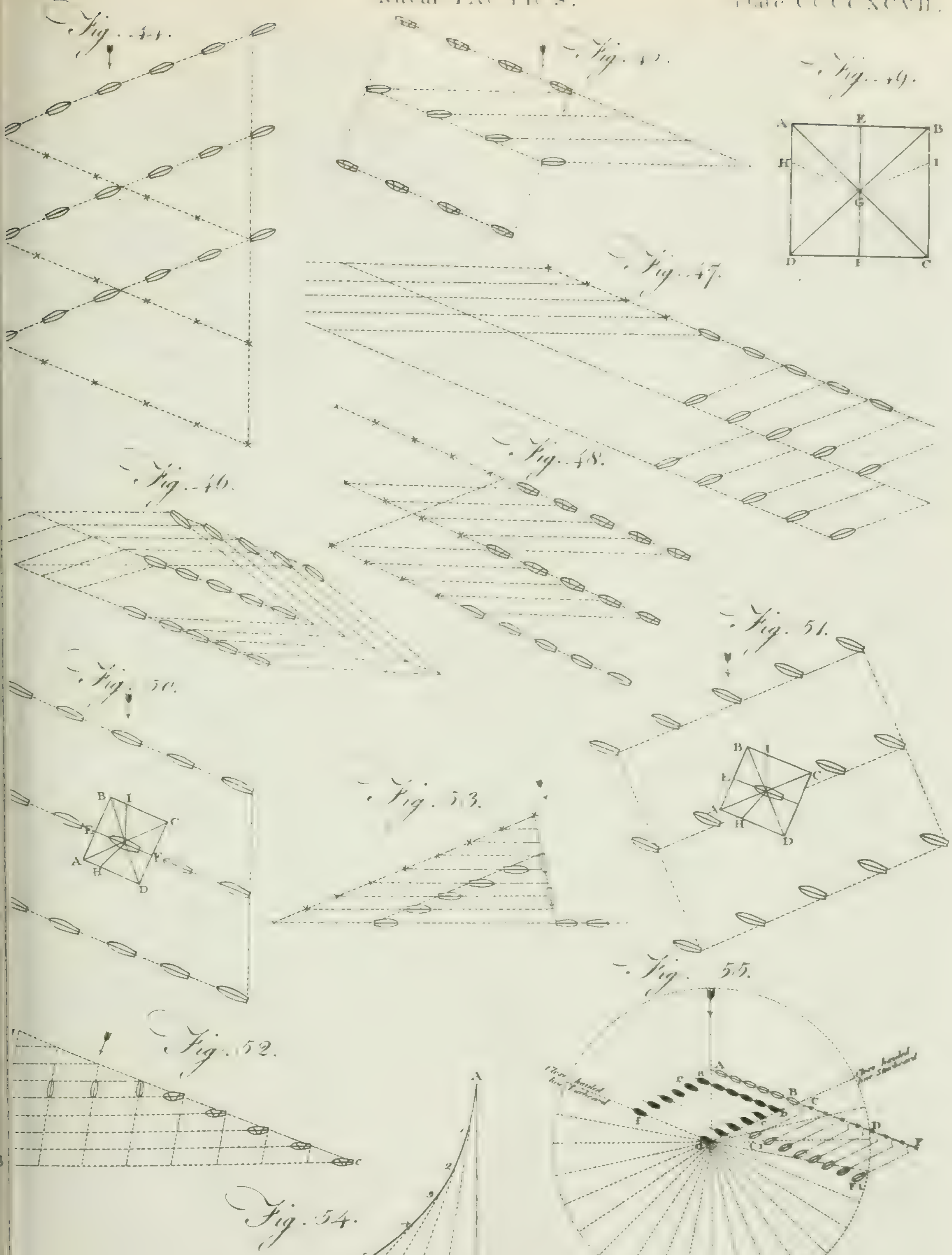
Fig. 44.
Fig. 45.
Fig. 49.
A E B
H I
G
D F C
Fig. 47.
Fig. 48.
Fig. 46.
Fig. 51.
B I
E C
A
H D
Fig. 50.
B I
C
E
A
H
D
Fig. 53.
Fig. 52.
Fig. 54.
A
B
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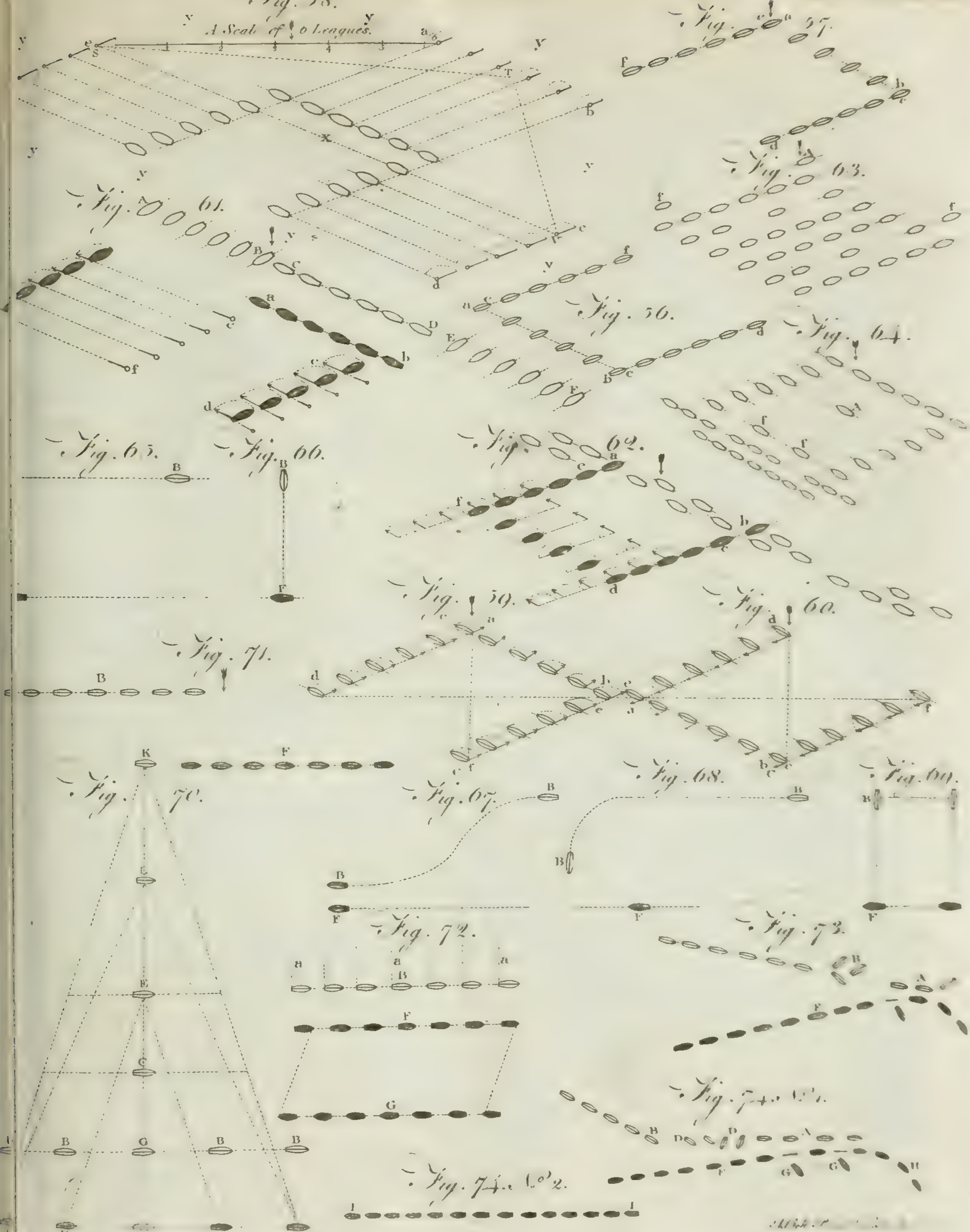
Fig. 55.
A
B
C
D
Close hauled Starboard
Close hauled Larboard



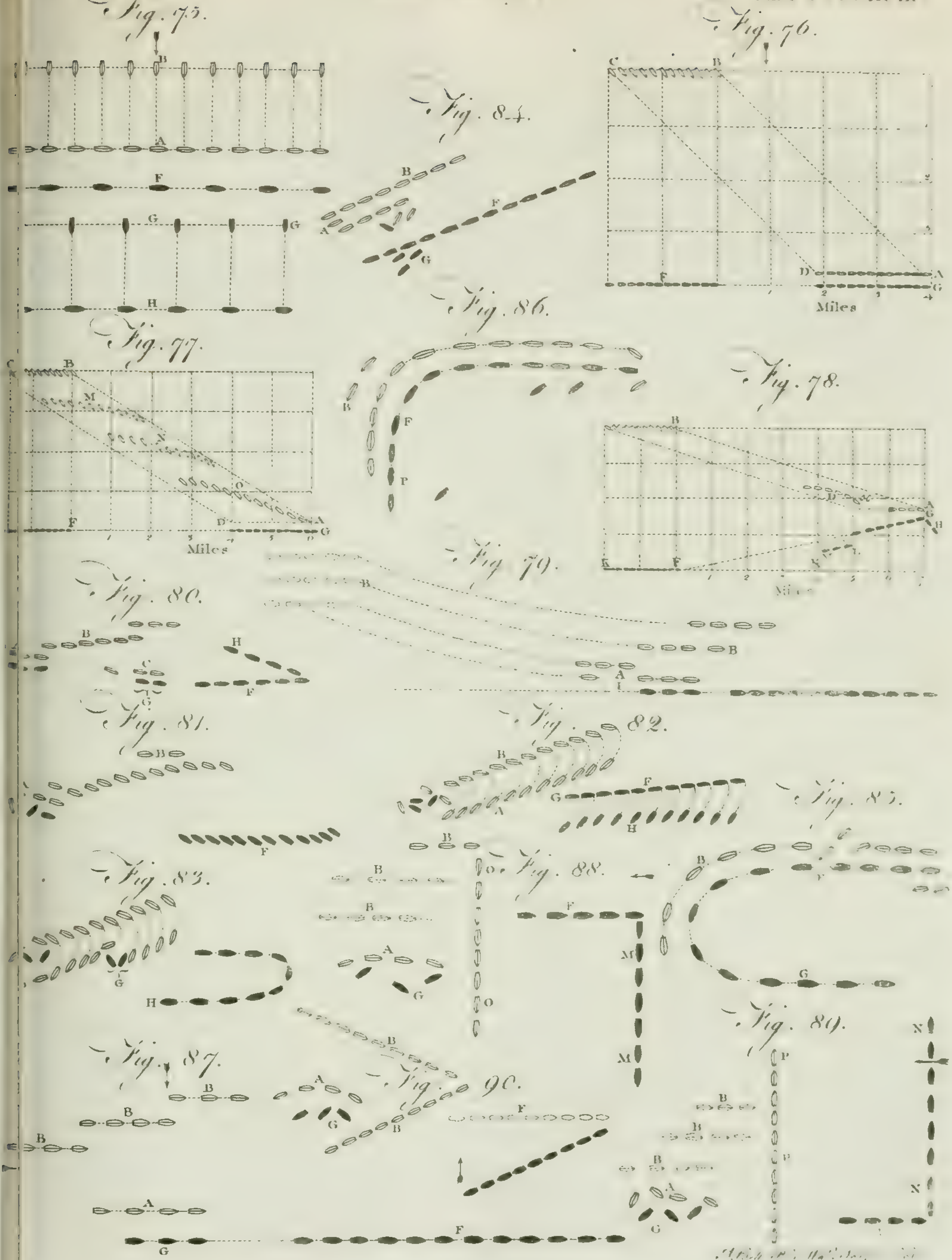


Fig. 75.
Fig. 76.
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Fig. 79.
Fig. 80.
Fig. 81.
Fig. 82.
Fig. 83.
Fig. 84.
Fig. 85.
Fig. 86.
Fig. 87.
Fig. 88.
Fig. 89.
Fig. 90.
Miles
Miles

can be got abreast of, at a proper distance, *may be disabled, and therefore commanded*, by the numerous fresh ships kept to windward for this purpose.

In all these various methods of attack, the fleet making the attack is supposed to sail faster than the other, or at least to come up with it; and that so soon as the ships are engaged, their velocity will consequently be diminished. That being premised, a more proper mode of attack than any of the preceding will perhaps be as follows:

5th, The first or headmost of the ships intended to make the attack is to range alongside of the enemy, and preserve that station. The second ship is to make all possible sail to luff up and pass the first ship, which is now supposed to be engaged, and get alongside of the last but one of the enemy, which she is to engage. In like manner, the third of the attacking ships is to get alongside of the last but two of the enemy, whom she is to engage; and if it be deemed expedient, the fourth, &c. ship may be engaged. It is, however, evident that this method can only be practised when the wind is brisk, and that a calm, in consequence of a vigorous cannonade, may render the attack upon more than three or four of the enemy's ships impossible. Partial Breezes of Wind.

In all the different attacks upon the rear, it has by some been thought a great object, if practicable, to throw a raking fire into the rear of an enemy's line of battle, by ships detached for that purpose. For if shot, as has been said, can take effect at a distance of two miles, from this position it will surely reach the sixth ship, if the enemy's line shall be formed at two cable's length asunder; and if formed at one cable's length asunder, it may reach and may cripple the twelfth ship.

We have now given a cursory view of Naval Tactics in its present improved state; and shall take leave of the subject, with earnestly recommending to our nautical readers Mr Clerk's Essay, which, if allowance be made for the author's peculiarity of style, will surely meet the approbation of every officer who wishes to see the practice of naval war founded on principles of science.

TADCASTER, a town in the West Riding of Yorkshire, noted for the great plenty of limestone dug up near it; and for being one of the first places in which a building was erected for Sunday schools. It is nine miles from York, and 188 from London.

TADMOR. See PALMYRA.

TADPOLE, a young frog before it has disengaged itself from the membranes that envelope it in its first stage of life.

TÆNIA, in zoology; a genus of animals belonging to the class of *vermes*, and order of *intestina*. The body is long, depressed, and jointed like a chain, and contains a mouth and viscera in each joint. According to Gmelin, there are 92 species; all which inhabit the intestines of various animals, particularly of quadrupeds. Tænia.

Seven species of tænia are peculiar to man. 1. The *visceralis*, which is inclosed in a vesicle, broad in the fore-part, and pointed in the hinder part, inhabits the liver, the placenta uterina, and the sack which contains the superfluous fluid of dropsical persons. 2. The *cellulosæ*, which is inclosed in a cartilaginous vesicle, inhabits the cellular substance of the muscles; is about an inch long, half an inch broad, and one-fourth of an inch thick, and is very tenacious of life. 3. The *dentata*, has a pointed head; the large joints are streaked transversely, and the small joints are all dilated; the osculum or opening in the middle of both margins is somewhat raised. It is narrow, 10 or 12 feet long, and broad in the fore-parts; its ovaria are not visible to the naked eye; and the head underneath resembles a heart in shape. It inhabits the intestines. 4. The *lata*, is white, with joints very short and knotty in the middle; the osculum is solitary. It is from 18 to 120 feet long; its joints are streaked transversely; its ovaria are disposed like the petals of a rose. 5. The *vulgaris*, or common tape-worm, has two lateral mouths in each joint; it attaches itself so firmly to the intestines, that it can scarcely be removed by the most violent medicines; it is slender, and has the appearance of being membranaceous; it is somewhat pellucid, from 10 to 16 feet long, and about four and an half lines broad at one end. 6. The *truttæ*, which chiefly inhabits the liver of the trout, but is also to be found in the intestines of the human species. 7. The *solium*, has a marginal mouth, one on each joint.

The structure and physiology of the tænia is curious, and it may be amusing as well as instructive to consider it with more attention. As the tænia is often the occasion of disease, we may be apt to consider it not only as useless, but even as naturally hurtful; but it is impossible to suppose that the Benevolent Father of mankind created a species of animals solely for the purpose of producing disease. The creation of the tænia is rather a striking instance of that rule which the Deity seems to have laid down to himself, to leave no place destitute of living creatures where they could multiply their species. He has therefore not only covered the earth with animals, but the surface of animals with other animals; and has even peopled such of their internal parts as could supply nourishment without disadvantage. Perhaps therefore a certain proportion of these animals is conducive to health, just as a certain proportion of different fluids is so, tho' an excessive increase always produces disease. For there is almost every different species of quadrupeds in a different species of tænia, which is a full proof that these worms have their structure and situation determined with as much attention and skill as any species of animals whatever. It is also a very curious fact, that those species of tænia which are peculiar to the human race are also peculiar to particular countries. Thus the vulgaris is most common in Sweden, the lata in Switzerland and Russia, and the solium in Great Britain, Saxony, and Holland.

The tænia appears destined to feed upon such juices of animals as are already animalized, and is therefore most commonly found in the alimentary canal, and in the upper part, where there is the greatest abundance of chyle; for chyle seems to be the natural food of the tænia. As it is thus supported by food which is already digested, it is destitute of the complicated organs of digestion. As the tænia solium is most frequent in this country, it may be proper to describe it more particularly,

It is from 3 to 30 feet long, some say 60 feet. It is composed of a head, in which is a mouth adapted to drink up fluids, and an apparatus for giving the head a fixed situation. The body is composed of a great number of distinct pieces articulated together, each joint having an organ whereby it attaches itself to the neighbouring part of the inner coat of the intestine. The joints nearest the head are always small, and they become gradually enlarged as they are farther removed from it; but towards the tail a few of the last joints again become diminished in size. The extremity of the body is terminated by a small semicircular joint, which has no opening in it.

The head of this animal is composed of the same kind of materials as the other parts of its body; it has a rounded

Tænia. opening at its extremity, which is considered to be its mouth. See Plate DI. fig. 1, 2. This opening is continued by a short duct into two canals; these canals pass round every joint of the animal's body, and convey the aliment (fig. 3.). Surrounding the opening of the mouth are placed a number of projecting radii, which are of a fibrous texture, whose direction is longitudinal. These radii appear to serve the purpose of tentacula for fixing the orifice of the mouth, as well as that of muscles to expand the cavity of the mouth, from their being inserted along the brim of that opening: (See fig. 1.) After the rounded extremity or head has been narrowed into the neck, as is represented in fig. 2. the lower part becomes flatted, and has two small tubercles placed upon each flatted side; the tubercles are concave in the middle, and appear destined to serve the purpose of suckers for attaching the head more effectually. The internal structure of the joints composing the body of this animal is partly vascular and partly cellular; the substance itself is white, and somewhat resembles in its texture the coagulated lymph of the human blood. The alimentary canal passes along each side of the animal, sending a cross canal over the bottom of each joint, which connects the two lateral canals together. See fig. 3.

Mr Carlisle, who gives the best account of the structure and economy of the tænia which we have seen, injected with a coloured size by a single push with a small syringe three feet in length of these canals, in the direction from the mouth downwards. He tried the injection the contrary way, but it seemed to be stopped by valves. The alimentary canal is impervious at the extreme joint, where it terminates without any opening analogous to an anus. Each joint has a vascular joint occupying the middle part, which is composed of a longitudinal canal, from which a great number of lateral canals branch off at right angles. These canals contain a fluid like milk.

The tænia seems to be one of the simplest vascular animals in nature. The way in which it is nourished is singular; the food being taken in by the mouth, passes into the alimentary canal, and is thus made to visit in a general way the different parts of the animal. As it has no excretory ducts, it would appear that the whole of its alimentary fluid is fit for nourishment; the decayed parts probably dissolve into a fluid which transudes through the skin, which is extremely porous.

This animal has nothing resembling a brain or nerves, and seems to have no organs of sense but that of touch. It is most probably propagated by ova, which may easily pass along the circulating vessels of other animals. We cannot otherwise explain the phenomena of worms being found in the eggs of fowls, and in the intestines of a fœtus before birth, except by supposing their ova to have passed through the circulating vessels of the mother, and by this means been conveyed to the fœtus.

The chance of an ovum being placed in a situation where it will be hatched, and the young find convenient subsistence, must be very small; hence the necessity for their being very prolific. If they had the same powers of being prolific which they now have, and their ova were afterwards very readily hatched, then the multiplication of these animals would be immense, and become a nuisance to the other parts of the creation.

Another mode of increase allowed to tænia (if we may call it increase) is by an addition to the number of their joints. If we consider the individual joints as distinct beings, it is so; and when we reflect upon the power of generation given to each joint, it makes this conjecture the more probable. We can hardly suppose that an ovum of a tænia, which at its full growth is 30 feet long, and composed of 400 joints, contained a young tænia composed of this number of pieces; but we have seen young tænia not half a foot long, and not possessed of 50 joints, which still were entire worms. We have also many reasons to believe, that when a part of this animal is broken off from the rest, it is capable of forming a head for itself, and becomes an independent being. The simple construction of the head makes its regeneration a much more easy operation than that of the tails and feet of lizards, which are composed of bones and complicated vessels; but this last operation has been proved by the experiments of Spallanzani and many other naturalists.

When intestinal worms produce a diseased state of the animal's body which they inhabit, various remedies are advised for removing them; many of which are ineffectual, and others very injurious by the violence of their operation. Drastic purges seem to operate upon tænia, partly by irritating the external surface of their bodies, so as to make them quit their holds, and partly by the violent contractions produced in the intestine, which may sometimes divide the bodies of tænia, and even kill them by bruising. Mr Carlisle proposes the trial of a simple remedy, which (*à priori*) promises to be successful; namely, small shocks of electricity passed frequently through the regions of the abdomen; the lives of the lower orders of animals seeming to be easily destroyed by such shocks of electricity as do not injure the larger and more perfect animals.

Plate DI. fig. 1. shows the head of the tænia magnified; the mouth is in the middle of the circular plane, where the body becomes flatted and broad; there are two hollow tubercles represented by the two dark shaded spots. Fig. 2. is the same head, of its natural bigness, and which belonged to a tænia 20 feet in length. Fig. 3. shows the alimentary canals, in a portion of the same tænia, of their natural bigness. The dark-shaded undulating lines are the alimentary canals, which are seen to their full extent in this portion of the worm. Fig. 4. shows the middle system of vessels, in two joints, which are represented by the dark lines. Fig. 5. shows two joints, from one side of which a slip was torn down to show the vessels underneath, and also the direction of the fibres in the slip, which are accumulated into little fasciculi like muscular fibres. Fig. 6. exhibits three joints, having the ducts leading from the lateral oscula injected; the dark transverse lines leading from each osculum show the size, direction, and extent of these ducts. Fig. 7. shows the edge of two joints turned forwards, and the appearance of the oscula in this point of view. Fig. 8. represents the whole of these canals in their relative situations.

For a more complete account of the tænia, we must refer to Mr Carlisle's ingenious paper in the Linnean Transactions.

TAFFETY or TAFFETA, in commerce, a fine smooth silken stuff, remarkably glossy. There are taffeties of all colours, some plain, and others striped with gold, silver, &c. others chequered, others flowered, &c. according to the fancy of the workmen.

TAGARA, a city of ancient India, the metropolis of a large district called *Ariaca*, which comprehended the greatest part of the Subah of Aurangabad, and the southern part of Concan. Arrian says, that it was situated about ten days journey to the eastward of Plithanah; which, according to the rate of travelling in that country with loaded carts, might be about 100 British miles. This fixes its situation at Deoghir, a place of great antiquity, and famous through all India on account of the pagodas of Elloura. It is now called *Doulet-abad*.

Tænia ‖ Tagetes. TAGETES, MARYGOLD, in botany: A genus of plants belonging to the class of *syngenesia*, and order of *polygamia superflua*; and in the natural system ranging under the 49th

 order,

order, *Compositæ*. The receptacle is naked; the pappus consists of five erect awns or beards; the calyx is monophyllous, quinquedentate, and tubular; and there are four persistent florets of the ray. There are three species, the *patula*, *erecta*, and *minuta*; of which the two first have been cultivated in the British gardens, at least, since the year 1596, for it is mentioned in Gerard's Herbal, which was published that year. They are both natives of Mexico.

The *erecta*, or African marygold, has a stem subdivided and spreading, and has formed itself into a great many varieties: 1. Pale yellow, or brimstone colour, with single, double, and fistulous flowers. 2. Deep yellow, with single, double, and fistulous flowers. 3. Orange-coloured, with single, double, and fistulous flowers. 4. Middling African, with orange-coloured flowers. 5. Sweet-scented African. These are all very subject to vary; so that unless the seeds are very carefully saved from the finest flowers, they are apt to degenerate: nor should the same seeds be too long sown in the same garden, for the same reason; therefore, those who are desirous to have these flowers in perfection should exchange their seeds with some person of integrity at a distance, where the soil is of a different nature, at least every other year. If this is done, the varieties may be continued in perfection. This plant is so well known as to need no description. It flowers from the beginning of July till the frost puts a stop to it.

The *patula* has a simple erect stem, and the peduncles are scaly and multiflorous.

It has been long in the British gardens, where it is distinguished from the first by the title of *French marygold*. Of this there are several varieties, some of which have much larger flowers than others, and their colour varies greatly: there are some which are beautifully variegated, and others quite plain; but as these are accidents arising from culture, so they do not merit farther distinction; for we have always found that seeds saved from the most beautiful flowers will degenerate, especially if they are sown in the same garden for two or three years together, without changing the seed.

These plants have a strong disagreeable scent, especially when handled; for which reason they are not so greatly esteemed for planting near habitations: but the flowers of the sweet-scented sort being more agreeable, are generally preferred, especially for planting in small gardens.

TAGUS, the largest river of Spain; which, taking its rise on the confines of Arragon, runs south-west through the provinces of New Castile and Estremadura; and passing by the cities of Aranjuez, Toledo, and Alcantara, and then crossing Portugal, forms the harbour of Lisbon, at which city it is about three miles over; and about eight or ten miles below this it falls into the Atlantic ocean.

TAHOEREWA, one of the Sandwich islands. It is small, destitute of wood, and its soil sandy and unfertile. It is situated in north latitude 20° 38′, in east longitude 203° 27′. See *Cook's Discoveries*, vol. v. n° 88. and SANDWICH-*Islands*.

TAHOORA, one of the Sandwich islands in the South Sea. It is uninhabited, and lies in north latitude 21° 43′, and in east longitude 199 36′. See SANDWICH-*Islands*.

TAJACU, or PECCARY, in zoology, a species of hog. See SUS.

TAI-OUAN, the Chinese name of the island of Formosa. See FORMOSA.—Tai-ouan is also the name of the capital of the island.

TAIL, the train of a beast, bird, or fish; which in land animals serves to drive away flies, &c. and in birds and fishes to direct their course, and assist them in ascending or descending in the air or water.

TAIL, OR FEE-TAIL, in law, is a conditional estate or fee, opposed to *fee-simple*. See FEE.

A conditional fee, at the common law, was a fee restrained to some particular heirs exclusive of others: as, to the heirs of a man's body, by which only his lineal descendants were admitted, in exclusion of collateral heirs; or to the heirs male of his body, in exclusion both of collaterals and lineal females also. It was called a *conditional fee*, by reason of the condition expressed or implied in the donation of it, that if the donee died without such particular heirs, the land should revert to the donor. For this was a condition annexed by law to all grants whatsoever, that on failure of the heirs specified in the grant, the grant should be at an end, and the land return to its ancient proprietor. Such conditional fees were strictly agreeable to the nature of feuds, when they first ceased to be mere estates of life, and were not yet arrived to be absolute estates in fee-simple.

With regard to the condition annexed to these fees by the common law, it was held, that such a gift (to a man and the heirs of his body) was a gift upon condition that it should revert to the donor if the donee had no heirs of his body; but if he had, it should then remain to the donee. They therefore called it a *fee-simple* on condition that he had issue. Now we must observe, that when any condition is performed, it is thenceforth entirely gone; and the thing to which it was before annexed becomes absolute and wholly unconditional. So that as soon as the grantee had any issue born, his estate was supposed to become absolute by the performance of the condition; at least for these three purposes: 1. To enable the tenant to alienate the land, and thereby to bar not only his own issue, but also the donor, of his interest in the reversion. 2. To subject him to forfeit it for treason: which he could not do till issue born longer than for his own life, lest thereby the inheritance of the issue and reversion of the donor might have been defeated. 3. To empower him to charge the land with rents, commons, and certain other encumbrances, so as to bind his issue. And this was thought the more reasonable, because, by the birth of issue, the possibility of the donor's reversion was rendered more distant and precarious: and his interest seems to have been the only one which the law, as it then stood, was solicitous to protect, without much regard to the right of succession intended to be vested in the issue. However, if the tenant did not in fact alienate the land, the course of descent was not altered by this performance of the condition: for if the issue had afterwards died, and then the tenant or original grantee had died, without making any alienation, the land, by the terms of the donation, could descend to none but the heirs of his body; and therefore, in default of them, must have reverted to the donor. For which reason, in order to subject the lands to the ordinary course of descent, the donees of these conditional fee-simples took care to alienate as soon as they had performed the condition by having issue; and afterwards repurchased the lands, which gave them a fee-simple absolute, that would descend to the heirs general, according to the course of the common law. And thus stood the old law with regard to conditional fees: which things, says Sir Edward Coke, though they seem ancient, are yet necessary to be known, as well for the declaring how the common law stood in such cases, as for the sake of annuities, and such-like inheritances, as are not within the statutes of entail, and therefore remain as the common law. The inconveniences which attended these limited and fettered inheritances were probably what induced the judges to give way to this subtle finesse (for such it undoubtedly was), in order to shorten the duration of these conditional estates. But, on the other hand, the nobility, who were willing to perpetuate their

Tail. possessions in their own families, to put a stop to this practice, procured the statute of Westminster the second (commonly called the statute *de donis conditionalibus*) to be made; which paid a greater regard to the private will and intentions of the donor, than to the propriety of such intentions, or any public considerations whatsoever. This statute revived in some sort the ancient feodal restraints which were originally laid on alienations, by enacting, that from thenceforth the will of the donor be observed; and that the tenements so given (to a man and the heirs of his body) should at all events go to the issue, if there were any; or if none, should revert to the donor.

Upon the construction of this act of parliament, the judges determined that the donee had no longer a conditional fee simple, which became absolute and at his own disposal the instant any issue was born; but they divided the estate into two parts, leaving in the donee a new kind of particular estate, which they denominated a *fee tail*; and vesting in the donor the ultimate fee-simple of the land, expectant on the failure of issue; which expectant estate is what we now call a *reversion*. And hence it is that Littleton tells us, that tenant in fee-tail is by virtue of the statute of Westminster the second. The expression *fee-tail*, or *feodum talliatum*, was borrowed from the feudists (see Crag. *l. s. t.* 10. § 24, 25.), among whom it signified any mutilated or truncated inheritance, from which the heirs general were cut off; being derived from the barbarous verb *taliare*, to cut; from which the French *tailler* and the Italian *tagliare* are formed, (Spelm. *Gloss.* 531.).

Having thus shown the original of estates tail, we now proceed to consider what things may or may not be entailed under the statute *de donis*. Tenements is the only word used in the statute: and this Sir Edward Coke expounds to comprehend all corporeal hereditaments whatsoever; and also all incorporeal hereditaments which savour of the realty, that is, which issue out of corporeal ones, or which concern or are annexed to or may be exercised within the same; as rents, estovers, commons, and the like. Also offices and dignities, which concern lands, or have relation to fixed and certain places, may be entailed. But mere personal chattels, which savour not at all of the reality, cannot be entailed. Neither can an office, which merely relates to such personal chattels; nor an annuity, which charges only the person, and not the lands of the granter. But in these last, if granted to a man and the heirs of his body, the grantee hath still a fee conditional at common law as before the statute, and by his alienation may bar the heir or reversioner. An estate to a man and his heirs for another's life cannot be entailed; for this is strictly no estate of inheritance, and therefore not within the statute *de donis*. Neither can a copyhold estate be entailed by virtue of the statute; for that would tend to encroach upon and restrain the will of the lord: but, by the special custom of the manor, a copyhold may be limited to the heirs of the body; for here the custom ascertains and and interprets the lord's will.

As to the several species of estates-tail, and how they are respectively created; they are either general or special. Tail-general is where lands and tenements are given to one, and the heirs of his body begotten: which is called *tail-general*; because, how often soever such donee in tail be married, his issue in general, by all and every such marriage, is, in successive order, capable of inheriting the estate-tail *per formam doni*. Tenant in *tail-special* is where the gift is restrained to certain heirs of the donee's body, and does not go to all of them in general. And this may happen several ways. We shall instance in only one; as where lands and tenements are given to a man and the heirs of his body, on Mary his now wife to be begotten. Here no issue can inherit but such special issue as is engendered between them two; not such as the husband may have by another wife; and therefore it is called *special tail*. And here we may observe, that the words of inheritance (to him and his heirs) give him an estate in fee; but they being heirs to be by him begotten, this makes it a fee tail; and the person being also limited, on whom such heirs shall be begotten (viz. Mary his present wife), this makes it a fee-tail special.

Estates in general and special tail are farther diversified by the distinction of sexes in such entails; for both of them may either be in tail male or tail female. As if lands be given to a man, and his heirs-male of his body begotten, this is an estate in tail male general; but if to a man, and the heirs-female of his body on his present wife begotten, this is an estate in tail female special. And in case of an entail male, the heirs-female shall never inherit, nor any derived from them; nor, *e converso*, the heirs-male in case of a gift in tail female. Thus, if the donee in tail male hath a daughter, who dies leaving a son, such grandson in this case cannot inherit the estate tail; for he cannot deduce his descent wholly by heirs-male. And as the heir-male must convey his descent wholly by males, so must the heir-female wholly by females. And therefore if a man hath two estates-tail, the one in tail male and the other in tail female, and he hath issue a daughter, which daughter hath issue a son; this grandson can succeed to neither of the estates, for he cannot convey his descent wholly either in the male or female line.

As the word *heirs* is necessary to create a fee, so, in farther imitation of the strictness of the feodal donation, the word *body*, or some other words of procreation, are necessary to make it a fee-tail, and ascertain to what heirs in particular the fee is limited. If, therefore, either the words of inheritance or words of procreation be omitted, albeit the others are inserted in the grant, this will not make an estate-tail. As if the grant be to a man and the issue of his body, to a man and his seed, to a man and his children or offspring; all these are only estates for life, there wanting the words of inheritance, "his heirs." So, on the other hand, a gift to a man, and his heirs male or female, is an estate in fee-simple and not in fee-tail; for there are no words to ascertain the body out of which they shall issue. Indeed, in last wills and testaments, wherein greater indulgence is allowed, an estate-tail may be created by a devise to a man and his seed, or to a man and his heirs-male, or by other irregular modes of expression.

There is still another species of entailed estates, now indeed grown out of use, yet still capable of subsisting in law; which are estates *in libero maritagio*, or FRANKMARRIAGE. See that article.

The incidents to a tenancy in tail, under the statute Westminster 2. are chiefly these: 1. That a tenant in tail may commit waste on the estate tail, by felling timber, pulling down houses, or the like, without being impeached or called to account for the same. 2. That the wife of the tenant in tail shall have her dower, or thirds, of the estate-tail. 3. That the husband of a female tenant in tail may be tenant by the curtesy of the estate-tail. 4. That an estate-tail may be barred, or destroyed, by a fine, by a common recovery, or by lineal warranty descending with assets to the heir. See ASSETS.

Thus much for the nature of estates-tail: the establishment of which family-law (as it is properly styled by Pigott) occasioned infinite difficulties and disputes. Children grew disobedient when they knew they could not be set aside: farmers were ousted of their leases made by tenants in tail; for if such leases had been valid, then, under colour of long leases, the issue might have been virtually disinherited: creditors were defrauded of their debts; for, if

a tenant in tail could have charged his estate with their payment, he might also have defeated his issue, by mortgaging it for as much as it was worth: innumerable latent entails were produced to deprive purchasers of the lands they had fairly bought; of suits in consequence of which, our ancient books are full: and treasons were encouraged, as estates tail were not liable to forfeiture longer than for the tenant's life. So that they were justly branded as the source of new contentions and mischiefs unknown to the common law; and almost universally considered as the common grievance of the realm. But as the nobility were always fond of this statute, because it preserved their family-estates from forfeiture, there was little hope of procuring a repeal by the legislature; and therefore, by the connivance of an active and politic prince, a method was devised to evade it.

About 200 years intervened between the making of the statute *de donis*, and the application of common recoveries to this intent, in the 12th year of Edward IV.; which were then openly declared by the judges to be a sufficient bar of an estate tail. For though the courts had, so long before as the reign of Edward III. very frequently hinted their opinion that a bar might be effected upon these principles, yet it was never carried into execution; till Edward IV. observing (in the disputes between the houses of York and Lancaster) how little effect attainders for treason had on families whose estates were protected by the sanctuary of entails, gave his countenance to this proceeding, and suffered Taltarum's case to be brought before the court: wherein, in consequence of the principles then laid down, it was in effect determined, that a common recovery suffered by tenant in tail should be an effectual destruction thereof. These common recoveries are fictitious proceedings, introduced by a kind of *pia fraus*, to elude the statute *de donis*, which was found so intolerably mischievous, and which yet one branch of the legislature would not then consent to repeal: and that these recoveries, however clandestinely begun, are now become by long use and acquiescence a most common assurance of lands; and are looked upon as the legal mode of conveyance, by which a tenant in tail may dispose of his lands and tenements: so that no court will suffer them to be shaken or reflected on, and even acts of parliament have by a side-wind countenanced and established them.

This expedient having greatly abridged estates-tail with regard to their duration, others were soon invented to strip them of other privileges. The next that was attacked was their freedom from forfeitures for treason. For, notwithstanding the large advances made by recoveries, in the compass of about threescore years, towards unfettering these inheritances, and thereby subjecting the lands to forfeiture, the rapacious prince then reigning, finding them frequently resettled in a similar manner to suit the convenience of families, had address enough to procure a statute, whereby all estates of inheritance (under which general words estates-tail were covertly included) are declared to be forfeited to the king upon any conviction of high-treason.

The next attack which they suffered, in order of time, was by the statute 32 Hen. VIII. c. 28. whereby certain leases made by tenants in tail, which do not tend to the prejudice of the issue, were allowed to be good in law, and to bind the issue in tail. But they received a more violent blow in the same session of parliament, by the construction put upon the statute of fines, by the statute 32 Hen. VIII. c. 36. which declares a fine duly levied by tenant in tail to be a complete bar to him and his heirs, and all other persons claiming under such entail. This was evidently agreeable to the intention of Henry VII. whose policy it was (before common recoveries had obtained their full strength and authority) to lay the road as open as possible to the alienation of landed property, in order to weaken the overgrown power of his nobles. But as they, from the opposite reasons, were not easily brought to consent to such a provision, it was therefore couched, in his act, under covert and obscure expressions. And the judges, though willing to construe that statute as favourably as possible for the defeating of entailed estates, yet hesitated at giving fines so extensive a power by mere implication, when the statute *de donis* had expressly declared that they should not be a bar to estates-tail. But the statute of Henry VIII. when the doctrine of alienation was better received, and the will of the prince more implicitly obeyed than before, avowed and established that intention. Yet, in order to preserve the property of the crown from any danger of infringement, all estates-tail created by the crown, and of which the crown has the reversion, are excepted out of this statute. And the same was done with regard to common recoveries, by the statute 34 and 35 Hen. VIII. c. 20. which enacts, that no feigned recovery had against tenants in tail, where the estate was created by the crown, and the remainder or reversion continues still in the crown, shall be of any force and effect. Which is allowing, indirectly and collaterally, their full force and effect with respect to ordinary estates tail, where the royal prerogative is not concerned.

Tail ‖ Talapoins.

Lastly, by a statute of the succeeding year, all estates-tail are rendered liable to be charged for payment of debts due to the king by record or special contract; as since, by the bankrupt-laws, they are also subjected to be sold for the debts contracted by a bankrupt. And, by the construction put on the statute 43 Eliz. c. 4. an appointment by tenant in tail of the lands entailed to a charitable use is good without fine or recovery.

Estates-tail being thus by degrees unfettered, are now reduced again to almost the same state, even before issue born, as conditional fees were in at common law, after the condition was performed by the birth of issue. For, first, the tenant in tail is now enabled to alienate his lands and tenements by fine, by recovery, or by certain other means; and thereby to defeat the interest as well of his own issue, though unborn, as also of the reversioner, except in the case of the crown: secondly, he is now liable to forfeit them for high treason: and, lastly, he may charge them with reasonable leases, and also with such of his debts as are due to the crown on specialties, or have been contracted with his fellow subjects in a course of extensive commerce.

TAILZIE, in Scots law, the same with TAIL. See LAW, N° clxxx. 9.

TALAPOINS or TALAPINS, priests of Siam.—They enjoy great privileges, but are enjoined celibacy and austerity of life. They live in monasteries contiguous to the temples: and what is singular, any one may enter into the priesthood, and after a certain age may quit it to marry, and return to society. There are talapoinesses too, or nuns, who live in the same convents, but are not admitted till they have passed their fortieth year. The talapoins educate children; and at every new and full moon explain the precepts of their religion in their temples; and during the rainy season they preach from six in the morning till noon, and from one in the afternoon till five in the evening. They dress in a very mean garb, go bareheaded and barefooted; and no person is admitted among them who is not well skilled in the Baly language.

They believe that the universe is eternal; but admit that certain parts of it, as this world, may be destroyed and again regenerated. They believe in a universal pervading spirit, and in the immortality and transmigration of the soul; but they extend this last doctrine, not only to all animals, but to vegetables and rocks. They have their good and evil

Talapoins. evil genii, and particular local deities, who preside over forests and rivers, and interfere in all sublunary affairs.

For the honour of human nature, we are happy to find so pure a system of morality prevail among these people: It not only forbids its followers to do ill, but enjoins the necessity of doing good, and of stifling every improper thought or criminal desire.

Those who wish to peruse a more particular account of the talapoins, may consult *Voyage de M. de la Loubere*; Sketches relating to the History, &c. of the Hindoos; or Payne's Geography.

TALC, in mineralogy, a species of fossil arranged under the magnesian earths. In Magellan's edition of Cronstedt's Mineralogy, it is considered as a species of MICA, and has accordingly been mentioned by us under that article. On the other hand, Dr Kirwan has classed the mica under the siliceous earths, while he places talc under the magnesian. According to the analysis of Dr Kirwan, "talc consists of pure magnesia, mixed with nearly twice its weight of silex, and less than its own weight of argil." It is composed of broad, flat, and smooth laminæ, or plates. There are two varieties of it, the Venetian talc and Muscovy talc; for the difference of which, see the article MICA.

The Venetian talc has not derived its name from being a production of the territories of Venice (for it is not often to be met with in that country), but probably from being an article of Venetian commerce. It abounds in England, Norway, Hungary, Bohemia, Spain, and in many countries of Asia. Venice talc, with half its weight of alkaline salt, may, in a strong fire, be brought into perfect fusion, though not to perfect transparency: with equal its weight, or less, of borax, it runs into a beautiful, pellucid, greenish yellow glass. Talc does not melt with any other earth, nor even bake or cohere with any but the argillaceous: Mixtures of it with them all are nevertheless brought into fusion by a remarkably less quantity of saline matter than the ingredients separately would require. Thus equal parts of talc and chalk, with only one-fourth their weight of borax, melt in no very vehement heat into a fine transparent greenish glass, of considerable hardness and great lustre. On substituting gypseous earths to chalk, the fusion was as easy, and the glass as beautiful; in colour not green, but yellow like the topaz. Talc, with half its weight of sand, and a quantity of nitre equal to both, yielded also a transparent topaz yellow glass. Several further experiments on talc may be seen in a memoir by Mr Pott in the *Mem. de l'Acad. de Berlin*, 1746.

Muscovy talc, called also *lapis specularis*, is found in many parts. The island of Cyprus abounds with it. It is very common also in Russia, and has of late been discovered to abound in the Alps, the Apennines, and many of the mountains of Germany. It is imported in large quantities into England, and is used by the lanthorn-makers instead of horn in their nicer works; by the painters to cover miniature pictures; and by the microscope-makers to preserve small objects for viewing by glasses. The ancients used it instead of glass in their windows. Some take the lapis specularis to have been a species of gypsum, and composed of the acid of vitriol and calcareous earth. It came into use at Rome in the age of Seneca *; and soon after its introduction was applied not only to lighten apartments, but to protect fruit-trees from the severity of the weather; and it is recorded, that the emperor Tiberius was enabled, principally by its means, to have cucumbers at his table during almost every month in the year. Dr Watson apprehends it is still used in some countries in the place of glass: however, it is well known, that it was so used in the time of Agricola; for he mentions † two churches in Saxony which were lighted by it.

Hill's Hist. of Foss. p. 72.

* Ep. 90.

† De Nat. Foss. lib. 5. p. 257.

Agricola esteemed it to have been a species of plaster-stone; and in speaking of it he remarks, that though it could bear, without being injured, the heat of summer and the cold of winter, yet the largest masses of it were wasted by the rain. It differs from plaster-stone in this property, that it does not, after being calcined and wetted with water, swell and concrete into a hard stony substance *.

* Hist. Acad. vol. p.

Although we have treated of Muscovy talc and lapis specularis as the same, we are not ignorant that a distinction has been made between them by some chemists: but as we have found a greater degree of confusion on this subject in several valuable systems of mineralogy than we had reason to expect, we continue the old names as formerly, till a more satisfactory analysis make it proper to apply them differently.

Talc is employed, in those places where it is found in any considerable quantity, in compositions for earthen vessels; and by some for tests and cupels. From its smoothness, unctuosity, and brightness, it has been greatly celebrated as a cosmetic; and the chemists have submitted it to a variety of operations, for procuring from it oils, salts, tinctures, magisteries, &c. for that intention. But all their labours have been in vain; and all the preparations sold under the name of talc have either contained nothing of that mineral, or only a fine powder of it.

TALENT, signifies both a weight and a coin very common among the ancients, but very different among different nations.

The common Attic talent of weight contains 60 Attic minæ, or 6000 Attic drachmæ; and weighed, according to Dr Arbuthnot, 56 lbs. 11 oz. $17\frac{1}{7}$ gr. English troy weight. There was another Attic talent, by some said to consist of 80, by others of 100 minæ. The Egyptian talent was 80 minæ; the Antiochian also 80; the Ptolemaic of Cleopatra $86\frac{2}{3}$; that of Alexandria 96; and the Insular talent 120. In the valuation of money, the Grecian talent, according to Dr Arbuthnot, was equal to 60 minæ, or, reckoning the mina at L. 3 : 4 : 7, equal to L. 193, 15s: The Syrian talent in this valuation consisted of 15 Attic minæ; the Ptolemaic of 20; the Antiochian of 60; the Euboic of 60; the Babylonic of 70; the Greater Attic of 80; the Tyrian of 80; the Eginean of 100; the Rhodian of 100; and the Egyptian of 80 minæ.

There is another talent much more ancient, which Dr Arbuthnot calls the *Homeric talent* of gold, which seems to have weighed six Attic drachms or three darics, a daric weighing very little more than a guinea. According to this talent, some reckon the treasure of king David, particularly that mentioned 1 Chron. xxii. 14. which, according to the common reckoning, would amount in gold talents to the value of L. 547,500,000, and the silver to above L. 342,000,000; or, reckoning according to the decuple proportion of gold to silver, the two sums would be equal. As David reigned in Judæa after the siege of Troy, it is not improbable but Homer and he might use the same numeral talent of gold.

Among the Romans there were two kinds of talents, the *little* and the *great* talent: the little was the common talent; and whenever they say simply *talentum*, they are to be understood of this. The little talent was 60 minæ or Roman pounds; the mina or pound estimated at 100 drachmæ or denarii: it was also estimated at 24 great sesterces, which amounted to 60 pounds.

The great talent exceeded the less by one-third part. Budæus computes, that the little talent of silver was worth L. 75 Sterling, and the greater L. 99 : 6 : 8 Sterling. The greater of gold was worth L. 1125 Sterling.

TALENT, as a species of money, among the Hebrews, was

ius was fometimes ufed for a gold coin, the fame with the fhekel of gold, called alfo *ftater*, and weighing only 4 drachms. The Hebrews reckoned by thefe talents as we do by pounds, &c. Thus a million of gold, or million of talents of gold, among them, was a million of fhekels or nummi; the nummus of gold being the fame weight with the fhekel, viz. four drachms.

But the Hebrew talent weight of filver, which they called *cicar*, was equivalent to that of 3000 fhekels, or 113 lb. 10 oz. 1 dwt. $10\frac{2}{7}$ gr. Englifh Troy weight, according to Arbuthnot's computation.

TALIACOTIUS (Gafpar), chief furgeon to the great duke of Tufcany, was born at Bononia in Italy in 1553. He wrote a Latin treatife intitled *Chirurgia Nota de Curtis Membris*, in which he teaches the art of engrafting nofes, ears, lips, &c. giving reprefentations of the inftruments and proper bandages; though many are of opinion that he never put his art in practice. However, his doctrine is not fingular; for he fhows that Alexander Benedictus, a famous chirurgical writer, defcribed the operation before.

TALLIO *(lex talionis)*, a fpecies of punifhment in the Mofaic law, whereby an evil is returned fimilar to that committed againft us by another; hence that expreffion, "Eye for eye, tooth for tooth." This law was at firft inferted in the 12 tables amongft the Romans; but afterwards fet afide, and a power given to the prætor to fix upon a fum of money for the damage done.

TALISMANS, magical figures cut or engraved with fuperftitious obfervations on the characterifms and configurations of the heavens, to which fome aftrologers have attributed wonderful virtues, particularly that of calling down celeftial influences. The talifmans of Samothrace, fo famous of old, were pieces of iron formed into certain images, and fet in rings; thefe were efteemed prefervatives againft all kinds of evils. There were likewife talifmans taken from vegetables, and others from minerals.

TALLAGE (*tallagium*), from the French *taillé*, is metaphorically ufed for a part or fhare of a man's fubftance carved out of the whole, paid by way of tribute, toll, or tax.

TALLOW, in commerce, the fat of certain animals melted and clarified. It is procured from moft animals, but chiefly from bullocks, fheep, hogs, and bears. Some kinds of tallow are ufed as unguents in medicine, fome for making foap and dreffing leather, and fome for making candles. See CHEMISTRY, n° 1429.

Tallow-Tree. See CROTON.

TALLY, is a ftick cut in two parts, on each whereof is marked, with notches or otherwife, what is due between debtor and creditor, as now ufed by brewers, &c. And this was the ancient way of keeping all accounts, one part being kept by the creditor, the other by the debtor, &c. Hence the tallier of the exchequer, whom we now call the *teller*. But there are two kinds of tallies mentioned in our ftatutes to have been long ufed in the exchequer. The one is termed *tallies of debt*, which are in the nature of an acquittance for debts paid to the king, on the payment whereof thefe tallies are delivered to the debtors, who carrying them to the clerk of the pipe-office, have there an acquittance in parchment for their full difcharge. The other are *tallies of reward* or allowance, being made to fheriffs of counties as a recompenfe for fuch matters as they have performed to their charge, or fuch money as is caft upon them in their accounts of courfe, but not leviable, &c. In the exchequer there is a tally-court, where attend the two deputy-chamberlains of the exchequer and the tally-cutter: and a tally is generally the king's acquittance for money paid or lent, and has written on it words proper to exprefs on what occafion the money is received.

Tally-Man, a perfon that fells or lets goods, clothes, &c. to be paid by fo much a-week. Talmud.

TALMUD, a collection of Jewifh traditions. There are two works which bear this name, the Talmud of Jerufalem, and the Talmud of Babylon. Each of thefe are compofed of two parts; the Mifhna, which is the text, and is common to both, and the Gemara or commentary. See MISHNA and GEMARA.

The Mifhna, which comprehends all the laws, inftitutions, and rules of life which, befide the ancient Hebrew fcriptures, the Jews thought themfelves bound to obferve, was compofed, according to the unanimous teftimony of the Jews, about the clofe of the fecond century. It was the work of Rabbi Jehuda (or Juda) Hakkadofh, who was the ornament of the fchool at Tiberias, and is faid to have occupied him forty years. The commentaries and additions which fucceeding Rabbis made were collected by Rabbi Jochanan Ben Eliezer, fome fay in the 5th, others fay in the 6th, and others in the 7th century, under the name of *Gemara*, that is, *completion*; becaufe it completed the Talmud. A fimilar addition was made to the Mifhna by the Babylonifh doctors in the beginning of the 6th century according to Enfield, and in the 7th according to others.

The Mifhna is divided into fix parts, of which every one which is intitled *order* is formed of treatifes, every treatife is divided into chapters, and every chapter into mifhnas or aphorifms. In the *firft* part is difcuffed whatever relates to feeds, fruits, and trees: in the *fecond* feafts: in the *third* women, their duties, their diforders, marriages, divorces, contracts, and nuptials: in the *fourth* are treated the damages or loffes fuftained by beafts or men, of things found, depofits, ufuries, rents, farms, partnerfhips in commerce, inheritance, fales and purchafes, oaths, witneffes, arrefts, idolatry; and here are named thofe by whom the oral law was received and preferved: in the *fifth* part are noticed what regards facrifices and holy things: and the *fixth* treats on purifications, veffels, furniture, clothes, houfes, leprofy, baths, and numerous other articles. All this forms the Mifhna.

As the learned reader may wifh to obtain fome notion of rabbinical compofition and judgment, we fhall gratify his curiofity fufficiently by the following fpecimen: "Adam's *body* was made of the earth of Babylon, his *head* of the land of Ifrael, his other *members* of other parts of the world. R. Meir thought he was compact of the earth gathered out of the whole earth: as it is written, *thine eyes did fee my fubftance*. Now it is elfewhere written, *the eyes of the Lord are over all the earth*. R. Aba exprefsly marks the twelve hours in which his various parts were formed. His ftature was from one end of the world to the other; and it was for his tranfgreffion that the Creator, laying his hand in anger on him, leffened him; for before (fays R. Eleazar), 'with his hand he reached the firmament.' R. Jehuda thinks his fin was herefy; but R. Ifaac thinks that 'it was in nourifhing his forefkin.'"

The Talmud of Babylon is moft valued by the Jews; and this is the book which they mean to exprefs when they talk of the Talmud in general. An abridgment of it was made by Maimonides in the 12th century, in which he rejected fome of its greateft abfurdities. The Gemara is ftuffed with dreams and chimeras, with many ignorant and impertinent queftions, and the ftyle very coarfe. The Mifhna is written in a ftyle comparatively pure, and may be very ufeful in explaining paffages of the New Teftament, where the phrafeology is fimilar. This is indeed the only ufe which Chriftians can make of it; but this renders it valuable. Lightfoot has judicioufly availed himfelf of fuch information as he could derive from it. Some of the pages, with a [illegible]

Talpa ‖ Tamarindus.

barous zeal, and a timidity of spirit for the success of the Christian religion, which the belief of its divinity can never excuse, ordered great numbers of the Talmud to be burned. Gregory IX. burned about 20 cart-loads, and Paul IV. ordered 12,000 copies of the Talmud to be destroyed.

The last edition of the Talmud of Babylon, printed at Amsterdam, is in 12 vols folio. The Talmud of Jerusalem is in one large folio.

TALPA, the MOLE; a genus of quadrupeds belonging to the order of *feræ* and class of *mammalia*. It has six unequal foreteeth in the upper jaw, and eight in the lower; one tusk on each side in each jaw; seven grinders on each side above, and six below. There are seven species; the European, the flava or American, the cristata, longicaudata, fusca, rubra, and aurea.

The European mole is the only species of this animal found in Britain. There are several varieties of it; the black, the variegated, the white, and the grey mole. This species inhabits the whole of Europe except Ireland, where it is said no moles are found. It is also common in the northerly parts of Asia and Africa. It chiefly frequents moist fields that are exposed to the sun, meadows, and gardens; through these it constructs subterraneous roads or galleries in every direction in search of worms, on which and the larvæ of insects it feeds, and not at all on vegetables, though it does great damage by loosening the roots of plants. It is most active in its operations before rain, because then the worms are in motion. The penis of the male is exceedingly long in proportion; they seem to pair and propagate in spring, the female bringing four or five young at a birth, which are placed in nests made of moss, leaves, and dried grass, under the largest hillocks of the field; these are constructed with wonderful ingenuity, consisting of an interior hillock, surrounded with a ditch, which communicates with several galleries, on purpose to carry off the moisture; and the nest is covered over with a dome of earth, like the flat arch of an oven. Moles are destroyed by means of a paste composed of palma-christi and white hellebore, or by flooding the fields which they infest; though, in the latter case, they sometimes escape by ascending trees.

This species is five inches and three quarters in length, and its tail is about one inch long. It has a large head, without any external ears, and eyes so very small and so completely hid in the fur as to make it vulgarly believed that it has none. As it lives entirely below ground, it has certainly no occasion for eyes like other quadrupeds; and as it probably finds its food by its sense of smell, which is acute, its eyes may serve merely as a safeguard to warn it when it happens to emerge from the ground to return to its subterraneous dwelling. This warning may be given by the light falling upon its eyes, which may produce a painful sensation. For the truth of this conjecture, however, we must refer to the anatomist, who might easily determine, from the structure of the eyes, what purpose they are fitted to serve

TAMANDAU, in zoology. See MYRMECOPHAGA.

TAMARINDUS, the TAMARIND-TREE, in botany: A genus of plants arranged by Linnæus under the class of *triandria* and order of *monogynia*; but Woodville, Schreber, and other late botanists, have found that it belongs to the class of *monodelphia* and order of *triandria*. In the natural system it is ranked under the *lomentaceæ*. There is only one species, the *indica*, which is a native of both Indies, of America, of Arabia, and Egypt, and was cultivated in Britain before the year 1633.

The tamarind-tree rises to the height of 30 or 40 feet, sending off numerous large branches, which spread to a considerable extent, and have a beautiful appearance; the trunk is erect, and covered with rough bark, of a greyish or ash-colour; the leaves are small and pinnated, and of a yellowish green colour: the flowers resemble the papilionaceous kind, and grow in lateral clusters: the calyx consists of four leaves, and the corolla of three petals, which are of a yellowish hue, and are beautifully diversified with red veins: the fruit is a pod of a roundish compressed form, from three to five inches long, containing two, three, or four seeds, lodged in a dark pulpy matter. The flowers appear, according to Jacquin, in October and November; but, according to Dr Wright, they continue during the whole of June and July, and then drop off.

The pulp of the tamarind, with the seeds connected together by numerous tough strings or fibres, are brought to us freed from the outer shell, and commonly preserved in syrup. According to Long, tamarinds are prepared for exportation at Jamaica in the following manner: "The fruit or pods are gathered (in June, July, and August) when full ripe, which is known by their fragility or easy breaking on small pressure between the finger and thumb. The fruit, taken out of the pod, and cleared from the shelly fragments, is placed in layers in a cask; and boiling syrup, just before it begins to granulate, is poured in, till the cask is filled: the syrup pervades every part quite down to the bottom, and when cool the cask is headed for sale." He observes, that the better mode of preserving this fruit is with sugar, well clarified with eggs, till a transparent syrup is formed, which gives the fruit a much pleasanter flavour: but as a principal medicinal purpose of the pulp depends upon its acidity, which is thus counteracted by the admixture of sugar, it would therefore be of more utility if always imported here in the pods. The fruit produced in the East Indies is more esteemed than that of the West, and easily to be distinguished by the greater length of the pods, and the pulp being dryer and of a darker colour.

Uses. This fruit, the use of which was first learned of the Arabians, contains a larger proportion of acid, with the saccharine matter, than is usually found in the *fructus acido-dulcis*, and is therefore not only employed as a laxative, but also for abating thirst and heat in various inflammatory complaints, and for correcting putrid disorders, especially those of a bilious kind; in which the cathartic, antiseptic, and refrigerant qualities of the fruit have been found equally useful. When intended merely as a laxative, it may be of advantage to join it with manna, or purgatives of a sweet kind, by which its use is rendered safer and more effectual. Three drachms of the pulp are usually sufficient to open the body; but to prove moderately cathartic, one or two ounces are required. It is an ingredient in *electuarium e cassia*, and *electuarium e senna* or lenitive electuary (A).

We are informed by Dr Wright, that preserved tamarinds are kept in most houses in Jamaica either as a sweet-meat, or for occasional use as a medicine. See PHARMACY, n° 394 and 395.

TAMARIX,

(A) " Tournefort relates, that an essential salt may be obtained from tamarinds, by dissolving the pulp in water, and setting the filtered solution, with some oil upon the surface, in a cellar for several months; that the salt is of a sourish taste, and difficultly dissoluble in water; and that a like salt is sometimes found also naturally concreted on the branches of the tree. The salt, as Beaumé observes, may be obtained more expeditiously, by clarifying the decoction of the tamarinds

TAMARIX, the TAMARISK, in botany: A genus of plants belonging to the class of *pentandria*, and order of *trigynia*; and in the natural system ranging under the 13th order, *Succulentæ*. The calyx is quinquepartite; the petals are five; the capsule is unilocular and trivalvular, and the seeds pappous. There are only two species known; the *gallica* or French tamarisk, and the *germanica* or German tamarisk.

TAMBAC, in the materia medica. See EXCÆCARIA.

TAMBOUR, in architecture, a term applied to the Corinthian and Composite capitals, as bearing some resemblance to a drum which the French call *tambour*. Some choose to call it the *vase*, and others *campana* or the bell.

TAMBOUR is also used for a little box of timber work, covered with a cieling, within-side the porch of certain churches; both to prevent the view of persons passing by, and to keep off the wind, &c. by means of folding doors, &c.

TAMBOUR, also denotes a round course of stone, several whereof form the shaft of a column, not so high as a diameter.

TAMBOUR, in the arts, is a species of embroidery. The tambour is an instrument of a spherical form, upon which is stretched, by means of a string and buckle, or other suitable appendage, a piece of linen or thin silken stuff; which is wrought with a needle of a particular form, and by means of silken or gold and silver threads, into leaves, flowers, or other figures.

TAMBOURIN, is the name of a dance performed on the French stage. The air is lively, and the movements are quick.

TAMERLANE, or TIMUR BEK, a celebrated prince and conqueror. At the age of 25 he attained the highest dignities, with surprising courage, and an ambition astonishing to all the world. Endeavouring to perfect the great talents which he had received from nature, he spent nine years in different countries; where his great sense and elevated genius appeared in councils and assemblies, while his intrepidity and valour, whether in personal combats or pitched battles, drew upon him the admiration of all mankind. He made himself master of the three empires of Jagatay Khân, Tushi Khân, and Hulâkû Khân; so that his power, riches, and magnificence, were immense. There remain vast monuments of his grandeur in the cities, towns, castles, and walls, which he built; in the rivers and canals which he dug, as well as the bridges, gardens, palaces, hospitals, mosques, and monasteries, which he erected in divers parts of Asia in so great a number, that a king might be accounted very powerful and magnificent, who should have employed 36 years only in building the great edifices which Timûr caused to be founded.

Timûr, according to the historian Arabshâh, was in his person very corpulent and tall. He had a large forehead and big head. His countenance was agreeable, and his complexion fair. He wore a large beard, was very strong, and well-limbed; had broad shoulders, thick fingers, and long legs. His constitution was amazingly vigorous; but he was maimed in one hand and lame of the right side. His eyes appeared full of fire; his voice was loud and piercing; he feared nothing; and when far advanced in years, his understanding was found and perfect, his body vigorous and robust, his mind constant and unshaken like a rock.

He did not like raillery, and could not bear a lie. There was no joking or fooling before him; for he loved the naked truth, even although it was to his own disadvantage. He neither grieved if he miscarried in any attempt, nor appeared overjoyed on any great success. The device of his seal was, "I am sincere and plain." He had a clear and solid understanding, was surprisingly happy in his conjectures; vigilant, active, and unshaken in his resolutions. He took great delight in reading history, and was well versed in the state of countries, provinces, and cities. He was penetrating, subtle, close, and dissembling; just by inclination, liberal from disposition; but ambition had in a great measure extinguished his humanity; war had familiarised him to blood; and his religious zeal had inspired him with the most cruel, implacable, and pernicious fanaticism. Tamerlane.

He died on the 1st of April 1405, in the 71st year of his age and 36th of his reign. When he found death approaching, he sent for his principal officers, declared his grandson his heir, and made them swear to execute his will. Having recommended brotherly love and concord to the princes his children, he ordered one of the doctors to read the Koran at his bed's head, and often repeat the unity of God. At night he several times made profession of his belief, "That there is no other God than God," and then expired. See MOGULS, n° 15, &c.

TAMTAM, a flat drum used by the Hindoos, resembling a tabor, but it is larger, and sounds louder.

TAMUS, BLACK BRIONY, in botany: A genus of plants belonging to the class of *diœcia*, and order of *hexandria*; and in the natural system ranging under the 11th order, *Sarmentaceæ*. The male and female flowers are both sexpartite; there is no corolla; the style is trifid; the berry is trilocular and inferior, and contains two seeds. There are only two species known; the elephantipes, which is a native of the Cape of Good Hope, and we believe was first described by L'Heritier; and the communis.

The *communis*, or common black briony, is a native of England, but has not been observed growing wild in Scotland. It has a large root, which sends forth several long slender stems: the leaves are large, heart-shaped, dark green, and grow on long footstalks: the flowers are greenish, and the berry red. It flowers from May to August, and is frequent in hedges.

TAN, the bark of the oak after it has been ground and used by the tanner. The smaller sort is generally made up in little square cakes called *turf*, and sold for firing. The coarser sort is sometimes dried in the sun, and used by bakers for heating their ovens, &c. but its chief use is for making of hot-beds to raise pine-apples and other plants.—William III. introduced the use of it from Holland, for the purpose of raising orange trees; after which it was discontinued for many years: but about 1719, when *ananas* were first brought into England, it came into general use, and has ever since been in great estimation with gardeners for all the purposes of forcing, &c. on account of its strong and lasting fermentation. The smaller the tan the quicker it heats; but the larger sort acquires heat more gradually and retains it longer: the skilful gardener therefore uses the one or the other, or a mixture of both, according to the time and purpose for which it is wanted. It is some time after the tan comes out of the tanner's pit before it begins to heat, and therefore it is not fit for immediate use; but having Tan.

rinds with whites of eggs, then filtering it, and evaporating it to a proper consistence, and setting it to cool: the salt shoots into crystals of a brown colour and very acid taste; but in dissolving and crystallizing them again, or barely washing them with water, they lose almost all their acidity, the acid principle of the tamarinds seeming not to be truly crystallizable." Vide *Lewis's Mat. Med.* p. 633.

ving lain a week or two, it enters into a ftate of fermentation, and if put into hot-beds properly prepared, will retain a moderate heat for three or four months. When it becomes ufelefs for the hot-houfe, it is faid by Miller and others to be an excellent manure for fome kinds of land.

The word *tan* is fometimes, though improperly, ufed for the *bark* itfelf, which is the chief ingredient in the tanning of leather. Oak bark, on account of its great aftringency and gummy-refinous properties, is preferred to all other fubftances for the purpofe of tanning, as it not only preferves the leather from rotting, but alfo, by condenfing the pores, renders it impervious to water. See TANNING.

TANACETUM, TANSY, in botany: A genus of plants belonging to the clafs of *fyngenefia*, and order of *polygamia fuperflua*: and in the natural fyftem ranging under the 49th order, *Compofitæ*. The receptacle is naked; the pappus fomewhat emarginated; the calyx imbricated and hemifpherical; the florets of the radius are trifid, and fcarcely diftinguifhable. Gmelin has enumerated feven fpecies; of which one only is a native of Britain, the *vulgare*.

The *vulgare*, or common tanfy, grows three or four feet high; the leaves are bipinnated and ferrated; the flowers yellow, and terminate the branches in flat umbels. It is found fometimes on the borders of fields and dry banks: it abounds at Wark, and Ford-caftle in the neighbourhood of Kelfo, on the borders of Scotland; and on the fide of Gareloch on the weftern coaft of Rofs-fhire: it has alfo been found in Breadalbane. It flowers generally in Auguft. Of this fpecies there is a variety with curled leaves, which is therefore called *curled tanfy*. The tanfy has a bitter tafte, and an aromatic fmell difagreeable to many people.

Ufes. It is efteemed good for warming and ftrengthening the ftomach; for which reafon the young leaves have obtained a place among the culinary herbs, their juice being an ingredient in puddings, &c. It is rarely ufed in medicine, though extolled as a good emmenagogue. A drachm of the dried flowers has been found very beneficial in hyfteric diforders arifing from fuppreffion. The feeds and leaves were formerly in confiderable efteem for deftroying worms in children, and are reckoned good in colics and flatulencies. In fome parts of Sweden and Lapland, a bath with a decoction of this plant is made ufe of to affift parturition. See PHARMACY, n° 103.

TANÆCIUM, in botany: A genus of the *angiofperma* order, belonging to the *didynamia* clafs of plants; and in the natural method ranking under the 25th order, *Putamineæ*. The calyx is monophyllous, tubulated, truncated, and entire; the corolla long, monopetalous, and white; the tube cylindrical; the lymbi erect, fpreading, and nearly equal; the fruit a berry covered with a thick bark, large, oblong, internally divided into two parts; in the pulp are contained a number of feeds. There are only two fpecies of this genus; the *jaroba* and *parafiticum*, both natives of Jamaica. They grow by the fides of rivers, and climb on trees and bufhes.

TANAGRA, TANAGER, in ornithology, a genus of birds belonging to the order of *pafferes*. The beak is conical, acuminated, emarginated, almoft triangular at the bafe, and inclining a little towards the point. Dr Latham has defcribed 44 fpecies, all of which are of foreign extraction.

TANAIS, or DON. See DON.

TANGENT *of an* ARCH, is a right line drawn perpendicularly from the end of a diameter, paffing to one extremity of the arch, and terminated by a right line drawn from the centre through the other end of that arch, and called the *fecant*. See GEOMETRY.

TANGIER, a port-town of Africa, in the empire of Morocco and kingdom of Fez, fituated at the entrance of the Straits of Gibraltar, in W. Long. 5. 50. N. Lat. 38. 49. In 1662, this place belonged to the Portuguefe, and was given to king Charles II. upon his marriage with the Infanta of Portugal: but he, growing weary of the charge of keeping it, caufed it to be blown up and deftroyed in 1684; ever fince which time it has been only a poor fifhing town. Anciently it was called *Tingis*, and gave name to the province of Mauritania Tingitana.

TANK, in the language of Indoftan, a place inclofed for receiving and retaining the rain. During the periodical rains the tanks are filled, and thus in the dry feafon furnifh water for the rice fields and cattle. Some of them are of great extent, meafuring 300 or 400 feet on the fide; they are of a quadrangular form, and lined with granite, defcending in regular fteps from the margin to the bottom

TANNER, one who dreffes hides by tanning them. See TANNING.

TANNER (Dr Thomas), an Englifh prelate and celebrated antiquarian, born in 1674. He was admitted of Queen's college Oxford, where a fimilarity of tafte for antiquities produced a clofe friendfhip between him and Edmund Gibfon afterwards bifhop of London. In 1697, he was chofen fellow of his college; and having already publifhed fome fpecimens of his fkill in the antiquarian way, foon after became known to Dr Moore bifhop of Norwich, who made him chancellor of his diocefe. In 1722, he was made archdeacon of Norwich, and in 1731 bifhop of St Afaph. He died at Oxford in 1735; and after his death was publifhed an elaborate work, faid to have employed him for 40 years, under this title, *Bibliotheca Britannica Hibernica, five de Scriptoribus qui in Anglia, Scotia, et Hibernia, ad feculi* XVII. *initium floruerunt*, &c.

TANNING, the art of manufacturing leather from raw hides and fkins.

Before we detail the procefs, it may be proper to obferve, that raw hides and fkins being compofed of minute fibres interfecting each other in every direction, the general operation of tanning confifts chiefly in expanding the pores, and diffolving a fort of greafy fubftance contained in them; and then, by means of the aftringency and gummy-refinous properties of oak bark, to fill and reunite them, fo as to give firmnefs and durability to the whole texture. But this theory has been controverted by fome chemifts, who fuppofe that the animal jelly contained in the fkin is not diffolved, but unites during the procefs with the aftringent principle of the bark, and forms a combination infoluble in water.

Method of tanning.

The procefs of tanning varies confiderably, not only in different countries, but even in different parts of the fame country. The following is the method moft approved and practifed in London and its vicinity, where the beft leather is generally allowed to be manufactured.

The leather tanned in England confifts chiefly of three forts, known by the name of *butts* or *backs*, *hides*, and *fkins*.

Butts.

Butts are generally made from the ftouteft and heavieft ox hides, and are managed as follows: After the horns are taken off, the hides are laid fmooth in heaps for one or two days in the fummer, and for five or fix in the winter: they are then hung on poles, in a clofe room called a *fmoke-houfe*, in which is kept a fmouldering fire of wet tan; this occafions a fmall degree of putrefaction, by which means the hair is eafily got off, by fpreading the hide on a fort of wooden horfe or beam, and fcraping it with a crooked knife. The hair being taken off, the hide is thrown into a pit or pool of water to cleanfe it from the dirt, &c. which being done, the hide is again fpread on the wooden beam, and the greafe, loofe flefh, extraneous filth, &c. carefully fcrubbed

Tanning. ſcrubbed out or taken off; the hides are then put into a pit of ſtrong liquor called *ooze* or *wooze*, prepared in pits called *letches* or *taps* kept for the purpoſe, by infuſing ground bark in water; this is termed *colouring*: after which they are removed into another pit called a *ſcowering*, which conſiſts of water ſtrongly impregnated with vitriolic acid, or with a vegetable acid prepared from rye or barley. This operation (which is called *raiſing*), by diſtending the pores of the hides, occaſions them more readily to imbibe the ooze, the effect of which is to aſtringe and condenſe the fibres, and give firmneſs to the leather. The hides are then taken out of the ſcowering, and ſpread ſmooth in a pit commonly filled with water, called a *binder*, with a quantity of ground bark ſtrewed between each. After lying a month or ſix weeks, they are taken up; and the decayed bark and liquor being drawn out of the pit, it is filled again with ſtrong ooze, when they are put in as before, with bark between each hide. They now lie two or three months, at the expiration of which the ſame operation is repeated; they then remain four or five months, when they again undergo the ſame proceſs; and after being three months in the laſt pit, are completely tanned, unleſs the hides are ſo remarkably ſtout as to want an additional pit or layer.—The whole proceſs requires from 11 to 18 months, and ſometimes two years, according to the ſubſtance of the hide, and diſcretion of the tanner. When taken out of the pit to be dried, they are hung on poles; and after being compreſſed by a ſteel pin, and beat out ſmooth by wooden hammers called *beetles*, the operation is complete; and when thoroughly dry, they are fit for ſale. Butts are chiefly uſed for the ſoles of ſtout ſhoes.

Hides. The leather which goes under the denomination of *hides* is generally made from cow hides, or the lighter ox hides, which are thus managed. After the horns are taken off, and the hides waſhed, they are put into a pit of water ſaturated with lime, where they remain a few days, when they are taken out, and the hair ſcraped off on a wooden beam, as before deſcribed; they are then waſhed in a pit or pool of water, and the looſe fleſh, &c. being taken off, they are removed into a pit of weak ooze, where they are taken up and put down (which is technically termed *handling*) two or three times a-day for the firſt week: every ſecond or third day they are ſhifted into a pit of freſh ooze, ſomewhat ſtronger than the former; till at the end of a month or ſix weeks they are put into a ſtrong ooze, in which they are handled once or twice a-week with freſh bark for two or three months. They are then removed into another pit, called a *layer*, in which they are laid ſmooth, with bark ground very fine ſtrewed between each hide. After remaining here two or three months, they are generally taken up, when the ooze is drawn out, and the hides put in again with freſh ooze and freſh bark; where, after lying two or three months more, they are completely tanned, except a few very ſtout hides, which may require an extra layer: they are then taken out, hung on poles, and being hammered and ſmoothed by a ſteel pin, are, when dry, fit for ſale.

Theſe hides are called *crop hides*; they are from 10 to 18 months in tanning, and are uſed for the ſoles of ſhoes.

Skins. *Skins* is the general term for the ſkins of calves, ſeals, hogs, dogs, &c. Theſe, after being waſhed in water, are put into lime-pits, as before mentioned, where they are taken up and put down every third or fourth day, for a fortnight or three weeks, in order to dilate the pores and diſſolve the gelatinous parts of the ſkin. The hair is then ſcraped off, and the fleſh and excreſcences being removed, they are put into a pit of water impregnated with pigeon-dung (called a *grainer* or *maſtring*), forming a ſtrong alkaline ley, which in a week or ten days ſoaking out the lime, greaſe, and ſaponaceous matter (during which period they are ſeveral times ſcraped over with a crooked knife to work out the dirt and filth), ſoftens the ſkins, and prepares them for the reception of the ooze. They are then put into a pit of weak ooze, in the ſame manner as the hides, and being frequently handled, are by degrees removed into a ſtronger and ſtill ſtronger liquor, for a month or ſix weeks, when they are put into a very ſtrong ooze, with freſh bark ground very fine, and at the end of two or three months, according to their ſubſtance, are ſufficiently tanned; when they are taken out, hung on poles, dried, and fit for ſale.

Theſe ſkins are afterwards dreſſed and blacked by the currier; and are uſed for the upper-leathers of ſhoes, boots, &c.

The lighter ſort of hides, called *dreſſing hides*, as well as horſe-hides, are managed nearly in the ſame manner as ſkins; and are uſed for coach-work, harneſs-work, &c, &c.

5 Schemes to ſhorten the proceſs and leſſen the expence.

As the method of tanning above deſcribed, and all others in general uſe, are extremely tedious and expenſive in their operation, various ſchemes have at different times been ſuggeſted to ſhorten the proceſs and leſſen the expence.—Though moſt of theſe ſchemes have ultimately proved unſucceſsful, yet it in a work of this kind it may be expected that we ſhould not paſs them over wholly unnoticed.

Some have imagined, and perhaps juſtly, that cold water alone is not an adequate menſtruum for extracting the reſinous qualities of bark, however aſſiſted by the mucilage of the bark and of the ſkin; a decoction, inſtead of ſimple infuſion, has therefore been recommended as a more effectual mode of obtaining thoſe properties.

The late Dr Macbride of Dublin having been concerned in a leather manufactory, publiſhed in 1778 a new method of tanning. His projected improvements may be briefly claſſed under two heads: the one recommending the uſe of *vitriolic* inſtead of *vegetable* acid, brewed from rye or barley: the other ſubſtituting *lime-water*, for the purpoſe of extracting the virtues of the bark, inſtead of the *water* commonly uſed by tanners. With reſpect to the firſt, it is generally acknowledged that the vitriolic acid is very proper for raiſing or diſtending the pores of the hides intended for butts, as its operation is not only more ſimple and certain than the acid formerly uſed, but as it tends more effectually to render the texture of the leather firm and durable: it is therefore ſtill preferred by the moſt ſkilful tanners. As to lime-water inſtead of water, it has been found inefficacious; and if the utmoſt care and attention be not obſerved, the leather is liable to ſuffer much injury. Even the ſhortening of the time and leſſening of the expence (which were its chief recommendations) being very problematical, it is now almoſt generally exploded.

A very ingenious chemiſt has obſerved, that it is neceſſary, on account of a chemical combination between the aſtringent principle and the animal ſubſtance in the proceſs of tanning, that free acceſs ſhould be given to the pure air; and therefore ſuppoſes that the proceſs could not be conducted properly in cloſe veſſels *.

* Phil. Trans. vol. lxvii. Bartholet.

The methods of tanning in different provinces of France are ſo various, ſo complicated, and ſo contrary to the acknowledged principles of the manufacture, that it would be an endleſs and uſeleſs taſk to endeavour to detail them: we ſhall therefore content ourſelves with a general reference to M. de la Lande's elaborate Treatiſe on this ſubject.

It has been ſaid, that every part of the oak tree contains a great portion of aſtringent, gummy-reſinous matter, and will therefore tan leather as effectually as the bark itſelf. This opinion, which was firſt publiſhed in 1674 by the Honourable Charles Howard (Phil. Tranſ. vol. ix.), has ſince been countenanced by the celebrated Buffon; who adds, that the

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the bark of birch will answer the purpose of tanning even sole leather, which, it is well known, requires the strongest and most penetrating materials †.

† Mem. Acad. Sc. Paris, 1780.

A long memoir, written by M. Gleditsch, recommends the leaves, branches, fruit, and flowers, of a vast number of plants as substitutes for oak bark. Heath dried and pulverised, small oats, and the bark of birch, are said by M. Gesner to be used in different provinces of Germany. Abbé Nollet informs us, that the leaves of myrtle are used by the tanners in Natolia. In Corsica they make use of the leaves of wild lentisk dried in the sun and beaten into powder, and in the island of St Kilda they tan with the tormentil root. In some parts of Italy leather is tanned with myrtle leaves. In Russia it is said, that leather is tanned with the bark of willow; and it may here be observed, that a late writer has recommended the extract of bark to be made in America, in order to lessen the expence of freight, &c. in conveying the bark itself to Europe.

In the year 17[illegible], the Society of Arts, &c. granted a premium of L. [illegible] for the discovery of a method of tanning with oak saw-dust; which method has been adopted in Germany; and the Reverend Mr Swayne has lately revived the exploded substitute (mentioned by Gleditsch and others) of oak leaves.

The following proposal was communicated to the Bath Society for extracting the essence of oak bark:

Suppose (says the author) the operator has at hand a common family brew-house, with its necessary utensils; let him procure a ton of good oak bark ground as usual for the pit; and having placed a strainer to the mash tub, fill it two-thirds with the bark; heat as much water, nearly boiling, as will sufficiently moisten it, and mash it well together. After it has stood about two hours, draw it off clear, and put it into a cask by itself. Make a second extract with a smaller quantity of boiling water than before, so as to draw off a quantity nearly equal to the first, and put that also into the same cask with the former.

These two extracts will probably contain in them as much of the virtues of the bark as the quantity of liquid will absorb.

A third extract, rather more in quantity than the other two, may be made from the same bark, and as soon as drawn off, should be returned into the copper again when empty, and employed for the first and second mash of a quantity of fresh bark, as the three extracts may be supposed to have carried off the virtues of the first. Then proceed as before till all the bark is steeped, and a strong liquid extract is drawn from it. The bark, when taken out of the copper, may be spread in the sun to dry, and serve as fuel in the succeeding operations.

The next process is, to evaporate the watery particles from the extract by a gentle heat, till it comes to the consistence of treacle. This may be done either by the air and heat of the sun, or by the still or iron pan over the fire.

Anthony Day, Esq; of London, obtained a patent, dated 17th July 1790, for a new method of tanning, "with half the bark in half the usual time." This plan chiefly consists in concentrating the bark into a strong extract, and in some mechanical improvements in the construction of the tan-yard. But neither the one nor the other have yet been adopted.

The [illegible]2th May 1795, a patent was granted to Mr Tucker of Wickham, Hants. He proposes that the vat, made of wood, be inclosed in a metallic coating or copper pot, completely soldered, to prevent the escape of any of the fluid. This is to be surrounded with a case of brick-work, leaving an interstice of a few inches; and a fire is to be made in a grate near the bottom of the pit, to keep the ooze moderately warm, and thus to shorten the process. But the great expence of these triple pits and of the fuel, it is to be feared, will counterbalance any advantages which might otherwise be derived from this invention.

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Monsieur Seguin of Paris has lately submitted to the French Convention a new method of tanning, which is said to possess wonderful advantages. He has certainly exploded the ignorant and absurd systems of the French tanners, which we have above hinted at, and has shown much ingenuity and chemical knowledge in the prosecution of his discoveries; but his leading principles seem, in fact, to be nearly similar to those which have been long known and practised in England.

An ingenious manufacturer in London has, by the application of warm air, conveyed by means of flues from stoves properly constructed, and by other contrivances not generally known, considerably abridged the usual process of tanning. Some experiments have likewise been lately made with the bark of ash and of horse-chesnut.

A substitute for oak bark, the price of which has lately been enormous, is the grand *desideratum* in the manufacture of leather. Most of those above enumerated have hitherto been found ineffectual; but a patent, bearing date 1[illegible]th January 1794, has been granted to Mr Ashton of Sheffield, Yorkshire, for his discovery of a cheap and expeditious method of tanning leather. This method chiefly consists in applying a preparation of mineral substances instead of oak bark. Those which, on account of their cheapness, are most to be preferred, are the dross of coal-pits, called *sulphur-stone* or *pyrites*, and the yellow ferruginous earth or red ochre; and, in general, all astringent, sulphureous, or vitriolated substances.

If this discovery, which is yet in its infancy, should prove successful, it may cause a material alteration in the process of this manufacture; and by reducing the expence, may ultimately be of great advantage to the public. Many other experiments are now making in England for the improvement of tanning; and as there are many persons of ingenuity and knowledge engaged in the leather manufacture, much may be expected from their industry and skill.

Acts of Parliament, &c. respecting leather.

As the acts of Parliament respecting leather, &c. are very numerous, and many of them almost obsolete, we shall refer our readers to Burn's Justice, or to the Statutes at Large. We cannot, however, help remarking, that the act of 1 James I. cap. 22. which prescribes the mode and manner in which leather shall be tanned, the materials to be used, and the time to be employed, is so palpably absurd and oppressive, that it ought to be immediately repealed.

The revenue arising from the duty on leather tanned in Great Britain (exclusive of oiled leather) is upwards of L. 200,000 *per annum*.

TANTALUS, in fabulous history, king of Phrygia and Paphlagonia, was the son of Jupiter and the nymph Plota. He one day entertained the gods at his table; when, to prove their divinity, he served up his son Pelops cut in pieces. All the deities, except Ceres, perceived his cruelty and impiety, and would not touch his provisions. That goddess, whose thoughts were solely employed about her daughter Proserpine, inadvertently eat a part of his left shoulder. Pelops, however, was restored to life; and an ivory shoulder given him in the room of that which had been eaten; while Tantalus was thrown into Tartarus, where he was punished with perpetual hunger and thirst. He was chained in a lake; the water of which reached up to his chin, but retired when he attempted to drink. The branch of a tree loaded with fruit hung down even to his lips, but on his attempting to pluck the fruit the branch sprung upwards.

Tantalus, in ornithology, a genus of birds belonging to the order of grallæ. The bill is long, tubulated, and somewhat crooked; the face naked; the tongue short: and the feet have four toes palmated on the under part. There are, according to Dr Latham, 23 species; of which the most remarkable is the *ibis*, the bird so much valued by the ancient Egyptians.

The ibis was formerly held in great veneration in Egypt, on account of its utility in freeing the country from serpents. Serpents must therefore have been numerous, or they could not have been very offensive; and the ibes must have been numerous, or they could not have been useful. Yet we are assured by Mr Bruce, that the ibis is at present unknown in Egypt, and serpents are no nuisance; and he thinks it impossible that a country, covered with water for five months of the year as Egypt is, could ever have abounded with serpents. He endeavours, however, to reconcile the accounts of ancient historians with the state of Egypt.

In former times, when Egypt was in its flourishing state, the inhabited country extended much farther than it does at present; reaching even a considerable way into the sandy desert of Libya, where serpents have their abode. These parts were supplied with water by immense lakes, dug by the magnificent princes of those times, and filled by the annual inundation of the Nile. These frontier districts would naturally be infested with vipers from the Libyan desert, and the vast lakes would as naturally be supplied by numbers of water fowl, of which the ibis is a species. This bird being likewise an enemy to serpents, the inhabitants would soon become acquainted with its use, and their superstition would soon reward him. In other ages, however, when the ancient improvements were lost, and the vast lakes dried up which brought the ibis thither, the serpents ceased to give any offence, because there were none of the human species there whom they could annoy; and in consequence of the want of water, the birds ceased to annoy them, retiring to their native place Ethiopia, where they continue to frequent the great stagnant pools which are common in that country.

Mr Bruce found a bird in Abyssinia, which, after comparing it with the description of the ancient writers, and the embalmed ibis of Egypt, he concludes is the same with the Egyptian ibis. It is called *abou Hannes*, signifying "father John," from its appearing annually on St John's day.

This bird is minutely described by Mr Bruce. It has a beak shaped like that of a curlew, two-thirds straight, and the remaining third crooked; the upper part of a green horny substance, and the lower part black. It measures four inches and an half from the occiput to the place where it joins the beak. The leg, from the lower joint of the thigh to the foot, is six inches; the bone round and very strong; and from the lower joint of the thigh to where it joins the body, is five inches and a half. The height of the body from the sole to the middle of the back is 19 inches; the aperture of the eye one inch; the feet and legs black: three toes before armed with sharp and straight claws; and a toe behind. The head is brown, and the plumage of the same colour down to the back, or the place where the neck and back are joined. The throat is white, as well as the back, breast, and thighs; the largest feathers of the wing are of a deep black for 13 inches from the tail; and six inches up the back from the extremity of the tail is black likewise.

Tantalus's Cup. See Hydrostatics, n° 44.

TANZY, or Tansy, in botany. See Tanacetum.

TAORMINA, a town in Sicily, is situated on a rock which rises to a considerable elevation above the level of the sea, and is surrounded by other rocks, the height of which is still more considerable. It is 28 miles south of Messina, and was founded by a colony from Naxos, which were probably induced to choose the situation, not so much on account of its grandeur, as for the security which it would afford. It is also very wholesome. The road to Taormina, up the north side of the hill on which it stands, is very steep and difficult of ascent. Taormina

Of the origin of Taormina, as of other cities, almost nothing is known. A colony from the isle of Naxos settled at the foot of Etna, at no great distance from the shore, and at about a league or a league and an half from the present situation of Taormina. Dionysius the Tyrant attacked this colony, and either took or burnt their city. The inhabitants retired to the rock of Mount Taurus; among which they found a tract of ground sufficiently level, and of sufficient extent, for them to rear habitations upon it. It was a situation in which they might be secure from every attack. Here, therefore, they built a city; which, after the mountain, they named *Tauromenium*. It was at length raised to a very flourishing state by trade, and became celebrated as a seat of the arts. There are still many remains to be seen, which show that the fine arts must have been once successfully cultivated at Tauromenium.

Among other remains of the ancient Tauromenium, still to be seen at Taormina, there is a spacious theatre. Near the theatre is a tomb, and behind the tomb a large natural grotto. The grotto appears to have been anciently adorned within with artificial ornaments. It was probably consecrated by the Greeks to some rural deity, perhaps to the nymphs, to whom the ancient heathens used generally to consecrate grottoes. After the inhabitants of Taormina embraced Christianity, they still continued to visit this grotto with devout veneration. Instead of the Pagan divinities to whom it had before been sacred, they substituted a saint, the venerable St Leonard, instead of the sportive nymphs. But St Leonard did not long draw crowds to this grotto; and the Christians have either defaced its Pagan decorations, or suffered them to fall into decay by the injuries of time. It is now black and smoky; and it is with difficulty that any remains of the Greek paintings with which it was once ornamented can be distinguished. Perhaps it might be sacred to Pales rather than the nymphs: She was the protectress of flocks; and the circumjacent grounds are, and always have been, excellent for pasture.

There are also to be seen in the neighbourhood of Taormina a variety of tombs, the remains of a gymnasium, with a number of other monuments which still preserve the memory of the ancient Tauromenium.

TAPE-worm. See Tænia.

TAPER, Tapering, is understood of a piece of timber, or the like, when thick at one end, and gradually diminishing to the other; as is the case in pyramids, cones, &c. Taper.

To measure Taper-Timber, &c. See *Sliding Rule*.

Taper-Bored, is applied to a piece of ordnance when it is wider at the mouth than towards the breech.

Taper, also denotes a kind of tall wax candle, placed in a candlestick, and burnt at funeral processions, and in other church solemnities.

Tapers are made of different sizes; in some places, as Italy, &c. they are cylindrical; but in most other countries, as England, France, &c. they are conical or taper; whence possibly the name; unless we rather choose to derive taper, in the adjective sense from the substantive taper, in the Saxon *tapen* or *tapon*, *cereus*, "wax-candle. Both kinds are pierced at bottom for a pin in the candlestick to enter.— There are two ways of making tapers, the first with the ladle, the second by hand; for which, see Candle.

Paschal

Taper, Tapestry.

Paschal TAPER, among the Romanists, is a large taper, whereon the deacon applies five bits of frankincense, in holes made for the purpose, in form of a cross; and which he lights with new fire in the ceremony of Easter-Saturday.

The Pontifical makes Pope Zosimus the author of this usage; but Baronius will have it more ancient, and quotes a hymn of Prudentius to prove it. That pope he supposes to have only established the use thereof in parish churches, which, till then, had been restrained to greater churches.

F. Papebroch explains the original of the paschal taper more distinctly, in his *Conatus Chronico-Historicus*, &c. It seems, though the council of Nice regulated the day whereon Easter was to be celebrated, it laid it on the patriarch of Alexandria to make a yearly canon thereof, and to send it to the pope. As all the other moveable feasts were to be regulated by that of Easter, a catalogue of them was made every year; and this was written on a taper, *cereus*, which was blessed in the church with much solemnity.

This taper, according to the abbot Chastelain, was not a wax-candle made to be burnt; it had no wick, nor was it any thing more than a kind of column of wax, made on purpose to write the list of moveable feasts on; and which would suffice to hold that list for the space of a year.

For among the ancients, when any thing was to be written to last for ever, they engraved it on marble or steel; when it was to last a long while, they wrote it on Egyptian paper; and when it was only to last a short time, they contented themselves to write it on wax. In process of time they came to write the moveable feasts on paper, but they still fastened it to the paschal taper. Such is the original of the benediction of the paschal taper.

TAPESTRY, a kind of cloth made of wool and silk, adorned with figures of different animals, &c. and formerly used for lining the walls of rooms, churches, &c.

The art of weaving tapestry is supposed to have been borrowed from the Saracens; accordingly the workmen employed in this manufacture in France were formerly called *Sarazins* or *Sarazinois*. Guicciardini ascribes the invention of tapestry hangings to the inhabitants of the Netherlands; but he has not mentioned at what time the discovery was made. This art was brought into England by William Sheldon, near the end of Henry VIII.'s reign. In 1619 a manufacture was established at Mortlake in Surry by Sir Francis Crane, who received L. 2000 from King James to encourage the design. The first manufacture of tapestry at Paris was set up under Henry IV. in 1606 or 1607, by several artists whom that monarch invited from Flanders. Under Louis XIV. the manufacture of the Gobelins was instituted, which has introduced very beautiful cloths, remarkable for strength, for elegance of design, and a happy choice of colours. The finest paintings are copied, and eminent painters have been employed in making designs for the work.

Tapestry-work is distinguished by the workmen into two kinds, viz. that of high and that of low warp; though the difference is rather in the manner of working than in the work itself; which is in effect the same in both: only the looms, and consequently the warps, are differently situated; those of the low warp being placed flat and parallel to the horizon, and those of the high warp erected perpendicularly. The English anciently excelled all the world in the tapestry of the high warp; and they still retain their former reputation, tho' with some little change: their low warps are still admired; but as for the high ones, they are quite laid aside by the French. The French, before the Revolution, had three considerable tapestry manufactures besides that of the Gobelins; the first at Aubusson in Auvergne, the second at Felletin in the Upper Marche, and the third at Beauvais. They were all equally established for the high and the low warp; but they had all laid aside the high warp excepting the Gobelins. There were admirable low warps likewise in Flanders, generally exceeding those of France; the chief and almost only Flemish manufactures were at Brussels, Antwerp, Oudenard, Lisle, Tournay, Bruges, and Valenciennes; but of the state of these manufactures now we are ignorant.

The usual widths of tapestry are from two ells to three ells Paris measure.

The Manufacture of Tapestry of the High Warp.—The loom on which it is wrought is placed perpendicularly: it consists of four principal pieces; two long planks or checks of wood, and two thick rollers or beams. The planks are set upright, and the beams across them, one at the top and the other at the bottom, or about a foot distance from the ground. They have each their trunnions, by which they are suspended on the planks, and are turned with bars. In each roller is a groove, from one end to the other, capable of containing a long round piece of wood, fastened therein with hooks. The use of it is to tie the ends of the warp to. The warp, which is a kind of worsted, or twisted woollen thread, is wound on the upper roller; and the work, as fast as wove, is wound on the lower. Withinside the planks, which are seven or eight feet high, fourteen or fifteen inches broad, and three or four thick, are holes pierced from top to bottom, in which are put thick pieces of iron, with hooks at one end serving to sustain the coat-stave: these pieces of iron have also holes pierced, by putting a pin in which the stave is drawn nearer or set farther off; and thus the coats or threads are stretched or loosened at pleasure. The coat-stave is about three inches diameter, and runs all the length of the loom; on this are fixed the coats or threads, which make the threads of the warp cross each other. It has much the same effect here as the spring-stave and treddles have in the common looms. The coats are little threads fastened to each thread of the warp with a kind of sliding knot, which forms a sort of mash or ring. They serve to keep the warp open for the passage of broaches wound with silks, woollens, or other matters used in the piece of tapestry. In the last place, there are a number of little sticks of different lengths, but all about an inch in diameter, which the workman keeps by him in baskets, to serve to make the threads of the warp cross each other, by passing them across; and, that the threads thus crossed may retain their proper situation, a packthread is run among the threads above the stick.

The loom being thus formed, and mounted with its warp, the first thing the workman does is to draw on the threads of this warp the principal lines and strokes of the design to be represented on the piece of tapestry; which is done by applying cartoons made from the painting he intends to copy to the side that is to be the wrong side of the piece, and then, with a black lead pencil, following and tracing out the contours thereof on the thread of the right side; so that the strokes appear equally both before and behind.

As for the original design the work is to be finished by, it is hung up behind the workmen, and wound on a long staff, from which a piece is unrolled from time to time as the work proceeds.

Besides the loom, &c. here described, there are three other principal instruments required for working the silk or the wool of the woof within the threads of the warp; these are a broach, a reed, and an iron needle. The broach is made of a hard-wood, seven or eight inches long, and two-thirds of an inch thick, ending in a point with a little handle. This serves as a shuttle; the silks, woollens, gold, or silver, to be used in the work being wound on it. The

reed or comb is alſo of wood, eight or nine inches long, and an inch thick on the back, whence it grows leſs and leſs to the extremity of the teeth, which are more or leſs apart, according to the greater or leſs degree of fineneſs of the intended work. Laſtly, the needle is made in form of the common needle, only bigger and longer. Its uſe is to preſs cloſe the wool and ſilks when there is any line or colour that does not fit well.

All things being prepared for the work, and the workman ready to begin, he places himſelf on the wrong ſide of the piece, with his back towards the deſign: ſo that he works as it were blindfold, ſeeing nothing of what he does, and being obliged to quit his poſt, and go to the other ſide of the loom whenever he would view and examine the piece, to correct it with his preſſing-needle. To put ſilk, &c. in the warp, he firſt turns and looks at the deſign; then, taking a broach full of the proper colour, he places it among the threads of the warp, which he brings croſs each other with his fingers, by means of the coats or threads faſtened to the ſtaff; this he repeats every time he is to change his colour. Having placed the ſilk or wool, he beats it with his reed or comb; and when he has thus wrought in ſeveral rows over each other, he goes to ſee the effects they have, in order to reform the contours with his needle, if there be occaſion. As the work advances, it is rolled upon the lower beam, and they unrol as much warp from the upper beam as ſuffices them to continue the piece: the like they do of the deſign behind them. When the pieces are wide, ſeveral workmen may be employed at once.

We have but two things to add: the firſt is, that the high warp tapeſtry goes on much more ſlowly than the low warp, and takes up almoſt twice the time and trouble. The ſecond is, that all the difference that the eye can perceive between the two kinds, conſiſts in this, that in the low warp there is a red fillet, about one-twelfth of an inch broad, running on each ſide from top to bottom, which is wanting in the high warp.

Manufacture of Tapeſtry of the Low Warp.—The loom or frame, whereon the low warp is wrought, is much like that of the weavers; the principal parts thereof are two ſtrong pieces of wood forming the ſides of the loom, and bearing a beam or roller at each end: they are ſuſtained at bottom with other ſtrong pieces of wood in manner of treſtes; and, to keep them the firmer, they are likewiſe faſtened to the floor with a kind of buttreſſes, which prevent any ſhaking, though there are ſometimes four or five workmen leaning on the fore-beam at once.

The rollers have each their trunnions, by which they are ſuſtained: they are turned by large iron pins three feet long. Along each beam runs a groove, wherein is placed the wich, a piece of wood of about two inches diameter, and almoſt of the length of the roller: this piece fills the groove entirely, and is faſtened therein, from ſpace to ſpace, by wooden pins. To the two wiches are faſtened the two extremities of the warp, which is wound on the farther roller, and the work, as it advances, on the nearer.

Acroſs the two ſides, almoſt in the middle of the loom, paſſes a wooden bar, which ſuſtains little pieces of wood, not unlike the beam of a balance: to theſe pieces are faſtened ſtrings, which bear certain ſpring-ſtaves, wherewith the workman, by means of two treddles under the loom whereon he ſets his feet, gives a motion to the coats, and makes the threads of the warp riſe and fall alternately. Each loom has more or fewer of theſe ſpring ſtaves, and each ſtaff more or fewer coats, as the tapeſtry conſiſts of more or fewer threads.

The deſign or painting the tapeſtry-man is to follow is placed underneath the warp; where it is ſuſtained from ſpace to ſpace with ſtrings, by means of which the deſign is brought nearer the warp.

The loom being mounted, there are two inſtruments uſed in working it, viz. the reed and the flute. The flute does the office of the weaver's ſhuttle; it is made of an hard poliſhed wood, three or four lines thick at the ends, and ſomewhat more in the middle, and three or four inches long. On it are wound the ſilks or other matters to be uſed as the woof of the tapeſtry. The comb or reed is of wood or ivory; it has uſually teeth on both ſides; it is about an inch thick in the middle, but diminiſhes each way to the extremity of the teeth: it ſerves to beat the threads of the woof cloſe to each other, as faſt as the workman has paſſed and placed them with his flute among the threads of the warp.

The workman is ſeated on a bench before the loom, with his breaſt againſt the beam, only a cuſhion or pillow between them; and, in this poſture, ſeparating, with his fingers, the threads of the warp, that he may ſee the deſign underneath, and taking a flute, mounted with a proper colour, he paſſes it among the threads, after having raiſed or lowered them, by means of the treddles moving the ſpring-ſtaves and coats.

Laſtly, To preſs and cloſe the threads of the ſilk or yarn, &c. thus placed, he ſtrikes each courſe (*i. e.* what the flute leaves in its paſſing and coming back again) with the reed.

TAPIOCA, a ſpecies of ſtarch, which the Brazileans make from the roots of the caſſada plant, which is already deſcribed under its botanic name JATROPHA.

TAPIR, in zoology, a quadruped of the order of *belluæ*, reſembling the hippopotamus, has the fore-hoofs divided into four, and the hind-hoofs into three parts. The noſe of the male extends far beyond the lower jaw, is ſlender, and forms a ſort of proboſcis; it is capable of being contracted or extended at pleaſure, and its ſides are ſulcated. The extremities of both jaws end in a point, and there are ten cutting teeth in each. Between them and the grinders there is a vacant ſpace; and there are ten grinders in each jaw. The ears are erect, the eyes ſmall, and the body is ſhaped like that of a hog. The back is arched; the legs are ſhort; and the hoofs ſmall, black, and hollow. The tail is very ſmall. The animal grows to the ſize of a heifer half a year old. The hair is ſhort: when young, it is ſpotted with white; when old, of a duſky colour.—It inhabits the woods and rivers of the eaſtern ſide of South America, from the Iſthmus of Darien to the river of Amazons. It ſleeps during day in the darkeſt and thickeſt foreſt adjacent to the banks, and goes out in the night-time in ſearch of food. It lives on graſs, ſugar-canes, and on fruits. If diſturbed, it takes to the water; ſweems very well; or ſinks below, and, like the hippopotamus, walks on the bottom as on dry ground. It makes a ſort of hiſſing noiſe.—This is the largeſt of the American animals.

TAPPING, in general, the act of piercing a hole in a veſſel, and applying a tube or canula in the aperture, for the commodious drawing off the liquor contained therein.

TAPPING, in ſurgery. See SURGERY.

TAPROBANE, the ancient name of the iſland of Ceylon. See CEYLON.

TAR, a thick, black, unctuous ſubſtance obtained chiefly from old pines and fir-trees by burning them with a cloſe ſmothering heat. It is prepared in great quantities in Norway, Sweden, Germany, Ruſſia, and North America, and in other countries where the pine and fir abound. For the method of obtaining it, ſee the article PINUS, page 765.

Becher, the celebrated chemiſt, firſt propoſed to make tar from pit-coal. Manufactures for this purpoſe have been eſtabliſhed many years ago in the biſhopric of Liege, and

in several parts of England. In the year 1781, the earl of Dundonald obtained a patent for extracting tar from pit-coal by a new process of distillation (see COAL, page 80.). Great hopes were entertained of the value of this discovery, but we have not heard that it has answered expectation.

Tar, which is well known for its economical uses, is properly an empyreumatic oil of turpentine, and has been much used as a medicine both internally and externally (see PHARMACY-*Index*). Tar-water, or water impregnated with the more soluble parts of tar, was formerly a popular remedy. See PHARMACY, n° 4[illegible].

TARENTO, the ancient TARENTUM, a sea port town of Italy, in the kingdom of Naples, and in the Terra de Otranto. It is a strong and populous place, with an archbishop's see, and the title of a principality. It is seated on a peninsula, and is defended by a strong castle; but the harbour is choked up. E. Long. 17. 29. N. Lat. 40. 35.

TARANTULA, a species of ARANEA, so called from Taranto, the place where they are said to abound. See ARANEA, species 13.

TARASCON, an ancient, populous, and handsome town of France, in the department of the Mouths of the Rhone, and late province of Provence, with a well-built castle, seated on the river Rhone, opposite Beaucaire, with which it communicates by a bridge of boats. Its commerce consists in oil, brandy, starch, and stuffs that are much worn, one sort being of coarse silk, and the other of the same material and wool. It is 10 miles north of Arles, and 375 south by east of Paris. E. Long. 4. 45. N. Lat. 43. 46.

TARAZONA, a strong town of Spain, in the kingdom of Arragon, and on the frontiers of Old Castile, with a bishop's see. It is seated partly on a rock, and partly in a fertile plain, on the river Chelles. It was taken from the Moors in 1110. W. Long. 1. 26. N. Lat. 42. 10.

TARCHONANTHUS, FLEA BANE, in botany: A genus of plants belonging to the class of *syngenesia*, and to the order of *polygamia æqualis*; and in the natural system ranging under the 49th order, *Compositæ*. The receptacle is villous, and the pappus plumy; the calyx is monophyllous, turbinated, and half divided into seven segments. There are only three species known; the *camphoratus*, *glaber*, and *ericoides*.

TARE, is an allowance for the outside package that contains such goods as cannot be unpacked without detriment; or for the papers, threads, bands, &c. that inclose or bind any goods imported loose; or though imported in casks, chests, &c. yet cannot be unpacked and weighed neat.

TARE, or VETCH. See VICIA.

TARGET, a kind of shield or weapon of defence made use of by the ancients.

TARGIONIA, in botany; a genus of plants belonging to the class of *cryptogamia*, and natural order of *algæ*. The calyx is bivalved, including a globular body. There is only one species; the *hypophylla*, which is a native of Great Britain. The hypophylla, or vetch targionia, has leaves about a quarter of an inch long, of a heart-shape, inverted, and growing prostrate in a clump together: their upper surface is green, covered with whitish papillæ, and their lower surface is black. The fructification grows at the great end of the leaf on the lower side, and consists of two concave valves or hemispheres, of a reddish black colour, inclosing a chocolate-coloured globule, resembling the seed of a tare or vetch, full of a yellow powder. The leaves increase by shooting out young offsets from their sides like the polypus. This plant is found in the north of England, and near the Tarbet of Cantire in Scotland.

TARGUM, a name given to the Chaldee paraphrases of the books of the Old Testament. They are called *paraphrases* or *expositions*, because they are rather commentaries and explications than literal translations of the text. They are written in the Chaldee tongue, which became familiar to the Jews after the time of their captivity in Babylon, and was more known to them than the Hebrew itself. So that when the Hebrew text was read in the synagogue, or in the temple, they generally added to it an explication in the Chaldee tongue for the service of the people, who had but a very imperfect knowledge of the Hebrew tongue. It is probable, that even from the time of Ezra this custom began, since this learned scribe, reading the law to the people in the temple, explained it, with the other priests that were with him, to make it understood by the people (Nehem. viii. 7—9).

But though the custom of making these sorts of expositions in the Chaldee language be very ancient among the Hebrews, yet have they no written paraphrases or targums before the era of Onkelos and Jonathan, who lived about the time of our Saviour. Jonathan is placed about 30 years before Christ, under the reign of Herod the Great. Onkelos is something more modern. The targum of Onkelos is the most of all esteemed, and copies are to be found in which it is inserted verse for verse with the Hebrew. It is so short and so simple, that it cannot be suspected of being corrupted. This paraphrast wrote only upon the books of Moses; and his style approaches nearly to the purity of the Chaldee, as it is found in Daniel and Ezra. This targum is quoted in the misna, but was not known either to Eusebius, St Jerome, or Origen.

The targum of Jonathan son of Uziel is upon the greater and lesser prophets. He is much more diffuse than Onkelos, and especially upon the lesser prophets, where he takes great liberties, and runs on in allegories. His style is pure enough, and approaches pretty near to the Chaldee of Onkelos. It is thought that the Jewish doctors who lived above 700 years after him made some additions to him.

The targum of Joseph the Blind is upon the Hagiographa. This author is much more modern, and less esteemed than those we have now mentioned. He has written upon the Psalms, Job, the Proverbs, the Canticles, Ecclesiastes, Ruth, and Esther. His style is a very corrupt Chaldee, with a great mixture of words from foreign languages.

The targum of Jerusalem is only upon the Pentateuch; nor is that entire or perfect. There are whole verses wanting, others transposed, others mutilated; which has made many of opinion that this is only a fragment of some ancient paraphrase that is now lost. There is no targum upon Daniel, or upon the books of Ezra and Nehemiah.

These targums are of great use for the better understanding not only of the Old Testament, on which they are written, but also of the New. As to the Old Testament, they serve to vindicate the genuineness of the present Hebrew text, by proving it to be the same that was in use when these targums were made, contrary to the opinion of those who think the Jews corrupted it after our Saviour's time. They help to explain many words and phrases in the Hebrew original, and they hand down to us many of the ancient customs of the Jews. And some of them, with the phraseologies, idioms, and peculiar forms of speech, which we find in them, do in many instances help as much for the better illustration and better understanding of the New Testament as of the Old; the Jerusalem Chaldee dialect, in which they are written, being the vulgar language of the Jews in our Saviour's time. They also very much serve the Christian cause against the Jews, by interpreting many of the prophecies of the Messiah in the Old Testament in the same

Tarif ‖ Tartary.

manner as the Christians do. Many instances are produced to this purpose by Dr Prideaux in his *Connect. of the Hist. of the Old and New Test.* vol. iv. p. 777, &c.

These targums are published to the best advantage in the second edition of the great Hebrew Bible set forth at Basil by Buxtorf the father, *anno* 1610; for he has rectified the Chaldee text, and reformed the vowel pointings in it: the targums having at first been written without vowel points, which were afterwards added very erroneously by some Jews.

TARIF, a table or catalogue containing the names of different sorts of merchandize, with the duties to be paid as settled by authority amongst trading nations.

TARPA (Spurius Mecius), a Latin critic in the time of Julius Cæsar and Augustus. He had his tribunal in the temple of Apollo, where, with four assistants, he passed sentence on the works of the poets. Cicero and Horace make honourable mention of this critic.

TARPAULIN, a piece of canvass, well tarred over, to keep off the rain from any place. The term is also often applied in a burlesque sense to a person that has been all his life bred to the sea.

TARPEIAN, in Roman antiquity, an appellation given to a steep rock in Rome; whence, by the law of the twelve tables, those guilty of certain crimes were precipitated. It took its name from Tarpeia, a vestal virgin, who was killed by the Sabines, as related under the article ROME, n 24.

TARQUIN *the* ELDER, king of Rome, succeeded Ancus Martius 615 B. C. See ROME, n° 35—40.

TARQUIN the Proud, a tyrant and usurper. See the article ROME, n° 49—51, &c.

TARRAGON, or DRAGON-WORT. See ARTEMISIA.

TARROCK, in ornithology, a species of LARUS.

TARSHISH, or TARTESSUS, a town frequently mentioned by ancient authors, the situation of which it is difficult to ascertain. See the opinions of Mr Bruce and Dr Doig on this subject under the article OPHIR.

TARTAN, in sea language, a small coasting vessel navigated in the Mediterranean sea, and having only one mast and a bowsprit, the principal sail, which is extremely large, being extended by a lateen-yard. When tartans put up a square sail, it is called a *sail of fortune*.

TARTAR, a hard solid substance which separates from wine after complete fermentation, and adheres to the top and sides of the casks. See the *Index* to CHEMISTRY and PHARMACY.

TARTARY, a very large country of Asia, situated between 57° and 160° of E. Long. reckoning from the west end of the isle of Ferro, and between 37° and 55° of Lat. It is bounded on the north by Siberia, or that part of Asia which belongs to Russia; on the west by the rivers Don, Wolga, and Kama, which separate it from Russia; on the south by the Euxine and Caspian Seas, Karazm, the two Bukharias, China, and Korea; and on the east, by the Oriental or Tartarian ocean. It extends from east to west the space of 104 degrees in longitude, or 4145 geographical miles; but its breadth is not proportionable, being not above 960 miles where broadest, and where narrowest 230.

This vast region is divided into two great parts; the one called the *Western*, the other the *Eastern Tartary*.

Western Tartary, which is much more extensive than the Eastern, containing 139 degrees of longitude out of 161, is inhabited by a great number of nations, or tribes of people, who are called *Mungls* or *Mungals*, by themselves; and *Moguls* or *Tartars*, indifferently, by other nations.

Tartary.

The principal mountains, or rather chains of mountains, found in this part of Great Tartary, may be divided into three classes: first, those which run along the northern borders of it; and though perhaps not always contiguous, or of the same denomination, go under the general name of *Ulug Tâg*, or *Dag*, that is, the *Great Mountain*. Secondly, those which make the southern bounds, and are called *Kichug Tâg*, or the *Lesser Mountain*. The third great chain is called *Mount Altay*, lying nearly in the middle, between the Caspian Sea and Eastern Tartary, and extending between the other two, in about the 110th degree of longitude.

The principal rivers of Western Tartary, besides the Dnieper, Don, and Wolga, are the Jaik or Yaik, and Yem, both descending from the Ulug Tag, and falling into the Caspian Sea on the north side: the river Ili or Khonghis, which rises out of the Kichug Tag, on the borders of Little Bukharia, and runs north-west into the lake Palkasi, which is about forty miles long, and 30 broad, in latitude 48°, longitude 97°, reckoning from the isle of Ferro: on this river the khan of the Eluths or Kalmucks usually resides: the river Irtish, Irtis, or Erchis, which rises in Mount Altay, and runs westward, inclining to the north, between two branches of it, into the lake Saysan, Sassan, or Isan, called also *Honhotu-Nor*, 90 miles long from west to east, and 40 broad, in latitude 47° 30′, longitude 104°; from whence issuing again, it passes north-west, through part of Siberia, and falls into the Oby, which has its source in the same mountain, about one degree to the north of that of the Irtish; and seven or eight degrees to the north-east rises the Kem or Jenisea, which runs westward for the space of seven or eight degrees, and then turning northward enters Siberia. The next river of note is the Selinga, which rises out of the lake Kofogol, Hutuktu or Khutuktu, which is 70 miles long from south to north, and 20 broad, in latitude 52°, longitude 118°, not far from the source of the Jenisea, and taking a sweep southward, round by the east, falls northward into the lake Baykal in Siberia, about 30 leagues north-west of the city Selinghinskoy, which stands upon it. Into the Selinga runs the Orkon, coming from the south-west; and into the Orkon the Tula, rising eastward in Mount Kentey. On the same mountain rises also two other rivers, *viz.* the Onon, called also by the Tartars *Saghalian Ula*, or the Dragon river, and by the Russians *Amur*; which running north-eastward, and then taking a large sweep by the south, rolls along the bounds of Eastern Tartary, and falls into the Eastern Ocean. On its banks stand two cities; Nerchinskoy or Nipchew, a frontier of the Russians, almost due north of Pekin in China; and Saghalian Ula, possessed by the Chinese. Another large river is the Kerlon or Kerulon, which running north-eastward, falls into the lake Kulon or Dalay, which is 60 miles long from south-west to north-east, and 27 broad, in latitude 48° 30′, longitude 135°, and issuing out again under the name of *Ergona* or *Argun*, joins the Saghalian Ula, about 170 miles beyond Nerchinskoy. To these let us add the river Kalka, from whence, though small, the Kalka-Moguls or Mongols take their name. It rises in the mountains, separating Eastern from Western Tartary, and, running eastward, falls into the lake Puir, and then into that of Kulon, before spoken of.

In the middle of a desert, on the banks of the river Irtish, is a remarkable piece of antiquity called SEDMY PALATY, or *the seven palaces*.

Above the Sedmy Palaty, towards the source of the Irtish, grows the best rhubarb in the world, without the least culture. In the plain of this country also, about eight or ten days journey from Tomsky in Siberia, are found many

Tartary. tombs and burying-places of ancient heroes, who in all probability fell in battle. These tombs are easily distinguished by the mounds of earth and stone raised over them. The Tartars say, Tamerlane had many engagements in this country with the Kalmucks, whom he in vain endeavoured to conquer. Many persons go from Tomsky, and other parts, every summer, to these graves, which they dig up, and find among the ashes of the dead considerable quantities of gold, silver, brass, and some precious stones, but particularly hilts of swords and armour. They find also ornaments of saddles and bridles, and other trappings for horses; and sometimes those of elephants. Whence it appears, that when any general or person of distinction was interred, all his arms, his favourite horse and servant, were buried with him in the same grave; this custom prevails to this day among the Kalmucks and other Tartars, and seems to be of great antiquity. It appears from the number of graves, that many thousands must have fallen in those places; for the people have continued to dig for treasure many years, and still find it unexhausted. They are, indeed, sometimes interrupted, and robbed of all their booty, by parties of Kalmucks, who abhor disturbing the ashes of the dead. Armed men on horseback, cast in brass, of no mean design and workmanship, with the figures of deer cast in pure gold, have been dug out of these tombs. They once discovered an arched vault, where they found the remains of a man, with his bow, lance, and other arms, lying on a silver table. On touching the body, it fell to dust. The value of the table and arms was very considerable. For the manners and customs of these Tartars, see KALMUCKS.

Great quantities of a kind of ivory, called by the natives *Mammons-horn*, are found in this country and in Siberia, on the banks of the Oby. They are commonly found on the banks of rivers that have been washed by floods. Some of them are very entire and fresh, like the best ivory in all respects, excepting only the colour, which is of a yellowish hue. In Siberia they make snuff-boxes, combs, and divers sorts of turnery ware of them. Some have been found weighing above 100 pounds English.

The most considerable tribes in Western Tartary, next to the Kalmucks, are the Kalkas and Mungls, or Mongals, properly so called. The country of the Kalkas extends eastward, from mount Altay to the source of the river Kalka, whence they derive their name, in the borders of Eastern Tartary, and 139th degree of longitude. The territories of the Mungls, or Mongalia, lie to the south of those of the Kalkas, between them and the great wall of China, to which empire both nations are subject. Besides these tribes, who are idolaters of the religion of the Delay Lama, there are others, who possess that part of Western Tartary called *Turkestan*, the original country of the Turks and Turkmans, situated to the north of Great Bukharia and Karazm, between those countries and the dominions of the Eluths. Under Western Tartary also is comprehended Tibet, Thibet, or Tobbut, subject to the Delay Lama, or great high-priest of the Pagan Tartars and Chinese.

In all the vast region of Western Tartary, there are but few towns, most of the inhabitants living under tents, especially in summer, and moving from place to place with their flocks and herds. They generally encamp near some river for the convenience of water.

The air of this country is temperate, wholesome, and pleasant, being equally removed from the extremes of heat and cold. As to the soil, though there are many mountains, lakes, and deserts in it, yet the banks of the rivers, and the plains, some of which are of great extent, are exceeding fertile. The mountains, woods, and deserts, abound with venison, game, and wild fowl; and the rivers and lakes both with fish and fowl. In particular, here are wild mules, horses, and dromedaries, wild boars, several kinds of deer, a species of goats with yellow hair, squirrels, foxes; an animal called *hautehan*, resembling an elk; another called *chulon* or *chelison*, that seems to be a sort of lynx; and a creature called *tael-pe*, as small as an ermine, of whose skins the Chinese make mantles to keep out the cold. Among other birds of extraordinary beauty, bred in this country, there is one called the *shonkar*, which is all over white except the beak, wings, and tail, which are of a very fine red. Notwithstanding the soil in many parts of Tartary is so luxuriant, yet we are told it does not produce a single wood of tall trees of any kind whatever, excepting in some few places towards the frontiers; all the wood that is found in the heart of the country consisting of shrubs, which never exceed the height of a pike, and even these are rare.

It is remarkable, that in all the vast dominions of Mongalia, there is not so much as a single house to be seen. All the people, even the prince and high-priest, live constantly in tents, and remove their cattle from place to place as conveniency requires. These people do not trouble themselves with ploughing or digging the ground in any fashion, but are content with the produce of their flocks, though the soil is exceeding fine, and capable, by proper culture, of producing grain of several sorts.

In the country of the Mongals the grass is very thick and rank, and would with little labour make excellent hay. This grass is often set on fire by the Mongals in the spring during high winds. At such times it burns most furiously, running like wild-fire, and spreading its flames to the distance of perhaps 10 or 20 miles, till its progress is interrupted by some river or barren hill. The rapidity of those flames, their smoke and crackling noise, cannot easily be conceived by those who have not seen them. When any person finds himself to the leeward of them, the only method by which he can save himself from their fury, is to kindle immediately the grass where he stands, and follow his own fire. For this purpose, every person is provided with flints, steel, and tinder. The reason why the Mongals set fire to the grass, is to procure early pasture to their cattle. The ashes left upon the gound sink into the earth at the melting of the snow, and prove an excellent manure; so that the grass in the spring rises on the lands which have been prepared in this manner as thick as a field of wheat. Caravans, travellers with merchandise, but especially armies, never encamp upon this rank grass; and there are several instances of considerable bodies of men being put in confusion, and even defeated, by the enemy's setting fire to the grass.

Eastern Tartary, according to the limits usually assigned it by historians and geographers, is bounded to the west by Western Tartary, or by that part possessed by the proper Mungls and Kalkas; on the north by Siberia; on the east by that part of the Oriental Ocean called the *Tartarian Sea*; and on the south by the same sea, the kingdom of Korea, and the Yellow Sea, which separates it from China. It is situated between the 137th and 160th degrees of longitude, being about 900 miles long from south to north, and near as many in breadth from west to east, yet but thinly peopled. This large region is at present divided into three great governments, all subject to the Chinese, viz. Shing-yang or Murden, Kurin-ula, and Tsitsikar.

The government of Shin-yang, containing all the ancient Lyau tong or Quan-tong, is bounded on the south by the great wall of China and the Yellow Sea; on the east, north, and west, it is inclosed by a wooden palisade, seven or eight feet high, fitter to mark its bounds and keep out petty robbers than to oppose an army.

2 The

Tartary

The lands of this province are for the general very fertile, producing abundance of wheat, millet, roots, and cotton. They alſo afford paſture to great numbers of ſheep and oxen, which are rarely ſeen in any of the provinces of China. They have indeed but little rice; yet, to make amends, there is plenty of apples, pears, hazel-nuts, filberds, and cheſnuts, even in the foreſts. The eaſtern part, which borders on the ancient country of the Manchews and kingdom of Korea, is full of deſerts and bogs. The principal cities of this government are Shing-yang or Mugden, Fong-whang ching, Inden, Ichew, and Kingchew. This country was the original ſeat of the Tartar tribe of the Manchews, who have been maſters of China above 100 years.

The government of Kirin-ula-hotun is bounded weſtward by the paliſade of Lyau-tong; on the eaſt, by the Eaſtern Ocean; ſouthward, by the kingdom of Korea; and on the north by the great river Saghalian; ſo that it extends no fewer than 12 degrees, and almoſt 20 degrees in longitude, being 750 miles in length and 600 in breadth.

This vaſt country abounds in millet and oats, with a ſort of grain unknown in Europe, called by the Chineſe *may-ſem-mi*, as being of a middle kind between wheat and rice. It is wholeſome, and much uſed in thoſe cold regions. There is but little wheat or rice here; but whether that is the fault of the ſoil or the inhabitants, we cannot aſſert. The cold begins much ſooner in theſe parts than at Paris, whoſe latitude is near 50 degrees. The foreſts, which are very thick and large the nearer you advance to the Eaſtern Ocean, contribute not a little to bring it on and keep it up. The banks of the rivers here, in ſummer, are enamelled with a variety of flowers common in Europe, excepting the yellow lilies, which are of a moſt lively colour, in height and ſhape exactly reſembling our white lilies, but are of a much weaker ſcent. But the plant which is moſt eſteemed, and draws a great number of herbaliſts into theſe deſerts, is the gin-ſeng*, called by the Manchews *orhota*, that is, the chief or queen of plants. It is highly valued for its virtues in curing ſeveral diſeaſes, and all decays of ſtrength proceeding from exceſſive labour of body or mind. For this reaſon it has always been the principal riches of Eaſtern Tartary; what is found in the north of Korea being conſumed in that kingdom.

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Formerly the Chineſe uſed to get into the gin-ſeng country among the mandarins and ſoldiers continually paſſing; but in 1700 the emperor Kang-hi, that his Manchews might reap this advantage, ordered 10,000 of his ſoldiers, encamped without the great wall, to go and gather it, on condition that each ſhould give him two ounces of the beſt, and take an equal weight of fine ſilver for the remainder: by which means the emperor got in that year 20,000 pounds of it for leſs than one-fourth of the price it bears at Pekin. The root is the only part that is uſed medicinally. Its value is enhanced by its age, for the largeſt and firmeſt are the beſt. This country abounds alſo in fine ſables, grey ermines, and black foxes.

One of the tribes of Tartars inhabiting this country are called the *Yu-pi Tartars*, whoſe manner of life is ſomewhat extraordinary. All the ſummer they ſpend in fiſhing: one part of what they catch is laid up to make oil for their lamps; another ſerves for their daily food; and the reſt, which they dry in the ſun, without ſalting, for they have no ſalt, is laid up for their winter's proviſions, whereof both men and cattle eat when the rivers are frozen. Notwithſtanding this diet, a great deal of ſtrength and vigour appears in moſt of theſe poor people. Their raiment conſiſts of the ſkins of fiſh, which, after dreſſing and dyeing of three or four colours, they ſhape and ſew in ſo delicate a manner, that one would imagine they made uſe of ſilk, till, on ripping a ſtitch or two, you perceive an exceeding fine thong, cut out of a very thin ſkin. When the rivers are frozen, their ſledges are drawn by dogs trained up for the purpoſe, and highly valued.

Although the Manchew language is as much uſed at the court of Pekin as the Chineſe, and all public acts are drawn up in the one as well as the other; yet it began to decline, and would probably have been loſt, had not the Tartars taken great pains to preſerve it, by tranſlating Chineſe books, and compiling dictionaries, under the emperor's patronage. Their language is ſingular in this reſpect, that the verb differs as often as the ſubſtantive governed by it; or, which is the ſame thing, to every different ſubſtantive they uſe a different verb; as for inſtance, when they would ſay, *make a verſe*, *a picture*, *a ſtatue*; for though the repetition of the ſame verb in diſcourſe might be excuſable, it is with them unpardonable in writing, as making a monſtrous grating to their ears.

Another ſingularity of their language is the copiouſneſs of it; for inſtance, beſides names for each ſpecies of animals, they have words to expreſs their ſeveral ages and qualities. *Judigon* is the general name for a dog; but *tayba* ſignifies a dog who has very long and thick hair both on his ears and tail; and *yolo*, a dog with a long thick muzzle and tail, large ears, and hanging lips. The horſe, as more ſerviceable to them, has 20 times more names than the dog; almoſt every motion of him giving occaſion to a different name. Where they could get that aſtoniſhing multitude of names and terms, is not eaſy to determine.

This country is but thinly peopled, and contains only four cities, namely, Kirinula-hotun or Khotun, Pedne or Petuna, Ninguta, and Putay-ula-hotun, which are very ill-built, and encompaſſed with no better than mud-walls. The firſt ſtands on the river Songari, and is the reſidence of the Manchew general, who has all the privileges of a viceroy, and commands the mandarines as well as the troops. Ninguta, which the family now reigning in China conſiders as its ancient patrimony, is ſituated on the Hurkapira, which runs northward into the Songari. Its name is compounded of two Tartarian words which ſignify ſeven chiefs, to expreſs the riſe of the Manchew kingdom, which was firſt eſtabliſhed by ſeven brothers of the late emperor Kanghi's great-grandfather's father.

The tribe of the Manchews, who inhabit a part of Eaſtern Tartary, and are lords of all the other inhabitants thereof, are called by the Ruſſians *Bogdoy*, and the emperor of China *Bogdoy Khan* and *Amulon Bogdoy Khan*.

The third government into which Eaſtern Tartary is divided, is that of Tſitſikar. It is 740 miles long and [illegible] broad; and belongs partly to China and partly to Ruſſia. The people are great hunters, dexterous archers, and pay their tribute in ſable-ſkins; each family being aſſeſſed two or three, or more a-year, according to the number of able perſons.

This province is inhabited chiefly by three ſorts of Tartars, the Manchews, the Solons, and Taguri, of whom the firſt are maſters. The Taguri are a large robuſt people, but not very numerous. They live in houſes or huts, and cultivate barley, oats, and millet. Their cattle are principally horſes, dromedaries, oxen, cows, and ſheep. They make much uſe of their oxen to ride on.

The Solons alſo are a brave robuſt people. Their dreſs is a ſhort jacket of wolves ſkins, with a cap of the ſame; and they have long cloaks made of fox or tiger ſkins, to defend them againſt the cold, eſpecially of the night. They hang their bows at their backs. Their women ride on horſeback, drive the plough, hunt ſtags and other game.

Beſides the country towns or villages, there are three ci-

Tartary. ties in the province of Tsitsikar, namely, Tsitsikar, Merghen, and Saghalian ula-hotun. The garrison of Tsitsikar, the capital, consists of Manchews; but the inhabitants are mostly Chinese. According to their own account, they are all shammams, or conjurors, and invoke the devil with frightful cries. They give their dead two burials, first leaving a hole at top of the grave, where the relations daily bring victuals, which they convey to the mouth of the deceased with a spoon, and leave drink in small tin cups standing round the grave. This ceremony holds for several weeks, after which they bury the body deeper in the ground.

Several rivers in this country produce pearls, which, though much cried up by the Tartars, would be little valued by Europeans, on account of their defects in shape and colour.

The kingdoms or countries of Corea, Lyau-tong, and Nyu-che, forming a part of Katay, Kitay, or Cathay, and by some included under Eastern Tartary, are more properly provinces of China, though they lie without the great wall.

Usbeck Tartary. To the north and north-east of Persia lie the countries of Karasm, and Great and Little Bukharia, which being mostly subject to and inhabited by the tribe of Usbeck Tartars, are commonly known by the general name of *Usbeck Tartary.*

The kingdom of Karasm was known to the ancient Greeks, as appears from Herodotus, Ptolemy, and other authors of that nation, by the name of *Khorasmia.* At present it is bounded on the north by the country of Turkestan, and the dominions of the great khan of the Eluths or Kalmucks; on the east, by Great Bukharia, from which it is separated partly by the mountains of Irdar, and partly by the deserts of Karak and Gaznah; on the south, by the provinces of Asterabad and Khorassan, belonging to Iran or Persia at large, from which it is divided by the river Jihun or Amu, and sundry deserts of a vast extent; and on the west by the Caspian Sea.

It may be about 440 miles in length from south to north, and 300 from west to east; being situated between the 39th and 46th degrees of north latitude, and the 71st and 77th degrees of east longitude. The country consists, for the most part, of vast sandy plains, some of which are barren deserts, but others afford excellent pasture. There is good land in several of the provinces, where vines grow, and wine is made; but water being scarce, a great part of the country turns to no account.

Karasm owes all its fertility to three rivers and a lake. The rivers are the Amu, Khesil, and Sir. The Amu, as it is called by the Usbecks and Persians, is the Jihun of the Arabs, and Oxus of the ancient Greeks. It has its source in those high mountains which separate Little Bukharia from the dominions of the Great Mogul; and, after passing through Great Bukharia and Karasm, divides into two branches, one of which falls into the Khesil, and the other into the Caspian Sea, towards the borders of the province of Astarabad. The Amu abounds with all sorts of excellent fish, and its banks are the most charming in the world. Along them grows those excellent melons and other fruits so much esteemed in Persia, the Indies, and Russia.

The river Khesil rises in the mountains to the north-east of the province of Samarkant, and falls into the lake of Aral or Eagles, 50 or 60 miles below its junction with a branch of the Amu. Its banks are exceeding fertile wherever they are cultivated.

The Sir or Daria rises in the mountains to the east of Little Bukharia, and after a long course westward, along the borders of the Bukharias and Karasm, falls at last into the lake Aral.

Karasm is at present inhabited by three sorts of people, the Sarts, Turkmans, and Usbeck Tartars. With regard to the first of these, we are told, that they are the ancient inhabitants of the country, or those who were settled there before the Usbecks became masters of it; and that they support themselves like the Turkmans by their cattle and husbandry. The Turkmans or Turkomans came originally from Turkestan or the parts of Tartary to the north of Karasm and Great Bukharia, towards the 11th century. They divided into two parties; one of which went round the north side of the Caspian Sea, and settled in the western parts of the Greater Armenia, from thence called *Turkomania*, or *the country of the Turkomans.* The second party turned south, and rested about the banks of the river Amu and the shores of the Caspian Sea, where they still possess a great many towns and villages, in the countries of Karasm and Astarabad.

The name of *Usbecks*, which the ruling tribe of the Tartars of Karasm and Great Bukharia bear at present, is derived from one of their khans. The Usbecks of Karasm are divided into several hords, and live for the most part by rapine; resembling in all respects those of Great Bukharia, excepting that they are much more rude and uncivilized. Like the Turkmans, they dwell in winter in the towns and villages which are towards the middle of Karasm; and in summer the greater part of them encamp in the neighbourhood of the Amu, or in other places where they can meet with pasture for their cattle; always watching for some convenient opportunity to rob and plunder. They never cease making incursions upon the adjacent territories of Persia or Great Bukharia, and are to be restrained by no treaties or engagements whatsoever. Although they have fixed habitations, yet, in travelling from one place to another, they carry with them all their effects of value, conformable to the way of living in use among their ancestors before they had settled dwellings.

These Tartars, it is said, never ride without their bows, arrows, and swords, although it be in hawking or taking any other diversion. They have no arts or sciences among them, neither do they till or sow. They are great devourers of flesh, which they cut in small pieces, and eat greedily by handfuls, especially horse-flesh.

Their chief drink is sour mare's milk, like that in use with the Nogays. They eat their victuals upon the ground, sitting with their legs double under them, which is their posture also when they pray.

All these tribes have abundance of camels, horses, and sheep, both wild and tame. Their sheep are extraordinary large, with great tails weighing 60 or 80 pounds. There are many wild horses in the country, which the Tartars frequently kill with their hawks. These birds are taught to seize upon the head or neck of the beast; which being tired with toiling to get rid of this cruel enemy, the hunter, who follows his game, comes up and kills him. Some travellers tell us, that the inhabitants of this country have not the use of gold, silver, or any other coin, but barter their cattle for necessaries. Others tell us, that they have money, particularly a piece of silver called *tanga*, the value near the fourth part of a crown. It is round, and has on one side the name of the country, and on the other that of the khan, with the year of the hegira. There are also, it is said, small pieces of copper, of different sizes, which answer to our pence, halfpence, and farthings.

As to the government of Karasm, the Usbecks being masters, it is commonly vested in divers princes of that tribe of the same house; of whom, notwithstanding, only one has the title of *khan*, with a kind of superiority over the others. This

This khan has no ſort of dependence on him of Great Bukharia, or any other prince.

Bukharia, *Bokharia*, *Bokaria*, *Bogaria*, or *Boharia*, is the name given to all that region or tract of land lying between Karaſm and the Great Kobi, or Sandy Deſert, bordering on China. It is divided into the Great and Little Bukharia. For an account of which, ſee the article BUKHARIA.

The inhabitants of theſe different countries, which are known by the name of *Tartary*, have a tradition among themſelves that they are all ſprung from one common ſtock, and that they are of the moſt remote antiquity. To this tradition much credit is due; for they are known to be the deſcendants of the ancient Scythians. But when M. Bailly contends that the Tartars are the moſt ancient of nations, and the civilizers of mankind, he writes without authority, and advances a paradox at which every mind muſt recoil. Among the Tartars there are no hiſtorical monuments of antiquity and credit; for all their writings extant, even thoſe in the Mogul dialect, are long ſubſequent to the time of Mohammed; nor is it poſſible, ſays Sir William Jones, to diſtinguiſh their traditions from thoſe of the Arabs, whoſe religious opinions they have in general adopted. M. Bailly diſplays indeed great learning and ingenuity in his attempt to derive civilization from this ſource; but the greateſt learning and acuteneſs, together with the charms of a moſt engaging ſtyle, can hardly render tolerable a ſyſtem, which places an earthly paradiſe, the gardens of *Heſperus*, the iſlands of the *Macares*, the groves of Elyſium, if not of Eden, the heaven of INDRA, the Periſtan or fairy-land of the Perſian poets, with its city of diamonds and its country of *Shadcam*, ſo named from Pleaſure and Love, not in any climate which the common ſenſe of mankind conſiders as the ſeat of delights, but beyond the mouth of the Oby, in the Frozen Sea, in a region equalled only by that where the wild imagination of Dante led him to fix the worſt of criminals in a ſtate of puniſhment after death, and of which he could not, he ſays, even think without ſhivering.

Before the era of Mohammed the Tartars had no literature. The magnificent Chengiz, whoſe empire included an area of near 80 ſquare degrees, could find none of his own Mongals, as the beſt authors inform us, able to write his diſpatches; and TIMUR or TAMERLANE, a ſavage of ſtrong natural parts, and paſſionately fond of hearing hiſtories read to him, could himſelf neither write nor read. It is true, that by ſome Arabian writers mention is made of a ſet of Tartarian characters, ſaid to conſiſt of 41 letters; but from the deſcription of theſe characters, Sir William Jones, with much plauſibility, ſuſpects them to have been thoſe of Tibet.

"From ancient monuments therefore (continues the learned preſident) we have no proof that the Tartars were themſelves well inſtructed, much leſs that they inſtructed the world; nor have we any ſtronger reaſon to conclude from their general manners and character, that they had made an early proficiency in arts and ſciences; even of poetry, the moſt univerſal and moſt natural of the fine arts, we find no genuine ſpecimens aſcribed to them, except ſome horrible war-ſongs expreſſed in Perſian by Ali of Yezd, and poſſibly invented by him. After the conqueſt of Perſia by the Mongals, their princes indeed encouraged learning, and even made aſtronomical obſervations at Samarkand; as the Turks became poliſhed by mixing with the Perſians and Arabs, though *their very nature*, as one of their own writers confeſſes, *had before been like an incurable diſtemper, and their minds clouded with ignorance*: thus alſo the Mancheu monarchs of China have been patrons of the learned and ingenious, and the emperor Tien-Long is, if he be now living, a fine Chineſe poet. In all theſe inſtances the Tartars have reſembled the Romans, who, before they had ſubdued Greece, were little better than tigers in war, and Fauns or Sylvans in ſcience and art.

"We may readily believe thoſe who aſſure us, that ſome tribes of wandering Tartars had real ſkill in applying herbs and minerals to the purpoſes of medicine, and pretended to ſkill in magic: but the general character of their nation ſeems to have been this; they were profeſſed hunters or fiſhers, dwelling, on that account, in foreſts or near great rivers, under huts or rude tents, or in waggons drawn by their cattle from ſtation to ſtation; they were dexterous archers, excellent horſemen, bold combatants, appearing often to flee in diſorder for the ſake of renewing their attack with advantage; drinking the milk of mares, and eating the fleſh of colts; and thus in many reſpects reſembling the old Arabs, but in nothing more than in their love of intoxicating liquors, and in nothing leſs than in a taſte for poetry and the improvement of their language."

Krim TARTARY. See CRIMEA.

TASSEL, a ſort of pendant ornament at the corners of a cuſhion or the like. In building, taſſels denote thoſe pieces of board that lie under the ends of the mantlet trees.

TASSO (Torquato), a juſtly celebrated Italian poet, was born at Sorrento in the kingdom of Naples, in 1544. He was the ſon of Bernardo Taſſo, the author of ſeveral ingenious compoſitions both in verſe and proſe; and of Portia de Roſſi, a lady of an illuſtrious family of Naples.

His father being obliged to accompany the prince of Salerno to the emperor Charles V. upon a deputation from Naples to remonſtrate againſt erecting the inquiſition there, committed the care of his ſon, then three years old, to Angeluzza, a man of great learning; who, we are told, at this tender age began to teach him grammar: at four he was ſent to the Jeſuit's college, and at ſeven was well acquainted with Latin and Greek. At 12 years of age he went from Rome to Mantua, where his father had entered into the ſervice of the duke Guglielmo Gonzago: he had then completed his knowledge of the Latin and Greek languages; he was well acquainted with rhetoric and poetry, and a maſter of Ariſtotle's ethics; he had alſo ſtudied the precepts of Mauritio Cataneo with particular attention, and ever after reverenced him as a ſecond father.

He was ſoon after ſent to the univerſity of Padua; and, in his 18th year, publiſhed his Rinaldo, a poem written upon the plan of Homer's Odyſſey. This extended his reputation throughout all Italy; but greatly diſpleaſed his father, who foreſaw that it would ſeduce him from ſtudies of more advantage. He went to Padua, to remonſtrate againſt his apparent purpoſe of giving himſelf up to philoſophy and poetry, and made uſe of many very harſh expreſſions, which Taſſo heard with a patience and tranquillity that made the old gentleman ſtill more angry: "Of what uſe is that philoſophy on which you value yourſelf ſo much?" "It has enabled me (replied Taſſo) to endure the harſhneſs of your reproofs."

He ſoon after went to Bologna, by the invitation of the city and college; but in a little time returned to Padua at the preſſing inſtances of Scipio Gonzaga, who had been elected prince of the academy that had been eſtabliſhed in that city by the name of the *Ætherei*. He was incorporated into this ſociety, and took upon himſelf the name of *Pentito*.

In this retreat he formed the deſign of his *Jeruſalem Delivered*, invented the fable, diſpoſed the parts, and determined to dedicate it to the houſe of Eſte; but whether to Alphonſo II. the laſt duke of Ferrara, or his brother the cardinal Luigi, to whom he had already dedicated his *Rinaldo*, he was yet in doubt. Being preſſed by both the brothers to reſide with them at Ferrara, he conſented. The

Taſſo. duke gave him an apartment in his palace, where he lived in peace and affluence, and proſecuted his work; which he now determined to dedicate to the duke, and which was publiſhed by his patrons, book by book, as he finiſhed them.

When he was about 27, he publiſhed a paſtoral comedy called *Aminta*; which was received with univerſal applauſe, as a maſterpiece in its kind, and is the original of the *Paſtor Fido* and *Filli di Sciro*.

In the 30th year of his age he finiſhed his *Jeruſalem*, and the whole was reprinted and publiſhed together: the ſucceſs of it was aſtoniſhing; it was tranſlated into Latin, French, Spaniſh, and even the Oriental languages, almoſt as ſoon as it appeared.

But it was Taſſo's fate to become wretched from the moment that he gained the ſummit of reputation: very ſoon after his *Jeruſalem* was publiſhed, he loſt his father, who died at Oſtia upon the Po, the government of which place had been given him by the duke of Mantua; his *Jeruſalem* was attacked by a ſwarm of ignorant but petulant critics, who gave the preference to the rhapſodies of Pulci and Boyardo; and the perfidy of a friend drew upon him much greater misfortunes.

This friend was a gentleman of Ferrara, to whom Taſſo had indiſcreetly communicated ſome tranſactions of a very delicate nature concerning his patron the duke, with whom he lived. This ſecret being betrayed, Taſſo reproached his friend for his treachery; and this reproach was retorted in ſuch a manner as provoked Taſſo to ſtrike him. A challenge immediately enſued, and the opponents met and engaged; but during the rencounter, three brothers of Taſſo's antagoniſt came up, and all fell upon him together: Taſſo defended himſelf ſo well, that he wounded two of them, and kept his ground againſt the others till ſome people came up and parted them. This made a great noiſe at Ferrara, where nothing was talked of but the valour of Taſſo; and it became a kind of proverb, "That Taſſo, with his pen and his ſword, was ſuperior to all men."

The duke being informed of the quarrel, baniſhed the brothers from his dominions, confiſcated their eſtates, and Taſſo himſelf he ſhut up in priſon, under pretence of ſecuring him from any future attacks of his enemies.

Taſſo found means to eſcape from this confinement, after having ſuffered it about a year; and, being now about 34 years of age, retired to Turin, where he was ſoon known and recommended to the duke of Savoy, who ſhowed him many marks of eſteem and affection: but Taſſo, fearing that the duke of Ferrara would require him to be delivered up, and that the duke of Savoy would chooſe rather to comply than forfeit the friendſhip of that prince, precipitately ſet out for Rome alone, and without proper neceſſaries for ſuch a journey.

He got ſafe, however, to Rome; where he went directly to his friend Mauritio Cataneo, who received him with great kindneſs, and the whole city ſeemed to rejoice at the preſence of ſo extraordinary a perſon. He was viſited by princes, cardinals, prelates, and all the learned in general. But being impatient of exile, he took meaſures to make his peace with the duke, and ſucceeded.

The duke received him with great appearance of ſatisfaction, and gave him freſh marks of his eſteem. But Taſſo having made ſome attempts on the princeſs Leonora, whom he has celebrated in ſeveral of his verſes, the duke her brother, believing, or pretending to believe, that his ill conduct proceeded from a diſordered underſtanding, cauſed him to be ſtrictly confined in the hoſpital of St Anne. Taſſo applied to the duke, by every friend he had, to releaſe him from this confinement; but the duke coldly anſwered, that inſtead of endeavouring to procure the enlargement of a perſon in his condition, they ought rather to exhort him to ſubmit patiently to ſuch remedies as were judged proper for him. Taſſo was certainly diſordered in his mind, whether as the effect or cauſe of this confinement: he was conſcious that he laboured under ſome diſtemper, and he believed the cauſe of it to be ſupernatural, and fancied himſelf haunted by a ſpirit that continually diſordered his books and papers; to which, however, the tricks played him by his keepers might contribute. He continued, notwithſtanding, to ſolicit the interpoſition of all the powers in Italy, to whom he could find means to apply, particularly the emperor and the pope; but without ſucceſs. At laſt, after he had been a priſoner ſeven years, Vincentio Gonzaga prince of Mantua came to Ferrara among other great perſonages, during the feſtivals and rejoicings that were held there on the marriage of Cæſar of Eſte with Virginia of Medicis, procured his liberty, and took him with him to Mantua, he being then in the 42d year of his age.

At Mantua he lived about a year in great favour with the prince, and in all the ſplendour and affluence which the favour of great princes confers: but he was weary of a ſtate of dependence, however ſplendid and luxurious; and therefore reſolved to go to Naples, and endeavour to recover his mother's jointure, which had been ſeized by her relations when he went into exile with his father Bernardo. With this view he procured letters of recommendation to the viceroy; and having taken leave of the prince of Mantua, he went firſt to Bergamo, where he ſtaid ſome time, and from thence proceeded to Naples.

At Naples he immediately commenced a ſuit at law for the recovery of his right, and divided his time between a proſecution of that and his ſtudies. But during the ſummer he retired to Biſaccio with one Giovanni Batiſta Manſo, with whom he had contracted an intimate friendſhip.

Taſſo, who was now in his 45th year, appeared to Manſo, while they were at Biſaccio, to be affected with a melancholy, which had very ſingular effects; he therefore very frequently queſtioned him about them; and Taſſo told him that he had a familiar ſpirit, with whom he frequently and freely converſed. Manſo treated this as an illuſion, but Taſſo ſtill affirmed it to be real; and telling him that the ſpirit would meet and converſe with him the next day, invited him to be preſent. Manſo coming at the hour appointed, ſaw Taſſo fix his eyes with great earneſtneſs upon a window, and perceiving him to continue without motion, he called him ſeveral times by his name. Taſſo made no reply; but at length cried out with great vehemence, "There is the friendly ſpirit that is come to converſe with me; look, and be convinced that what I have ſaid is true." Manſo looked, not without ſome ſurpriſe, but ſaw nothing except the ſun beams which ſhone through the window. He was juſt going to aſk where the pretended ſpirit was, when he was prevented by Taſſo's ſpeaking with great earneſtneſs to ſome imaginary being, ſometimes putting queſtions, and ſometimes giving anſwers, in a manner ſo pleaſing, and with ſuch elevation of expreſſion, that Manſo had no deſire to interrupt him: the converſation at laſt ended by the ſuppoſed departure of the ſpirit; when Taſſo turning round to his friend, aſked if his doubts were removed? To which he made no reply, being ſo much amazed that he gladly waved all farther converſation on the ſubject.

Finding his law-ſuit not likely to be ſoon determined, he went from Naples to Rome, where he continued about a year in high favour with Pope Sextus Quintus; and then went to Florence, at the preſſing invitation of Ferdinando grand duke of Tuſcany, who had been cardinal at Rome when Taſſo firſt reſided there.

Having

Having spent about another year at Florence, he returned again to Naples; and there applied himself to correct his *Jerusalem Delivered*. Soon after the publication of this work, Hippolito Aldrobandini succeeded Sextus Quintus to the papacy, by the name of *Clement the VIIth;* and his two nephews, Cynthio and Pietro Aldrobandini, were created cardinals. Cynthio, who was a great patron of learning and genius, and had known Tasso when he last resided at Rome, prevailed with him once more to leave his retreat at Naples, and live with him in that city. Here he continued till his 50th year; and being then again weary of his situation, and desirous to prosecute his law-suit, he obtained permission to retire once more to Naples, where he took up his abode with the Benedictine fathers in the convent of St Severin. Cardinal Cynthio, however, found means to recal him again to Rome, after a very short absence, by having prevailed with the Pope to confer upon him the honour of being publicly and solemnly crowned with laurel in the Capitol.

He set out from Naples to receive this honour, with a presage that he should never return; and arrived at Rome in the beginning of the year 1595, being then about 51 years old: he was met at the entrance of the city by many prelates and persons of distinction, and was introduced by the two cardinals to the pope, who complimented him by saying, "That his merit would confer as much honour on the laurel he was about to receive, as the laurel had formerly conferred on others." Orders were immediately given to decorate not only the pope's palace and the Capitol, but all the principal streets through which the procession was to pass: but Tasso, whether from an habitual dejection of mind, or a secret sensation of the first approaches of a disease which he apprehended would be fatal, declared that all these pompous preparations would be in vain.

It happened, that while they were waiting for fair weather to celebrate the solemnity, cardinal Cynthio fell sick; and, before he was perfectly recovered, Tasso himself was taken ill, and died on the 15th day of his sickness, aged 51. His poems have acquired him an immortal reputation. The principal of them are, 1. Jerusalem Delivered. 2. Jerusalem Conquered. 3. Rinaldo. 4. The Seven Days of the Creation. 5. The Tragedy of Torimond. 6. Aminta, &c. All Tasso's works were printed together at Florence in 1724, in six volumes folio, with the pieces for and against his Jerusalem Delivered. A splendid edition of this last poem was printed at Venice in 1745, in folio. The best edition of Mirebaud's French translation is that of Paris in 1735, in two vols 12mo. His *Aminta* and *Gierusalemme Liberata* have been translated into English.

TASTE, a certain sensation, or class of sensations, excited in the mind by certain bodies, which are called *sapid*, applied to the tongue and palate, and moistened with the saliva. This is the original and proper meaning of the word *taste* (see METAPHYSICS, n° 46); but as the qualities of bodies which produce these sensations are unknown, they have in all languages got the names of the sensations themselves, by that figure of speech which substitutes the cause for the effect. Hence we talk of the tastes of sugar, wormwood, honey, vinegar, &c.; and say, that the taste of sugar is sweet and of vinegar sour. Tastes have been divided into simple and compound; and philosophers have to very little purpose endeavoured to ascertain the number of each species. Attempts have likewise been made to determine from their tastes the effects of different substances on the human body, taken into the stomach as food or physic; but by stating the results of the various inquiries, we should be more likely to mislead the unlearned reader, than to communicate useful information to readers of any description. Whoever is desirous of information on the subject may consult *Phil. Transf.* N° 280, 299; and *Abercromb. Nov. Med. Clavis*.

Taste.

TASTE is likewise used in a figurative sense, to denote that faculty of the mind by which we perceive and enjoy whatever is beautiful or sublime in the works of nature or of art. Like the taste of the palate, this faculty relishes some things, is disgusted with others, and to many is indifferent; and from these obvious analogies between it and the external sense it has obtained its name. It has likewise been called an internal *sense*, and by one philosopher * a *reflex sense*; whilst others have considered it, not as a distinct faculty or sense, but as the joint exertion of perception and judgment in some cases, and as a play of the imagination in others.

* Dr Hutcheson.

To decide among these different opinions, it will be necessary to ascertain, if we can, what are the objects of this faculty; for we hardly think that every thing which is beautiful, either in nature or art, can with propriety be called an object of taste. *Scarlet*, *blue*, *green*, and *yellow*, are all beautiful colours, and a *cube* and a *sphere* are beautiful figures; but it does not appear to us, that a man could be said to have either a good or a bad taste for relishing the perception of a *scarlet* more than that of a *yellow* colour, or a *spherical* more than a *cubical* figure. A native of Africa considers thick lips and a flat nose as essential to female beauty; whilst the inhabitant of Europe prefers to all other forms of the nose that which is called *Grecian*, and is disgusted with lips either very thick or very thin. But upon what principles can we say that the African has a bad, and the European a good, taste?

With respect to the objects of the external sense, we are generally so constituted by nature as to relish, in the highest degree, those kinds of food which are most wholesome; and such a taste, which we believe is always found in infants, is justly said to be sound and uncorrupted. It is in the highest perfection too at first; for it depends not upon culture of any kind, and is incapable of improvement. The reverse of all this is the case with respect to internal taste; of which the variety is obvious to the most careless observer, and is found, on examination, to be still greater in reality than it is in appearance. Every voice is indeed united in applauding elegance, propriety, simplicity, spirit in writing; and in blaming fustian, affectation, coldness, and a false brilliancy: but when critics come to particulars, this seeming unanimity vanishes; and it is found that they had affixed very different meanings to the same expressions. Perhaps no man ever attentively beheld the rising or the setting sun without feeling some emotions of pleasure which filled his mind; or went for the first time into such a building as the cathedral church of York, without being struck with a pleasing, though solemn, reverence. Yet it is certain, that the emotions of the clown, however acute he may be by nature, and perfect in all his faculties, are not the same, at least in degree, with those of the poet or philosopher when contemplating the rising or setting sun; or of the scientific mechanic when viewing the structure of the pillars and roof of the Gothic cathedral. We are not indeed sure that the pleasure of the clown on these occasions rises above that of mere sensation. Any bright and beautiful object presented to the eye, gives a pleasing sensation to the mind, in consequence of that peculiar agitation which such objects communicate to the optic nerves and the brain; and to us it appears, that the clown feels nothing more than this from the view of the rising sun or the magnificent church. Perhaps he may compare the sensations which he feels on these occasions with others which he has formerly felt in some degree similar to them, and have his pleasure heightened by the

exercise

Taste

exercise of that faculty of which the province is to judge upon comparison; but we have no reason to suppose, that from the rising sun he receives any emotions different in kind from what he would receive from a blazing heath, were it accompanied with the same varying tints of colour; or that the church impresses on his fancy more than that wonder with which he would view any other building equally large and equally novel, though of a form very different. In poetry and painting the vulgar are always delighted with the melody of the verse and the brilliancy of the colours; and think of nothing else as beauties, either in the one or in the other, unless the painting be the picture of some known object, and the poem describe scenes or actions in which they may be selfishly interested. Hence it is that the vulgar are more captivated by the splendor of the Venetian style of painting, than by the simple grandeur of the Roman and Bolognian Schools; for the art of the former, which has been carried to the highest degree of perfection, is to give pleasure to the eye or the sense; that of the latter is to fill the imagination. The powers exerted in the former school Sir Joshua Reynolds calls the *language* of painters, which he compares to an *empty tale told by an idiot, full of sound and fury, signifying nothing*. The compositions of the latter schools may be compared to the sublimity of Milton's sentiments, which would be disgraced by those petty ornaments to which it leaves not the reader at leisure to attend.

If this be so, the pleasures which the vulgar derive from what are called objects of taste are merely gratifications of the senses; or if any of these objects ever interest their higher faculties, it must be by inspiring them with confidence or dread; confidence of their own safety, for instance, if the building which they admire appear to them to be stable; and dread, if they have formed of it a contrary opinion. Very different is the pleasure which the man of cultivated taste derives from the beauties either of nature or of art: when he beholds the rising or the setting sun, he has indeed the pleasing sensation, which is all that the rude man feels; but along with this arises in his imagination a train of ideas, which hurries him beyond the object before him to its beneficent effects and its Almighty Creator: and if he has been much conversant with the works of descriptive poets, a number of pleasing ideas treasured up in his memory will, by the principle of association, pass in review before him, though they be not connected either with one another, or with the rising or setting sun, by a relation so close as that of cause and effect. In like manner, when the scientific architect views the Gothic cathedral, he must admire its solemn magnificence, though with less wonder than it excites in the breast of the clown; but he feels an additional pleasure, derived from a source to which the other has no access. He perceives the many contrivances displayed in its structure for uniting stability with lightness; and from contemplating the building, he is instantly led by a natural train of thought to admire the skill of the builder.

The nature of any person's taste, therefore, is generally determined from the character of his imagination and the soundness of his judgment. When any object either of sublimity or beauty is presented to the mind, every man is conscious of a train of thought being immediately awakened in his imagination, analogous to the character or expression of the original object. The simple perception of the object we frequently find is insufficient to excite these emotions, unless it is accompanied with this operation of mind; unless, according to common expression, our imagination is seized, and our fancy busied in the pursuit of all those trains of thought which are allied to this character or expression. Thus, when we feel either the beauty or sublimity of natural scenery, the gay lustre of a morning in spring, or the mild radiance of a summer evening, the savage majesty of a wintry storm, or the wild magnificence of a tempestuous ocean, we are conscious of a variety of images in our minds, very different from those which the objects themselves can present to the eye. Trains of pleasing or of solemn thought arise spontaneously within our minds; our hearts swell with emotions, of which the objects before us seem to afford no adequate cause; and we are never so much satiated with delight, as when, in recalling our attention, we are unable to trace either the progress or the connection of those thoughts which have passed with so much rapidity through our imagination.

If the mind is in such a state as to prevent this freedom of imagination, the emotion, whether of sublimity or beauty, is unperceived. In so far as the beauties of art or nature affect the external senses, their effect is the same upon every man who is in possession of these senses. But to a man in pain or in grief, whose mind by these means is attentive only to one object or consideration, the same scene or the same form will produce no feeling of admiration, which, at other times, when his imagination was at liberty, would have produced it in its fullest perfection. It is upon the vacant and the unemployed, accordingly, that the objects of taste make the strongest impression. It is in such hours alone that we turn to the compositions of music or of poetry for amusement. The seasons of care, of grief, or of business, have other occupations, and destroy, for the time at least, our sensibility to the beautiful or the sublime, in the same proportion that they produce a state of mind unfavourable to the indulgence of imagination.

There are many objects of taste, however, which produce not their full effect on the imagination, but through the medium of the judgment. We have given one instance in architecture, and shall give another in sculpture. The beauty of the Farnese Hercules is one kind of beauty; that of the gladiator in the palace of Chighi another; and that of the Apollo of Belvidere a third. Each of these figures is acknowledged to be perfect in its kind; and yet Sir Joshua Reynolds affirms, that the highest perfection of the human figure is not to be found in any one of them, but in that form which might be taken from them all, and would partake equally of the activity of the gladiator, of the delicacy of the Apollo, and of the muscular strength of the Hercules. If the judgment of this eminent artist be admitted, the perfection of these statues cannot consist in any thing which is the immediate object of sense, either external or internal; but in something which, being perceived by the eye, is referred by the understanding to what we know of the characters of Hercules, Apollo, and the Gladiator, and which we believe it was the intention of the statuaries to express. Nay, there are objects of which taste is sometimes said to judge, though they have little or no effect whatever on the imagination. A book of abstract science, written in a prolix and intricate style, might be said to be in a bad taste; and had Swift, in his clear and simple style, written *An Essay on the Human Understanding*, his work, supposing him master of the subject, would undoubtedly have displayed more taste than Locke's, in which the terms are sometimes vague, and the periods often incumbered. This is actually the case of Berkeley, whom every man admits to have been a writer of good taste, though neither *The Principles of Human Knowledge*, *The Dialogues on Matter*, nor the beautiful work intitled *The Minute Philosopher*, is capable of affording pleasure to the senses or the imagination. His beauty consists merely in the perspicuity of his style, of which the understanding alone is the judge. The metaphysical

phyſical writings of Dr Reid poſſeſs in an eminent degree the ſame beauty; and no man of true taſte can read them without admiring the elegant ſimplicity of the compoſition as much as the ſtrength of the reaſoning, and feeling from the whole a pleaſure which the poetical ſtyle of Shafteſbury cannot communicate.

If this be a juſt account of the pleaſures of taſte, that faculty cannot be properly conſidered as a mere internal ſenſe, ſince to its enjoyments a well-ſtored fancy is neceſſary in ſome caſes, and the reaſoning power in all; and the poet and the painter who wiſh to excel in their reſpective profeſſions, muſt not content themſelves, the one with filling the ear of the reader with mellifluous ſounds, and the other with dazzling or deceiving the eye of the ſpectator by the brilliancy of his colours, but both muſt ſtrive for fame by captivating the imagination; whilſt the architect, who aſpires to a ſimilar celebrity, muſt make the purpoſe of his ornaments obvious to every perſon capable of judging. The landſcapes of Claude Lorrain, the muſic of Handel, the poetry of Milton, excite feeble emotions in our minds, when our attention is confined to the qualities they preſent to our ſenſes, or when it is to ſuch qualities of their compoſition that we turn our regard. It is then only we feel the ſublimity or beauty of their productions, when our imaginations are kindled by their power, when we loſe ourſelves amid the number of images that paſs before our minds, and when we waken at laſt from this play of fancy as from the charm of a romantic dream.

It is well obſerved by Sir Joſhua Reynolds*, that taſte is ſometimes praiſed in ſuch terms by orators and poets, who call it *inſpiration*, and *a gift from heaven*, that though a ſtudent by ſuch praiſe may have his attention rouſed, and a deſire excited of obtaining this gift, he is more likely to be deterred than encouraged in the purſuit of his object. "He examines his own mind, and perceives *there* nothing of that divine inſpiration with which he is told ſo many others have been favoured. He never travelled to heaven to gather new ideas; and he finds himſelf poſſeſſed of no other qualifications than what mere common obſervation and a plain underſtanding are able to confer. Thus he becomes gloomy amidſt the ſplendour of figurative declamation, and thinks it hopeleſs to purſue an object which he ſuppoſes out of the reach of human induſtry. But on this, as on many other occaſions, we ought to diſtinguiſh how much is to be given to enthuſiaſm, and how much to common ſenſe; taking care not to loſe in terms of vague admiration that ſolidity and truth of principle upon which alone we can reaſon." Whoever poſſeſſes the ordinary powers of perception, ſenſibility of heart, good ſenſe, and an imagination capable of being rouſed by the ſtriking objects of nature and of art, may, without inſpiration, become, by mere experience, a man of fine taſte in the objects of which he aſpires to be a critical judge.

This being the caſe, we may eaſily account for the variety of taſtes which prevail among men, not only as individuals but as nations. We have already mentioned the difference in one inſtance between the European taſte and the African reſpecting female beauty; and we may now affirm, as we hope to prove our affirmation, that the one taſte is equally correct with the other. The charms of female beauty exiſt not in the mere external form and colour conſidered by themſelves (for then the inanimate ſtatue of the Venus de Medicis would give more delight to the European beholder than the fineſt woman that ever lived); but we aſſociate external beauty with ſweetneſs of diſpoſition, and with all the train of endearments which take place in the union of the ſexes; and it is this aſſociation which delights the man of taſte, as giving refinement to an appetite which in itſelf is groſs and ſenſual. A ſimilar aſſociation muſt be formed in the breaſt of the African who has any taſte; and as he never knew feminine ſoftneſs, or any of the endearing qualities of the ſex, but as united with thick lips, a flat noſe, a black ſkin, and woolly hair—a ſable beauty of that deſcription muſt excite in his breaſt the ſame emotions that are excited in the breaſt of an European by the fair woman with Grecian features.

But is there not an ideal or perfect beauty of the human form? There certainly is, as of every other natural object; but it cannot be the ſame in Europe as in Africa, unleſs to a Being who is acquainted with all the peculiarities of form, national and individual, that are to be found among the inhabitants of the whole earth. It has been ſuppoſed, and we think completely proved, by one of the beſt writers that we have on the philoſophy of taſte*, that the ſublimity or beauty of forms ariſes altogether from the aſſociations we connect with them, or the qualities of which they are expreſſive to us. The qualities expreſſed by the male and female forms are very different; and we would by no means think the woman beautiful who ſhould have the form of the Farneſe Hercules, or admire the ſhapes of the hero who ſhould be formed like the Venus de Medicis; becauſe the proportions of ſuch a woman would indicate ſtrength and intrepidity, where we wiſh to find only gentleneſs and delicacy; and the delicate form of the hero would indicate ſoftneſs and effeminacy, where the oppoſite qualities only can be eſteemed. As we aſſociate with the female form many deſirable qualities, every woman is eſteemed more or leſs beautiful as her figure and features indicate a greater or ſmaller number of theſe qualities; and the ſame is the caſe with reſpect to the qualities which adorn the male character, and the form and features by which they are expreſſed. Upon comparing a number of human beings with one another, we find, that with reſpect to every feature and limb, there is one central form to which nature always tends, though ſhe be continually deviating from it on the right hand and on the left: (See Nose). This form therefore is conſidered as the moſt perfect form of the ſpecies, and moſt expreſſive of the qualities for which that ſpecies is valued; but in Africa, the central form, with reſpect to the proportions of the human body and the features of the human face, is very different from what it is in Europe; and therefore the ideal or perfect beauty of the human form and features cannot be the ſame in both countries. No doubt, if a man could examine the limbs and features of every individual of the human race, he would diſcover one central form belonging to the whole, and be led to eſteem it the ſtandard of beauty; but as this is obviouſly impoſſible, the common idea or central form belonging to each great claſs of mankind muſt be eſteemed the ſtandard of beauty in that claſs, as indicating moſt completely the qualities for which individuals are eſteemed. Thus there is a common form in childhood and a common form in age; each of which is the more perfect as it is the more remote from peculiarities: but though age and childhood have ſomething in common, we ſhould not deem the child beautiful who was formed exactly like the moſt handſome man, nor the man handſome who was formed exactly like the moſt beautiful child. This doctrine is well illuſtrated by Sir Joſhua Reynolds*, who has applied it to every object eſteemed beautiful in nature; and proved, that the ſuperiority of Claude Lorrain over the landſcape-painters of the Dutch and Flemiſh ſchools, ariſes chiefly from his having generalized his conceptions, and formed his pictures by compounding together the various draughts which he had previouſly made from various beautiful ſcenes and proſpects. "On the whole (ſays he), it ſeems to me that there is but one preſiding principle which regulates and

* Mr Aliſon.

Taſte.

gives ſtability to every art. The works, whether of poets, painters, moraliſts, or hiſtorians, which are built upon general nature, live for ever; while thoſe which depend for their exiſtence on particular cuſtoms and habits, a particular view of nature, or the fluctuation of faſhion, can only be coeval with that which firſt raiſed them from obſcurity. All the individual objects which are exhibited to our view by nature, upon cloſe examination, will be found to have their blemiſhes and defects. The moſt beautiful forms have ſomething about them like weakneſs, minuteneſs, or imperfection. Yet it is not every eye that perceives theſe blemiſhes: It muſt be an eye long uſed to the contemplation and compariſon of theſe forms; which alone can diſcern what any ſet of objects of the ſame kind has in common, and what each wants in particular."

From theſe reaſonings the ſame great artiſt concludes, that the man who is ambitious of the character of poſſeſſing a correct taſte, ought to acquire a "habit of comparing and digeſting his notions. He ought not to be wholly unacquainted with that part of philoſophy which gives him an inſight into human nature, and relates to the manners, characters, paſſions, and affections. He ought to know *ſomething* concerning the *mind*, as well as a great deal concerning the *body*, and the various external works of nature and of art; for it is only the power of diſtinguiſhing right from wrong that is properly denominated *taſte*.

"Genius and taſte, in their common acceptation, appear to be very nearly related; the difference lies only in this, that genius has ſuperadded to it a habit or power of execution. Or we may ſay, that taſte, when this power is added, changes its name, and is called *genius*. They both, in the popular opinion, pretend to an entire exemption from the reſtraint of rules. It is ſuppoſed that their powers are intuitive; that under the name of *genius* great works are produced, and under the name of *taſte* an exact judgment is given, without our knowing why, and without being under the leaſt obligation to reaſon, precept, or experience.

"One can ſcarce ſtate theſe opinions without expoſing their abſurdity; yet they are conſtantly in the mouths of men, and particularly of illiterate and affected connoiſſeurs. The natural appetite, or taſte of the human mind, is for *truth;* whether that truth reſults from the real agreement or equality of original ideas among themſelves, from the agreement of the repreſentation of any object with the thing repreſented, or from the correſpondence of the ſeveral parts of any arrangement with each other. It is the very ſame taſte which reliſhes a demonſtration in geometry, that is pleaſed with the reſemblance of a picture to an original, and touched with the harmony of muſic.

"But beſides *real,* there is alſo *apparent* truth, or opinion, or prejudice. With regard to real truth, when it is known, the taſte which conforms to it is and muſt be uniform. With regard to the ſecond ſort of truth, which may be called *truth upon ſufferance*, or *truth by courteſy*, it is not fixed but variable. However, whilſt theſe opinions and prejudices on which it is founded continue, they operate as truth; and the art, whoſe office it is to pleaſe the mind as well as inſtruct it, muſt direct itſelf according to *opinion*, or it will not attain its end. In proportion as theſe prejudices are known to be generally diffuſed or long received, the taſte which conforms to them approaches nearer to certainty, and to a ſort of reſemblance to real ſcience, even where opinions are found to be no better than prejudices. And ſince they deſerve, on account of their duration and extent, to be conſidered as really true, they become capable of no ſmall degree of ſtability and determination by their permanent and uniform nature.

"Of the judgment which we make on the works of art, and the preference that we give to one claſs of art over another, if a reaſon be demanded, the queſtion is perhaps evaded by anſwering, I judge from my taſte; but it does not follow that a better anſwer cannot be given, though for common gazers this may be ſufficient. Every man is not obliged to inveſtigate the cauſes of his approbation or diſlike. The arts would lie open for ever to caprice and caſualty, if thoſe who are to judge of their excellencies had no ſettled principles by which they are to regulate their deciſions, and the merit or defect of performances were to be determined by unguided fancy. And indeed we may venture to aſſert, that whatever ſpeculative knowledge is neceſſary to the artiſt, is equally and indiſpenſably neceſſary to the critic and the connoiſſeur.

"The firſt idea that occurs in the conſideration of what is fixed in art or in taſte, is that preſiding principle which we have already mentioned, the general idea of nature. The beginning, the middle, and the end of every thing that is valuable in taſte, is compriſed in the knowledge of what is truly nature; for whatever ideas are not conformable to thoſe of nature or univerſal opinion, muſt be conſidered as more or leſs capricious; the idea of nature comprehending not only the forms which nature produces, but alſo the nature and internal fabric and organization, as I may call it, of the human mind and imagination. General ideas, beauty, or nature, are but different ways of expreſſing the ſame thing, whether we apply theſe terms to ſtatues, poetry, or picture. Deformity is not nature, but an accidental deviation from her accuſtomed practice. This general idea therefore ought to be called *nature;* and nothing elſe, correctly ſpeaking, has a right to that name. Hence it plainly appears, that as a work is conducted under the influence of general ideas, or partial, it is principally to be conſidered as the effect of a good or a bad taſte."

Upon the whole, we may conclude that the real ſubſtance, as it may be called, of what goes under the name of *taſte*, is fixed and eſtabliſhed in the nature of things; that there are certain and regular cauſes by which the imagination and paſſions of men are affected; and that the knowledge of theſe cauſes is acquired by a laborious and diligent inveſtigation of nature, and by the ſame ſlow progreſs as wiſdom or knowledge of every kind, however inſtantaneous its operations may appear when thus acquired. A man of real taſte is always a man of judgment in other reſpects; and thoſe inventions which either diſdain or ſhrink from reaſon, are generally more like the dreams of a diſtempered brain than the exalted enthuſiaſm of a ſound and true genius. In the midſt of the higheſt flights of fancy or imagination, reaſon ought to preſide from firſt to laſt; and he who ſhall decide on the beauties of any one of the fine arts by an imaginary innate ſenſe or feeling, will make as ridiculous an appearance as the connoiſſeur mentioned by Dr Moor, who praiſed as a work of the divine Raphael the wretched daubing by a Swiſs copyiſt. The reader who wiſhes for further inſtruction in the philoſophy of taſte, may conſult Gerard's Eſſay on Taſte, with the diſſertations of Voltaire, d'Alembert, and Monteſquieu; Dr Blair's Lectures on the Belles Lettres; Dr Reid's Eſſays on the Intellectual Powers of Man; Aliſon's Eſſays on the Nature and Principles of Taſte; and Sir Joſhua Reynold's Diſcourſes delivered in the Royal Academy.

TATE (Nahum), an Engliſh poet, born about the middle of the reign of Charles II. in Ireland, where he received his education. He was made poet-laureat to King William upon the death of Shadwell, and held that place until the reign of George I. whoſe firſt birth-day ode he

lived to write, and executed it with unusual spirit. He died in the mint in 1716, and was succeeded in the laurel by Mr Eusden. He was the author of nine dramatic performances, a great number of poems, and a version of the Psalms in conjunction with Dr Nicholas Brady.

TATIAN, a writer of the primitive church in the second century. He was born in Assyria, and trained up in the heathen religion and learning. Coming over to Christianity, he became the disciple of Justin Martyr, whom he attended to Rome. While Justin lived, he continued steadily orthodox: but after Justin's death he made a schism, and became the author of a new sect, condemning marriage, enjoining abstinence from wine and animal-food, and suffering only water to be used in the holy mysteries; whence his followers were called *Encratitæ* and *Hydroparastatæ*. None of his works are now extant but his piece against the Gentiles; or, as it is usually intitled, his *Oration to the Greeks*.

TATIUS (Achilles), a native of Alexandria, was the author of a book on the sphere, which father Petau translated into Latin. There is also attributed to him a Greek romance on the loves of Leucippe and Clitophon, of which Salmasius has given a beautiful edition in Greek and Latin, with notes. Suidas says, that this Achilles Tatius was a Pagan, but that he afterwards embraced the Christian religion, and became a bishop. Photius mentions him in his Bibliotheca.

TATONNEUR, in zoology. See LEMUR.

TATTOOING, or TATTOWING, an operation in use among the islanders in the South Sea for marking their bodies with figures of various kinds which they consider as ornamental. It is performed by puncturing the skin, and rubbing a black colour into the wounds. The instrument used somewhat resembles a comb, the teeth of which are repeatedly struck into the skin by means of a small mallet. It is very painful; but the children are forced by their relations to submit to it.

TATTOO, a beat of a drum at night to advertise the soldiers to retreat, or repair to their quarters in the garrison, or to their tents in a camp.

TAVERNIER (John Baptist), a famous French traveller, was born in 1605. In the course of 40 years he travelled six times to Turkey, Persia, and the East Indies, and visited all the countries in Europe, travelling mostly on foot. His travels have been frequently reprinted in six vols 12mo. He died on his seventh journey to the east, at Moscow, in 1689.

TAVIRA, or TAVILA, a considerable town of Portugal, and capital of the province of Algarve, with a handsome castle, and one of the best harbours in the kingdom, defended by a fort. It is seated in a pleasant fertile country, at the mouth of the river Gilaon, between Cape Vincent and the Strait of Gibraltar, 100 miles west by north of Cadiz. W. Long. 7. 46. N. Lat. 37. 18.

TAVISTOCK, a town of Devonshire in England, situated on the river Tavey or Tave, W. Long. 4. 12. N. Lat. 50. 37. It sends two members to parliament, and gives the title of *marquis* to the noble family of Russel duke of Bedford.

TAUNTON, a large, elegant, and well built town of Somersetshire, 146 miles from London. It consists principally of four streets paved and lighted; the market-place is spacious, and has a handsome market-house, with a town hall over it, which was finished in 1773. It has an extensive woollen manufactory; and in 1780 a silk manufactory was introduced. Its castle, the ruins of which remain, was in 1645 defended for the parliament by colonel Blake against an army of 10,000 men under lord Goring, but was dismantled by Charles II. In 1685 the duke of Monmouth made this place his head quarters. Its church, which is large and beautiful, is a fine specimen of the florid Gothic style of architecture. The tower, which is lofty, is of excellent workmanship, crowned at the top with four stately pinnacles, 32 feet high. The whole perhaps is not equalled in the kingdom. Taunton is pleasantly seated on the river Tone, which is navigable to Bridgewater; is reckoned the best town in the county; and sends two members to parliament. W. Long. 3. 17. N. Lat. 50. 59.

TAURIS, or TEBRIS, a town of Persia, and capital of Aderbeitzan. It was formerly the capital of Persia, and is now the most considerable next to Ispahan; for it contains 15,000 houses, besides many separate shops, and about 200,000 inhabitants. It is about five miles in circumference, and carries on a prodigious trade in cotton, cloth, silks, gold and silver brocades, fine turbans, and shagreen leather. There are 300 caravanseras, and 250 mosques. Some travellers suppose it to be the ancient Echatana; but of this there is no certainty. It is seated in a delightful plain, surrounded with mountains, from whence a stream issues, which runs through the city. E. Long. 47. 50. N. Lat. 38. 18.

TAURUS, a great chain of mountains in Asia, which begin at the eastern part of Little Carimania, and extend very far into the India. In different places they have different names.

TAURUS, in astronomy, one of the 12 signs of the zodiac.

TAUTOLOGY, a needless repeating of the same thing in different words.

TAWING, the art of dressing skins in white, so as to be fit for divers manufactures, particularly gloves, &c.

All skins may be tawed; but those chiefly used for this purpose are lamb, sheep, kid, and goat skins.

The method of tawing is this: Having cleared the skins of wool or hair by means of lime, they are laid in a large vatt of wood or stone, set on the ground full of water, in which quicklime has been slacked; wherein they are allowed to lie a month or six weeks, according as the weather is more or less hot, or as the skins are required to be more or less soft and pliant.

While they are in the vatt, the water and lime is changed twice, and the skins are taken out and put in again every day: and when they are taken out for the last time, they are laid all night to soak in a running water, to get out the greatest part of the lime; and in the morning are laid together by sixes one upon another, upon a wooden leg, and are scraped stoutly one after another, to get the flesh off from the fleshy side, with a cutting two-handled instrument called a *knife*; and then they cut off the legs (if they are not cut off before) and other superfluous parts about the extremes. Then they are laid in a vatt or pit with a little water, where they are fulled with wooden pestles for the space of a quarter of an hour; and then the vatt is filled up with water, and they are rinsed in it.

In the next place, they are thrown on a clean pavement to drain, and afterwards cast into a fresh pit of water, out of which they take them well, and are laid again on the wooden leg, six at a time, with the hair side outermost: over which they rub a kind of whetstone very briskly, to soften and fit them to receive four or five more preparations, given them on the leg both on the flesh side and the hair-side, with the knife, after the manner above mentioned.

After this they are put into a pit of water and wheaten-bran, and stirred about in it with wooden poles, till the bran is perceived to stick to them, and then they are left: as they rise of themselves to the top of the water by a kind of fermentation, they are plunged down again to the bottom; and at the same time fire is set to the liquor, which burns as

Tawing, Tax. eaſily as if it were brandy, but goes out the moment the ſkins are all covered.

They repeat this operation as often as the ſkins riſe above the water; and when they have done riſing they take them out, lay them on the wooden leg, the fleſhy ſide outwards, and paſs the knife over them to ſcrape off the bran.

Having thus cleared them of the bran, they lay the ſkins in a large baſket, and load them with huge ſtones to promote their draining: and when they have drained ſufficiently, they give them their feeding; which is performed after the manner following:

For 100 of large ſheep ſkins, and for ſmaller in proportion, they take eight pounds of alum and three of ſea-ſalt, and melt the whole with water in a veſſel over the fire, pouring the ſolution out, while yet lukewarm, into a kind of trough, in which is twenty pounds of the fineſt wheat-flower, with the yolks of eight dozen of eggs; of all which is formed a kind of paſte, a little thicker than children's pap; which, when done, is put into another veſſel, to be uſed in the following manner.

They pour a quantity of hot water into the trough in which the paſte was prepared, mixing two ſpoonfuls of the paſte with it; to do which they uſe a wooden ſpoon, which contains juſt as much as is required for a dozen of ſkins: and when the whole is well diluted, two dozen of the ſkins are plunged into it; but they take care that the water be not too hot, which would ſpoil the paſte and burn the ſkins.

After they have lain ſome time in the trough they take them out, one after another, with the hand, and ſtretch them out; this they do twice: and after they have given them all their paſte, they put them into tubs, and there full them afreſh with wooden peſtles.

Then they put them into a vatt, where they are ſuffered to lie for five or ſix days, or more; then they take them out in fair weather, and hang them to dry on cords or racks: and the quicker they are dried the better; for if they be too long a-drying, the ſalt and alum within them are apt to make them riſe in a grain, which is an eſſential fault in this kind of dreſſing.

When the ſkins are dry, they are made up into bundles, and juſt dipt in fair water, and taken out and drained: they are then thrown into an empty tub; and after having lain ſome time are taken out and trampled under foot.

Then they draw them over a flat iron inſtrument, the top of which is round like a battledore, and the bottom fixed into a wooden block, to ſtretch and open them; and having been opened, they are hung in the air upon cords to dry; and being dry, they are opened a ſecond time, by paſſing them again over the ſame inſtrument.

In the laſt place, they are laid on a table, pulled out, and laid ſmooth, and are then fit for ſale.

TAX (*Taxa*, from the Greek [illegible], i. e. *ordo*, *tributum*), a tribute or impoſition laid upon the ſubject for the ſupport of government. See REVENUE.

It is the ancient indiſputable privilege and right of the houſe of commons, that all grants of ſubſidies or parliamentary aids do begin in their houſe, and are firſt beſtowed by them; although their grants are not effectual to all intents and purpoſes until they have the aſſent of the other two branches of the legiſlature. See COMMONS. The general reaſon given for this excluſive privilege of the houſe of commons is, that the ſupplies are raiſed upon the body of the people, and therefore it is proper that they alone ſhould have the right of taxing themſelves. This reaſon would be unanſwerable, if the commons taxed none but themſelves: but it is notorious, that a very large ſhare of property is in the poſſeſſion of the houſe of lords; that this property is equally taxable, and taxed, as the property of the commons; and therefore the commons, not being the ſole perſons taxed, this cannot be the reaſon of their having the ſole right of raiſing and modelling the ſupply. The true reaſon, ariſing from the ſpirit of our conſtitution, ſeems to be this. The lords being a permanent hereditary body, created at pleaſure by the king, are ſuppoſed more liable to be influenced by the crown, and when once influenced to continue ſo, than the commons, who are a temporary elective body, freely nominated by the people. It would therefore be extremely dangerous to give the lords any power of framing new taxes for the ſubject; it is ſufficient that they have a power of rejecting, if they think the commons too laviſh or improvident in their grants. But ſo reaſonably jealous are the commons of this valuable privilege, that herein they will not ſuffer the other houſe to exert any power but that of rejecting. They will not permit the leaſt alteration or amendment to be made by the lords to the mode of taxing the people by a money-bill: under which appellation are included all bills by which money is directed to be raiſed upon the ſubject, for any purpoſe or in any ſhape whatſoever; either for the exigencies of government, and collected from the kingdom in general, as the land-tax; or for private benefit, and collected in any particular diſtrict, as by turnpikes, pariſh-rates, and the like. Yet Sir Matthew Hale mentions one caſe, founded on the practice of parliament in the reign of Henry VI. wherein he thinks the lords may alter a money-bill: and that is, if the commons grant a tax, as that of tonnage and poundage, for four years; and the lords alter it to a leſs time, as for two years: here, he ſays, the bill need not be ſent back to the commons for their concurrence, but may receive the royal aſſent without farther ceremony; for the alteration of the lords is conſiſtent with the grant of the commons. But ſuch an experiment will hardly be repeated by the lords, under the preſent improved idea of the privilege of the houſe of commons; and, in any caſe where a money-bill is remanded to the commons, all amendments in the mode of taxation are ſure to be rejected.

The commons, when they have voted a ſupply to his majeſty, and ſettled the *quantum* of that ſupply, uſually reſolve themſelves into what is called *a committee of ways and means*, to conſider the ways and means of raiſing the ſupply ſo voted. And in this committee every member (though it is looked upon as the peculiar province of the chancellor of the exchequer) may propoſe ſuch ſcheme of taxation as he thinks will be leaſt detrimental to the public. The reſolutions of this committee (when approved by a vote of the houſe) are in general eſteemed to be (as it were) final and concluſive. For though the ſupply cannot be actually raiſed upon the ſubject till directed by an act of the whole parliament, yet no monied man will ſcruple to advance to the government any quantity of ready caſh, on the credit of a bare vote of the houſe of commons, though no law be yet paſſed to eſtabliſh it.

The taxes which are raiſed upon the ſubject are either annual or perpetual.

I. The uſual annual taxes are thoſe upon land and malt. See LAND and MALT.

II. The perpetual are, 1. The cuſtoms. 2. The exciſe-duty. 3. The ſalt-duty. 4. The poſt-office. 5. The ſtamp-duty. 6. Houſe and window duty. 7. The duty on hackney-coaches and chairs. 8. That on offices and penſions.—See the articles CUSTOMS, EXCISE, POST, STAMP, HOUSE, HACKNEY, and *OFFICES and Penſions*.

As to the application of all theſe, see the articles REVENUE, *NATIONAL Debt*, FUNDS, and *Civil LIST*.

TAXATION. See REVENUE, TAX, and *Feodal System*.

TAXUS, the YEW TREE, in botany: A genus of plants belonging to the class of *diœcia*, and order of *monadelphia*; and in the natural system ranging under the 51st order, *Coniferæ*. The male calyx is triphyllous, gemmaceous, and imbricated: there is no corolla; the stamina are numerous; the antheræ peltated and octofid. The female calyx resembles the male; there is no corolla nor style, and only one seed with a calycle resembling a berry very entire. There are only two species mentioned by Linnæus, the baccata and nucifera. M. Sonnerat has added a third, called *capensis*; and Sir Charles Thunberg has inserted two more, the macrophylla and verticellata, in his *Flora Japonica*.

The *baccata*, or common yew tree, is a native of Britain, France, Switzerland, &c. and of North America. It is distinguished from the other species by linear leaves which grow very close, and by the receptacles of the male flowers being subglobose. The wood is reddish, full of veins, and flexible, very hard and smooth, and almost incorruptible. Its hardness renders it very proper for turners and cabinet-makers. It produces berries which are red, mucilaginous, and have a sweet mawkish taste. They are often eaten by birds, and are therefore not poisonous: But it is a common opinion that the leaves are poisonous to cattle, and many facts are mentioned of horses and cows having died by eating them. Others, however, deny these facts. It is found in several parts of the Highlands of Scotland in a wild state. At Glenlure, near Glen-Creran, in Upper Lorn, are the remains of an old wood of it. The place takes its name from the trees which grow in it; for *Glenlure* in the Gaelic language is no other than a corruption of *Gleaniuir*, *i. e.* "the valley of yew trees." It is of no great height, but the trunk grows to a large size. Mr Pennant has taken notice of a very remarkable decayed one in Fortingal church-yard, the remains of which measured 56 feet and an half in circumference.

The yew is at present almost peculiar to church-yards; hence some naturalists suspect that it is an exotic. Several reasons have been assigned for its frequency in church-yards. The first is, that before the invention of gunpowder the warrior might never be at a loss for a bow. This is an opinion for which we have found no historical evidence; and till some be produced it is considered merely as a conjecture. There are several laws enacted by our forefathers for encouraging archery, but none of them mention the cultivation of the yew. The bows used in England were indeed made frequently of yew, but it was yew of foreign growth. In the reign of Elizabeth, a bow of the best foreign yew sold for 6s. 8d. while one made of English yew sold only for 2s. In 12 Edw. IV. it was ordained that every foreign merchant that should convey any goods from any country from which bow-staves had formerly been brought to this country, should for every ton of goods bring four bow-staves. A similar law was framed in the time of Richard III. It appears therefore that the church-yards did not supply the nation with bows.

A second opinion concerning the introduction of yew trees into church-yards is, that they were intended to defend the church against storms. But there are many other trees that would have answered this purpose much better; for the yew is of so slow a growth, that it would be long before it could be of any service at all, and is so low that it could never be a sufficient shelter. A third opinion is, that being an evergreen, it is an emblem of immortality. This is a pretty idea; but the misfortune is, that yew is always considered as a tree of baleful influence. This opinion is as old as Statius, who says, *metuenda succo taxus*. A fourth opinion is, that when anciently it was the custom, as it still is in Catholic countries, to carry palms on Palm Sunday, the yew was substituted on such occasions for the palm. Two or three trees, the usual number growing in church-yards, were sufficient for such purposes. This is the only opinion which receives any countenance from history. The following extract from Caxton's Direction for keeping Feasts all the Year, printed in 1483, will probably be considered as decisive on this subject. It is taken out of the lecture for Palm-Sunday; where the writer, after giving the scriptural account of our Saviour's triumphant entrance into Jerusalem, proceeds thus: "Wherefore holy chirche this day makyth solempne processyon, in mynde of the processyon that Cryst made this day. But for encheson that we have non olyue that berith grene leef, algate therefore *we take ewe instede of palme and olyve*, and beren about in processyon, and so is thys day callyd Palme Sonday." As a confirmation of this fact, we may add, that the yews in the church-yards of East Kent are at this day called *palms*.

TAY, called by the Romans *Tavus* or *Taus*, the largest river in Scotland. It rises in Braidalbane, on the frontiers of Lorn; and having in the passage of a few miles augmented its stream by the accession of several small rills, spreads itself into a lake called *Loch Dochart*; out of which having run but a little space, it expands itself again. Leaving this second lake, it rolls some miles with a considerable body of water, and then diffuses itself abroad in the spacious Loch Tay; which, reckoning from the source of the river, is 24 miles in length, though, strictly speaking, the lake is but 13: almost as soon as it issues from hence, it receives the river Lyon, coming out of Loch Lyon, and running through Glen Lyon; which, having travelled in a manner parallel to it, from its source, for a space of 25 miles, at length joins the Tay as it enters Athol, which it next traverses, and, directing its course in a manner due east, receives almost all the waters of that country. Bending then to the south, at the distance of six miles, it reaches Dunkeld; which, in the language of our ancestors, signifies "the hill of hazels," was the very centre of the old Caledonia, and is at present esteemed the heart of the Highlands. The river is very broad here, insomuch that there is a ferry-boat over it at each end of the town. Declining still to the south-east, with a winding course, for above 12 miles, the Tay receives a large supply of waters from the county of Angus; and then running south-west for eight miles more, is joined in that space by several rivers, the most considerable of which is the Almond. Turning then to the south east, at the distance of about three miles, this copious river comes with a swelling stream to Perth, or St Johnston's, which is the capital of the shire of that name.

The Tay, continuing still a south-east course, receives, a few miles below Perth, the river Erne; which, issuing from a loch of the same name, traverses the county of Strathern, and passes by Abernethy, once the capital of the Pictish kingdom; swelled by the waters of this last river, the Tay, running next directly east, enlarges itself till it becomes about three miles broad; but contracts again before the town of Dundee; soon after which it opens into the German ocean. At the entrance of the frith, there are sands both on the north and on the south side: the former styled *Goa*, the latter *Aberlay* and *Drumlan*: and before these, in the very mouth of the frith, those which are called the *Cross Sands*. At Buttonness, which is the northern promontory, there are two light-houses. The space between the north and the south sands may be near a mile, with about three fathoms water; but being within the frith, it grows deeper, and in the road of Dundee is full six fathoms. The frith

Taylor.

of Tay is not indeed ſo large or ſo commodious as that of Forth, but from Buttomels to Perth it is not leſs than 40 miles; and the whole may be, without any great impropriety, ſtyled a harbour, which has Fife on one ſide, and the ſhires of Perth and Angus on the other, both very fertile and pleaſant countries.

TAYLOR (Dr Jeremy), biſhop of Down and Connor in Ireland, was the ſon of a barber at Cambridge, and there had his education. Upon entering into orders, he became divinity lecturer of St Paul's in London; and was, by the intereſt of archbiſhop Laud, elected fellow of All ſoul's college, Cambridge, in 1636. Two years after he became one of the chaplains of the archbiſhop, who beſtowed on him the rectory of Uppingham in Rutlandſhire. In 1642 he was chaplain to the king; and a frequent preacher before him and the court at Oxford. He afterward attended in the king's army in the condition of a chaplain. Upon the declining of his majeſty's cauſe, he retired into Wales, where he was permitted to officiate as miniſter, and to keep a ſchool, in order to maintain himſelf and his children. In this retirement he wrote ſeveral of his works. Having ſpent ſeveral years there, his family was viſited with ſickneſs; and he loſt three ſons of great hopes within the ſpace of two or three months. This affliction touched him ſo ſenſibly, that it made him deſirous to leave the country; and, going to London, he for a time officiated in a private congregation of loyaliſts to his great hazard. At length meeting with Edward lord Conway, that nobleman carried him over with him into Ireland, and ſettled him at Portmore, where he wrote his *Ductor Dubitantium*. Upon the Reſtoration he returned to England; ſoon after, he was advanced to the biſhopric of Down and Connor in Ireland; and had the adminiſtration of the ſee of Dromore granted to him. He was likewiſe made privy-counſellor and vice-chancellor of the univerſity of Dublin; which place he held till his death. He died of a fever at Lisnegarvy in 1667, and was interred in a chapel which he himſelf had built on the ruins of the old cathedral of Dromore.

TAYLOR (Dr Brook), was born at Edmonton, Auguſt 18th 1685. He was the ſon of John Taylor, Eſq; of Biffron's-houſe in Kent, by Olivia, daughter of Sir Nicholas Tempeſt, of Durham, Baronet. His grandfather, Nathaniel Taylor, was one of thoſe puritans whom "Cromwell thought fit to elect by a letter, dated June 14th 1653, to repreſent the county of Bedford in parliament." The character of his father partook in no ſmall degree of the auſterity that had been tranſmitted to him in the line of his anceſtors, and by the ſpirit of the times in which they lived; and to this cauſe may be aſcribed the diſaffection which ſometimes ſubſiſted between the father and even ſuch a ſon as is the ſubject of this article. The old gentleman's moroſe temper, however, yielded to the powers of muſic; and the moſt eminent profeſſors of the art in that period were hoſpitably welcomed in his houſe. His ſon Brook was induced, by his natural genius, and by the diſpoſition of his father, which he wiſhed by all the means in his power to conciliate, to direct his particular attention to muſic; and he became in very early life a diſtinguiſhed proficient in it.— "In a large family-piece, he is repreſented at the age of 13 ſitting in the centre of his brothers and ſiſters; the two elder of whom, Olivia and Mary, crown him with laurel, bearing the inſignia of harmony."

To muſic he added another accompliſhment, in which he equally excelled. "His drawings and paintings, of which ſome are ſtill preſerved, require not thoſe allowances for error or imperfection with which we ſcan the performances of even the ſuperior *dilettanti*:—they will bear the teſt of ſcrutiny and criticiſm from artiſts themſelves, and thoſe of the firſt genius and profeſſional abilities." Though he was eminent in the culture and practice both of muſic and drawing in his early youth, his whole attention was not occupied by theſe faſcinating arts. His claſſical education was conducted at home under a private tutor; and his proficiency in the ordinary branches of the languages and the mathematics was ſo great, that he was deemed qualified for the univerſity at the early age of 15.

In 1701 he was entered a Fellow Commoner of St John's College, Cambridge. At that period mathematics engaged more particularly the attention of the univerſity; and the examples of eminence in the learned world, derived from that branch of ſcience, attracted the notice and rouſed the emulation of every youth poſſeſſed of talents and of application. We may preſume, that Brook Taylor, from the very hour of his admiſſion at college, adopted the courſe of ſtudy which a Machin, a Keil, and, above all, a Newton, had opened to the mind of man, as leading to diſcoveries of the celeſtial ſyſtem.—That he applied early to theſe ſtudies, and without remiſſion, is to be inferred from the early notice and kind attention with which he was honoured by thoſe eminent perſons, and from the extraordinary progreſs which he made in their favourite ſcience."

In 1708 he wrote his treatiſe On the Centre of Oſcillation, which was not publiſhed in the Philoſophical Tranſactions till ſome years afterwards. In 1709, he took his degree of Bachelor of Laws. In 1712, he was choſen a Fellow of the Royal Society. During the interval between theſe two periods, he correſponded with Profeſſor Keil on ſeveral of the moſt abſtruſe ſubjects of mathematical diſquiſition. Sir William Young informs us, that he has in his poſſeſſion a letter, dated in 1712, addreſſed to Mr Machin, which contains at length a ſolution of Kepler's problem, and marking the uſe to be derived from that ſolution. In this year he preſented to the Royal Society three different papers: one On the Aſcent of Water between two Glaſs Plates; a ſecond, On the Centre of Oſcillation; and a third, On the Motion of a ſtretched String. It appears from his correſpondence with Keil, that in 1713 he preſented a paper on his favourite ſubject of Muſic: but this is not preſerved in the Tranſactions.

His diſtinguiſhed proficiency in thoſe branches of ſcience, which engaged the particular attention of the Royal Society at this period, and which embroiled them in conteſts with foreign academies, recommended him to the notice of its moſt illuſtrious members; and in 1714 he was elected to the office of ſecretary. In this year he took at Cambridge his degree of Doctor of Laws; and at this time he tranſmitted, in a letter to Sir Hans Sloane, An Account of ſome curious Experiments relative to Magnetiſm; which, however, was not delivered to the Society till many years afterward, when it was printed in the Tranſactions. His application to thoſe ſtudies to which his genius inclined was indefatigable: for we find that in 1715 he publiſhed in Latin his *Methodus Incrementorum*; alſo a curious eſſay preſerved in the Philoſophical Tranſactions, entitled An Account of an Experiment for the Diſcovery of the Laws of Magnetic Attraction; likewiſe a treatiſe well known to mathematicians, and highly valued by the beſt judges, On the Principles of Linear Perſpective. In the ſame year (ſuch were his admirable talents, and ſo capable were they of being directed to various ſubjects), he conducted a controverſial correſpondence with the Count Raymond de Montmort, on the Tenets of Malebranche; which occaſioned his being particularly noticed in the eulogium pronounced by the French academy on the deceaſe of that eminent metaphyſician.

The new philoſophy of Newton (as it was then called) en-

engaged the attention of mathematicians and philofophers both at home and abroad. At Paris it was in high eftimation; and the men of fcience in that city were defirous of obtaining a perfonal acquaintance with the learned fecretary of the Royal Society, whofe reputation was fo generally acknowledged, and who had particularly diftinguifhed himfelf in the Leibnitzian or German controverfy, as we may denominate it, of that period. In confequence of many urgent invitations, he determined to vifit his friends at Paris in the year 1716. He was received with every poffible token of affection and refpect; and had an opportunity of difplaying many traits of character, which mark the general fcholar and accomplifhed gentleman, as well as the profound mathematician. His company was courted by all "who had temper to enjoy, or talents to improve, the charms of focial intercourfe." Befides the mathematicians, to whom he had always free accefs, he was here introduced to Lord Bolingbroke, the Count de Caylus, and Bifhop Boffuet. "He infpired partiality on his firft addrefs; he gained imperceptibly on acquaintance; and the favourable impreffions which he made from genius and accomplifhments, he fixed in further intimacy by the fundamental qualities of benevolence and integrity."

Among the ladies who honoured Dr Brook Taylor with a particular regard, we may mention the names of Marcilly de Villette, and of Mifs Brunton, the beautiful and accomplifhed niece of Sir Ifaac Newton.

Early in 1717 he returned to London, and compofed three treatifes, which were prefented to the Royal Society, and publifhed in the 30th volume of the Tranfactions. About this time his intenfe application had impaired his health to a confiderable degree; and he was under the neceffity of repairing, for relaxation and relief, to Aix-la-Chapelle. Having likewife a defire of directing his attention to fubjects of moral and religious fpeculation, he refigned his office of fecretary to the Royal Society in 1718.

After his return to England in 1719, he applied to fubjects of a very different kind from thofe that had employed the thoughts and labours of his more early life. Among his papers of this date, Sir William Young has found detached parts of A Treatife on the Jewifh Sacrifices, and a differtation of confiderable length On the Lawfulnefs of eating Blood. He did not, however, wholly neglect his former fubjects of ftudy, but employed his leifure hours in combining fcience and art; with this view he revifed and improved his treatife on Linear Perfpective. Drawing continued to be his favourite amufement to his lateft hour; and it is not improbable, that his valuable life was fhortened by the fedentary habits which this amufement, fucceeding his feverer ftudies, occafioned.

"He drew figures with extraordinary precifion and beauty of pencil. Landfcape was yet his favourite branch of defign. His original landfcapes are moftly painted in water colours, but with all the richnefs and ftrength of oils. They have a force of colour, a freedom of touch, a varied difpofition of planes of diftance, and a learned ufe of aerial as well as linear perfpective, which all profeffional men who have feen thefe paintings have admired. Some pieces are compofitions; fome are drawn from nature; and the general characteriftic of their effect may be exemplified, in fuppofing the bold fore-grounds of Salvator Rofa to be backed by the fucceffion of diftances, and mellowed by the fober harmony, which diftinguifh the productions of Gafpar Pouffin. The fmall figures interfperfed in the landfcapes would not have difgraced the pencil of the correct and claffic Nicholas."

The work of Dr Brook Taylor in linear perfpective was cenfured by Bernoulli, in a treatife publifhed in the Acta of Leipfic, as "abftrufe to all, and as unintelligible to artifts for whom it was more efpecially written." It muft be acknowledged that this excellent work, for fo it deferves to be called, was not level to the apprehenfions of practitioners in the art of drawing and defign: but it was much efteemed by mathematicians. Three editions of it have been publifhed; and as it is now fcarce, a republication of it in its moft improved and perfect ftate would be very acceptable. Mr Kirby, however, has made it more plain and popular, in his treatife entitled "Brook Taylor's Perfpective made eafy;" and this book, detailing and illuftrating the principles of the original work, has been the *vade mecum* of artifts. Dr Brook Taylor was incenfed by the invidious attacks of Bernoulli; and he publifhed An Apology againft J. Bernoulli's Objections, which may be feen in the 30th volume of the Philofophical Tranfactions. Bernoulli, with his ufual envy of Britifh mathematicians, had difputed our author's right to his own work. We have no reafon to doubt Dr Taylor's claims to the undecided difcovery of the method which he defcribes, though he is not an original inventor. This method was long before publifhed by Guido Ubaldi, in his Perfpective, printed at Pefaro in 1600; where it is delivered very clearly, and confirmed by moft elegant demonftrations; and where it is actually applied to the art of delineating the fcenes of a theatre. Taylor.

Toward the end of the year 1720, Dr Brook Taylor accepted the invitation of Lord Bolingbroke to fpend fome time at La Source, a country-feat near Orleans, which he held in right of his wife, the widow of the Marquis de Villette, nephew of Madame de Maintenon. During his refidence at this beautiful fpot, he fixed and cemented a friendfhip with its noble owners which terminated only with life.

In the next year he returned to England, and publifhed the laft paper which appears with his name in the Philofophical Tranfactions, entitled, An Experiment made to afcertain the Proportion of Expanfion of Liquor in the Thermometer, with regard to the degrees of Heat.

In 1721, Dr Brook Taylor married Mifs Bridges of Wallington in the county of Surry, a young lady of good family, but of fmall fortune; and this marriage occafioned a rupture with his father, whofe confent he had never obtained. The death of this lady in 1725, and that of an infant fon, whom the parents regarded as the pledge and pledge of reconciliation with the father, and who actually proved fuch, deeply affected the fenfibility of Dr Taylor. However, during the two fucceeding years he refided with his father at Bifrons, where "the mufical parties, fo agreeable to his tafte and early proficiency, and the affectionate attentions of a numerous family welcoming an amiable brother, fo long eftranged by paternal refentment, not only foothed his forrows, but ultimately engaged him to a fcene of country retirement, and domefticated and fixed his habits of life. He could no more recur to the defultory refources and cold folace of fociety, which cafual vifits, flight acquaintance, and diftant friendfhips, afford the man—who hath *none to move, and where a ftranger at home*."

In 1725 he formed a new connection; and with the full approbation of his father and family, married Sabetta, daughter of John Sawbridge, Efq; of Olantigh, in Kent. In 1729, on the death of his father, he fucceeded to the family eftate of Bifrons. In the following year he loft his wife in child-bed. The daughter whofe birth occafioned the misfortune furvived, and became the mother of Sir William Young, to whom we owe thefe memoirs of his grandfather.

In the interval that elapfed between the years 1721 and 1730 no production by Brook Taylor appears in the Philofophical

losophical Transactions; nor did he publish in the course of that time any work. His biographer has found no traces of his learned labour, excepting a Treatise of Logarithms, which was committed to his friend Lord Paisley (afterward Abercorn), in order to be prepared for the press; but which probably was never printed. His health was now much impaired; relaxation became necessary, and he was diverted by new connections from the habit of severe study, which had distinguished the early period of his life, and which had contributed to contract the duration of it. Happy in the social circle of domestic enjoyment, and devoting his attention to business or amusement as they occurred, his application and his literary emulation seem to have declined. He did not long survive the loss of his second wife; and his remaining days were days of increasing imbecillity and sorrow.

"The essay entitled *Contemplatio Philosophica*, published by Sir William Young, 1793, appears to have been written about this time, and probably with a view to abstract his mind from painful recollections and regret. It was the effort of a strong mind, and is a most remarkable example of the close logic of the mathematician applied to metaphysics. But the blow was too deep at heart for study to afford more than temporary relief. The very resource was hurtful, and intense study but accelerated the decline of his health. His friends offered every comfort; in particular Lord Bolingbroke pressed his consolation, and sought to call his mind from regret of domestic endearments to social friendship at Dawley.

The attention and kindness of his friends, however, could not ward off the approaches of dissolution. "Having survived his second wife little more than a year, Dr Brook Taylor died of a decline in the 46th year of his age, December the 29th 1731, and was buried in the church yard of St Ann's, Soho. I am spared (says his descendant) the necessity of closing this biographical sketch with a prolix detail of his character: in the best acceptation of duties relative to each situation of life in which he was engaged, his own writings, and the writings of those who best knew him, prove him to have been the finished Christian, gentleman, and scholar."

TAYLOR (Dr John), a learned dissenting minister, born in Lancashire. He settled first at Kirkstead in Lincolnshire, where he preached to a small congregation, and taught a grammar-school for near 20 years. Afterward he removed to Norwich, where he preached many years in great repute, until he was invited to superintend the academy formed at Warrington in Lancashire: but a few idle differences on formal punctilios and uncertain doctrines kindled into such a flame there, as subjected him to much scurrility and ill treatment, and endangered the very being of the academy. He died in 1761; and among several other judicious performances, his Hebrew and English Concordance, 2 vols folio, will remain a monument of his critical skill and indefatigable industry.

Taylor-Bird. See MOTACILLA.

TEA, the dried leaves of the tea plant.—A commodity with which we are so well acquainted, which affords a beverage so generally used and so generally agreeable, and which forms so considerable an article of commerce, must excite the curiosity of the public at large to know something of its history, and of the nature of the plant from which it is obtained. We are sorry that we can neither gratify their curiosity nor our own completely. We have consulted all the botanical books to which we had access, and we believe we have had access to the best, yet we have not been able to discover with certainty whether there be various species of the tea plant; or whether all the different kinds of tea, so unlike to one another in their flavour, and strength, and colour, be derived from one single species. As an apology for this imperfection in botanical knowledge, it is proper to observe, that the country of which the tea plant is a native is hidden from the exploring eye of the philosopher; that it is jealous of Europeans, and seldom gives them an opportunity of studying its productions. While we apologize for the ignorance of Europeans in this point, and sincerely regret it, we shall be careful to select every important fact, that we may present our readers with as accurate and complete an account as our materials can supply.

The tea plant is a native of Japan, China, and Tonquin, and has not, as far as we can learn, been found growing spontaneously in any other parts of the world. Linnæus arranged it under the class of *polyandria*, and order of *monogynia*. We are told he was led into this mistake from having no specimens of the flower to examine but such as were dried. If Linnæus has in this arrangement fallen into error, it is surprising that he has not been corrected by one who had the best opportunity of examining the matter. Sir Charles Thunberg, one of the most distinguished pupils of that illustrious botanist, who resided 16 months in Batavia and Japan, has given a full botanical description of the tea plant; and having classed it in the same manner as his master, says expressly that it has only one style. Several of the British botanists, on the other hand, refer it to the order of *trigynia;* deriving their authority from a plant in the Duke of Northumberland's garden at Sion-house, which had three styles.

Linnæus says that there are two species of the tea plant; the *bohea*, the corolla of which has six petals; and the *viridis* or green tea, which has nine petals. Thunberg makes only one species, the bohea, consisting of two varieties; the one with broad and the other with narrow leaves. This botanist's authority is decisive respecting the Japanese tea plants; but as China has not yet been explored, we cannot determine what number of species there are in that country. Of the bohea plant we have been favoured with a beautiful drawing, and an accurate botanical description, by a learned gentleman, which we shall here present to our readers.

Calyx. K, fig. 1, 2, 3, 10. a perianthium quinquepartite, very small, flat, the segments round, obtuse, permanent. Fig. 1. K.

Corolla. C, fig. 1, 3, 4, 5, 7, 8. the petals six, roundish, concave; two exterior (fig. 4, 7.) CC; less, unequal, inclosing the flower before fully blown (fig. 3.) C; four interior (fig. 5, 6.) CCCC; large, equal, before they fall off recurvate (fig. 8.) CC; (A).

Stamens. *f*, fig. 6, 9, 10, 11. the filaments numerous (B) fig. 6, 9. *f a;* about 200; filiform, white, shorter than the corolla, and inserted in the receptacle; *a*, the antheras cordate; and didymous (fig. 10, 11.) *, magnified (C).

Pistillum. Fig. 1, 10, 12. * magnified; *g*, the germen, three globular bodies joined in a triangular form; *s*, the styles, three, connected at their base (fig. 12.); subulate, re-

(A) Thunberg says, that three of the petals are exterior and three inferior.
(B) In a flower received from J. Ellis, Esq; upwards of 280 filaments were told.
(C) Kempfer describes the antheras as single.


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.
Fig. 12.
Fig. 13.
Fig. 14.
Fig. 15.
Fig. 16.
Fig. 17.

recurvate, of the length of the ftamens, preffed together, and as if united in one by the thickfet furrounding ftamens (D) fig. 6, 9, 10.; but after the petals and ftamens have fallen off they part, fpread open, increafe in length, and wither on the germen, fig. 1, 12.; the ftigmas fimple, *t*, fig. 1, 9, 10, 12.

Pericarpium. P, fig. 1, 13, 14. a capfule in the form of three globular bodies united, fig. 13. trilocular, fig. 14. gaping at the top in three directions, fig. 13.

Seeds. S, fig. 14. fingle, globofe, angulate on the inward fide.

Trunk. T, fig. 1. ramofe, lignous, round; branches alternate, vague, ftiffifh, inclining to afh colour, towards the top reddifh; the peduncles axillary, *p*, fig. 1. alternate, fingle, curved, uniflorous, incraffate, fig. 1, 2, 7. ftipulate, the ftipula fingle; fubulate, erect, *d*, fig. 1, 2, 7, 9.

Leaves. F, fig. 1, 15, 16, 17. alternate, elliptical, obtufely ferrated, with the edges between the teeth recurvate, with the apex emarginate (E) * magnified, fig. 15. *e*, at the bafe very entire, fig. 16, 17. the furface fmooth, gloffy, bullate, venofe on the under fide, of a firm texture, petiolate; the petiols very fhort, *b*, fig. 1, 16, 17. round on the under fide, gibbous, fig. 16. *b*, * magnified; on the upper fide flattifh and flightly channelled, fig. 17. *b*.

The tea plant, which is an evergreen, grows to the height of five or fix feet; Le Compte fays ten or twelve. The leaves, which are the only valuable part of it, are about an inch and a half long, narrow, indented, and tapering to a point, like thofe of the fweet briar, and of a dark green colour. The root is like that of the peach tree, and its flowers refemble thofe of the white wild rofe. The ftem fpreads into many irregular branches. The wood is hard, of a whitifh green colour, and the bark is of a greenifh colour, with a bitter, naufeous, and aftringent tafte. The fruit is fmall, and contains feveral round blackifh feeds, about the bignefs of a bean or large pea.

This plant delights in valleys, is frequent on the floping fides of mountains and the banks of rivers, where it enjoys a fouthern expofure. It flourifhes in the northern latitudes of Pekin as well as round Canton, but attains the greateft perfection in the mild temperate regions of Nankin. It is faid only to be found between the 30th and 45th degree of north latitude. In Japan it is planted round the borders of fields, without regard to the foil; but as it is an important article of commerce with the Chinefe, whole fields are covered with it, it is by them cultivated with care. The Abbé Rochen fays, it grows equally well in a poor as in a rich foil; but that there are certain places where it is of a better quality. The tea which grows in rocky ground is fuperior to that which grows in a light foil; and the worft kind is that which is produced in a clay foil. It is propagated by feeds; from fix to twelve are put into a hole about five inches deep, at certain diftances from each other. The reafon why fo many feeds are fown in the fame hole is faid to be, that only a fifth part vegetate. Being thus fown, they grow without any other care. Some, however, manure the land, and remove the weeds; for the Chinefe are as fond of good tea, and take as much pains to procure it of an excellent quality, as the Europeans do to procure excellent wine.

The leaves are not fit for being plucked till the fhrub be of three years growth. In feven years it rifes to a man's height; but as it then bears but few leaves, it is cut down to the ftem, and this produces a new crop of frefh fhoots the following fummer, every one of which bears nearly as many leaves as a whole fhrub. Sometimes the plants are not cut down till they are ten years old. We are informed by Kœmpfer, that there are three feafons in which the leaves are collected in the ifles of Japan, from which the tea derives different degrees of perfection.

The firft gathering commences at the end of February or beginning of March. The leaves are then fmall, tender, and unfolded, and not above three or four days old: thefe are called *ficki-tfiaa*, or "tea in powder," becaufe it is pulverifed; it is alfo called *imperial tea*, being generally referved for the court and people of rank; and fometimes alfo it is named *bloom tea*. It is fold in China for 20 d. or 2 s. *per* pound. The labourers employed in collecting it do not pull the leaves by handfuls, but pick them one by one, and take every precaution that they may not break them. However long and tedious this labour may appear, they gather from 4 to 10 or 15 pounds a-day.

The fecond crop is gathered about the end of March or beginning of April. At this feafon part of their leaves have attained their full growth, and the reft are not above half their fize. This difference does not, however, prevent them from being all gathered indifcriminately. They are afterwards picked and affortea into different parcels, according to their age and fize. The youngeft, which are carefully feparated from the reft, are often fold for leaves of the firft crop, or for imperial tea. Tea gathered at this feafon is called *too-tfiaa*, or "Chinefe tea," becaufe the people of Japan infufe it, and drink it after the Chinefe manner.

The third crop is gathered in the end of May or in the month of June. The leaves are then very numerous and thick, and have acquired their full growth. This kind of tea, which is called *Ben-tfiaa*, is the coarfeft of all, and is referved for the common people. Some of the Japanefe collect their tea only at two feafons of the year, which correfpond to the fecond and third already mentioned; others confine themfelves to one general gathering of their crop, towards the month of June: however, they always form afterwards different affortments of their leaves.

The fineft and moft celebrated tea of Japan is that which grows near Ud-fi, a fmall village fituated clofe to the fea, and not far diftant from Meaco. In the diftrict of this village is a delightful mountain, having the fame name, the climate of which is faid to be extremely favourable to the culture of tea; it is therefore inclofed by a hedge, and furrounded with wide ditches, which prevent all accefs to it. The tea fhrubs that grow on this mountain are planted in regular order, and are divided by different avenues and alleys.

The care of this place is entrufted to people who are ordered to guard the leaves from duft, and to defend them from the inclemency of the weather. The labourers who are appointed to collect the tea abftain from every kind of grofs food for fome weeks before they begin, that their breath and perfpiration may not in the leaft injure the leaves. They gather them with the moft fcrupulous nicety, and never touch them but with very fine gloves. When this choice tea has undergone the procefs neceffary for its pre-

(D) It was this circumftance that led Linnæus to place it under the order monogynia.

(E) No author has hitherto remarked this obvious circumftance; even Kœmpfer fays the leaves terminate in a fharp point.

Tea. preparation, it is escorted by the superintendant of the mountain and a strong guard to the emperor's court, and reserved for the use of the imperial family.

As the tea shrub grows often on the rugged banks of steep mountains, access to which is dangerous, and sometimes impracticable, the Chinese, in order to come at the leaves, make use of a singular stratagem: These steep places are generally frequented by great numbers of monkeys, which being irritated and provoked, to revenge themselves tear off the branches, and shower them down upon those who have insulted them. The Chinese immediately collect these branches, and strip them of their leaves.

When the tea leaves have been collected, they are exposed to the steam of boiling water; after which they are put upon plates of copper, and held over the fire until they become dry and shrivelled, and appear such as we have them in Europe. According to the testimony of Kœmpfer, tea is prepared in the same manner in the isles of Japan. "There are to be seen there (says this traveller) public buildings erected for the purpose of preparing the fresh gathered tea. Every private person who has not suitable conveniences, or who is unacquainted with the operation, may carry his leaves thither as they dry. These buildings contain a great number of small stoves raised about three feet high, each of which has a broad plate of iron fixed over its mouth. The workmen are seated round a large table covered with mats, and are employed in rolling the tea leaves which are spread out upon them. When the iron plates are heated to a certain degree by the fire, they cover them with a few pounds of fresh gathered leaves, which being green and full of sap crackle as soon as they touch the plate. It is then the business of the workman to stir them with his naked hands as quickly as possible, until they become so warm that he cannot easily endure the heat. He then takes off the leaves with a kind of shovel, and lays them upon mats. The people who are employed in mixing them, take a small quantity at a time, roll them in their hands always in the same direction; while others keep continually stirring them, in order that they may cool sooner, and preserve their shrivelled figure the longer. This process is repeated two or three times, and even oftener, before the tea is deposited in the warehouses. These precautions are necessary to extract all the moisture from the leaves."

The people of Japan and China generally keep their tea a year before using it, because, when quite fresh and newly gathered, it possesses a narcotic quality which hurts the brain. Imperial tea is generally preserved in porcelain vases, or in leaden or tin canisters covered with fine mats made of bamboo. Common tea is kept in narrow-mouthed earthen pots; and coarse tea, the flavour of which is not so easily injured, is packed up in baskets of straw.

An infusion of tea is the common drink of the Chinese; and indeed when we consider one circumstance in their situation, we must acknowledge that Providence has displayed much goodness in scattering this plant with so much profusion in the empire of China. The water is said to be unwholesome and nauseous, and would therefore perhaps, without some corrective, be unfit for the purposes of life. The Chinese pour boiling water over their tea, and leave it to infuse, as we do in Europe; but they drink it without any mixture, and even without sugar. The people of Japan reduce theirs to a fine powder, which they dilute with warm water until it has acquired the consistence of thin soup. Their manner of serving tea is as follows: They place before the company the tea equipage, and the box in which this powder is contained; they fill the cups with warm water, and taking from the box as much powder as the point of a knife can contain, throw it into each of the cups, and stir it with a tooth-pick until the liquor begins to foam; it is then presented to the company, who sip it while it is warm. According to F. du Halde, this method is not peculiar to the Japanese; it is also used in some of the provinces of China.

The first European writer who mentions tea is Giovanni Botero, an eminent Italian author, who published a treatise about the year 1590, Of the Causes of the Magnificence and Greatness of Cities. He does not indeed mention its name, but describes it in such a manner that it is impossible to mistake it. "The Chinese (says he) have an herb out of which they press a delicate juice, which serves them for drink instead of wine: it also preserves their health, and frees them from all those evils which the immoderate use of wine produces among us *."

Tea was introduced into Europe in the year 1610 by the Dutch East India Company. It is generally said, that it was first imported from Holland into England, in 1666, by the lords Arlington and Offory, who brought it into fashion among people of quality. But it was used in coffee-houses before this period, as appears from an act of parliament made in 1660, in which a duty of 8 d. was laid on every gallon of the infusion sold in these places. In 1666 it was sold in London for 60 s. *per* pound, though it did not cost more than 2 s. 6 d. or 3 s. 6 d. at Batavia. It continued at this price till 1707. In 1715 green tea began to be used; and as great quantities were then imported, the price was lessened, and the practice of drinking tea descended to the lower ranks †. In 1720 the French began to send it to us by a clandestine commerce. Since that period the demand has been increasing yearly, and it has become almost a necessary of life in several parts of Europe, and among the lowest as well as the highest ranks.

The following table will give an idea of the quantity of tea imported annually into Great Britain and Ireland since 1717:

From 1717 to 1726	-	700,000 lbs.
1732 to 1742	-	1,200,000
1755 near	-	4,000,000
1766	-	6,000,000
1785 about	-	12,000,000
1794 from		16 to 20,000,000

Besides these immense quantities imported into Britain and Ireland, much has been brought to Europe by other nations. In 1766 the whole tea imported into Europe from China amounted to 17 millions of pounds; in 1785 it was computed to be about 19 millions of pounds ‡.

Several researches have been made in Europe to determine whether the tea plant grows spontaneously; but these researches have been hitherto in vain. When Captain Cook visited Teneriffe in his last voyage, Mr Anderson his surgeon was informed by a gentleman of acknowledged veracity, that a shrub is common near Santa Cruz which agrees exactly with the description given of the tea-plant by Linnæus. It is considered as a weed, and large quantities are rooted out of the vineyards every year: But the Spaniards who inhabit the island sometimes make use of it, and ascribe to it all the qualities of the tea imported from China.

Many attempts have been made to introduce this valuable plant into Europe; but from want of proper precautions most of these attempts have miscarried. The seeds, being of an oily nature, are apt to grow rancid during a long voyage, unless proper care is taken to preserve them. There are two methods of preserving these seeds: The first is, to inclose them in wax after they have been dried in the sun; the second is, to leave them in their husks, and shut them up closely in a box made of tin: but neither of these methods has been attended with general success, whatever care

* An... Com... vol. p. 1...

† H... Jou...

‡ R... vol... Rol... Ind...

care has been taken to obtain fresh feeds, or to preferve them. The beft method would be, to fow frefh feeds in fine light earth immediately on leaving Canton, and to cover them with wire to fecure them from rats and other animals that might attack them. The boxes ought not to be too much expofed to the air, nor to that kind of dew which rifes from the fea. The earth in the boxes muft neither be hard nor dry, and fhould from time to time be gently watered with frefh or rain water; and when the fhoots begin to appear, they ought to be kept in a flight moifture, and fheltered from the fun. The tea-plants to be found in England have been procured by thefe means only; and though feveral of the young rifing fhoots perifhed, the laft method propofed is probably that which may be followed with greateft fuccefs.

The fineft tea-plant known in England was raifed in Kew gardens; it was carried thither by Sir J. Ellis, who brought it from feed: but the firft that ever flourifhed in Europe was one belonging to the Duke of Northumberland at Zion, from a drawing of which our engraving is taken. The plants which are cultivated in the gardens near London thrive well in the green-houfe during winter, and fome ftand that feafon in the open air. Linnæus, who obtained this fhrub in its growing ftate, contrived to preferve it in the open air in the northern latitude of Sweden. France has alfo procured fome plants. There can be no doubt but they would fucceed in many countries of Europe, if proper care were paid to their cultivation till they became inured to one climate. It will be a great advantage if we can rear that plant, which can never fuffer fo much from change of foil as from growing mufty during the long voyage from China. Befides, the demand for tea is now become fo great, that the Chinefe find it neceffary, or at leaft profitable, to adulterate it. Bad tea is now become an univerfal complaint. The Abbé Grofier tells us, that there is a kind of mofs which grows in the neighbourhood of the little city of Mang-ing-hien, which is fold as a delicate fpecies of tea. If this delicious commodity is adulterated in China, can we flatter ourfelves that none comes to us but what is pure and unmixed? How would our fine ladies like to be told, that inftead of tea they drink nothing but the infufion of mofs from the rocks of Mang-ing-hien (F)?

Of the chemical qualities and effects of tea on the conftitution, many various and oppofite opinions have been formed. About a century ago, Bontikoe, a Dutch phyfician, beftowed extravagant encomiums on the benefits of tea. With him it was good for every thing; and any quantity might be drunk, even to the amount of 200 difhes in a day. Whether Bontikoe in this cafe acted as a phyfician, or, being a Dutchman, was eager to encourage the fale of an important article of his country's commerce, is not eafy to fay. On the other hand, the pernicious effects of tea upon the nervous fyftem have been often repeated, and very oppofite effects have been afcribed to it. Some affirm that green tea is mildly aftringent; others fay it is relaxing: Some fay it is narcotic, and procures fleep; while others contend, that taken before bed-time it affuredly prevents it.

Dr Lettfom, who has written the Natural Hiftory of the Tea Tree, made feveral experiments to determine its chemical qualities. He found an infufion of it preferved beef frefh; it is therefore antifeptic: and from its ftriking a purple colour with the falt (fulphate) of iron, he juftly concludes that it is aftringent. He concludes alfo, that the effential qualities of tea refide in its fragrant and volatile parts.

We have heard much of the bad effects of tea, but we have neither felt nor obferved it. If it were fo pernicious as it has been reprefented by fome, its effects muft certainly be evident in China, where it is drunk by all ranks; yet fo far from being thought hurtful in that country, it is in high eftimation. The prefent emperor has compofed a kind of eloge on the virtues of tea. We are told by thofe who have written the hiftory of China, that inflammatory difeafes are lefs frequent there than in many other countries, which is afcribed folely to the liberal ufe of tea. It muft be obferved by all, that tea is an antidote againft intemperance, and that he who relifhes the one feldom runs into the other. Raynal fays, that tea has contributed more to the fobriety of this nation than the fevereft laws, the moft eloquent harangues of Chriftian orators, or the beft treatifes of morality. We have no doubt but it may be hurtful to fome conftitutions in particular circumftances; but we fufpect that the nervous diforders fo often attributed to tea, are rather owing to hereditary difeafes, to want of exercife, and to irregularity in food or fleep, than to tea. "Weak tea drunk too hot (fays Dr Leake) will enervate, and if very ftrong, may prove equally pernicious by affecting the head or ftomach. But when it is drunk in moderation, and not too warm, with a large addition of milk, I believe it will feldom prove hurtful, but, on the contrary, falutary. After ftudy or fatigue it is a moft refrefhing and grateful repaft; it quenches thirft, and cheers the fpirits, without heating the blood; and the pleafing fociety, in which we fo often partake of it, is no inconfiderable addi-

(F) There is very good reafon to believe, that the adulteration of tea is not confined to China. It is practifed, and often with too much fuccefs, among ourfelves. Mr Twining, a confiderable tea-dealer in London, publifhed a pamphlet fome years ago, in which he has expofed this infamous traffic. The information (he fays) was obtained from a gentleman who had made very accurate inquiries into this fubject.

The fmouch for mixing with black teas is made of the leaves of the afh. When gathered, they are firft dried in the fun, then baked: they are next put upon a floor, and trod upon until the leaves are fmall, then fifted and fteeped in copperas with fheeps dung; after which, being dried on a floor, they are fit for ufe. There is alfo another mode: When the leaves are gathered, they are boiled in a copper with copperas and fheeps dung; when the liquor is ftrained off, they are baked and trod upon, until the leaves are fmall, after which they are fit for ufe. The quantity manufactured at a fmall village, and within eight or ten miles thereof, cannot be afcertained, but is fuppofed to be about 20 tons in a year. One man acknowledges to have made 600 weight in every week for fix months together. The fine is fold at 4l. 4s. *per* cwt. equal to 9d. *per* lb. The coarfe is fold at 2l. 2s. *per* cwt. equal to 4½d. *per* lb. Elder buds are manufactured in fome places to reprefent fine teas.

For the honour of human nature, we hope fuch a traffic as this is not very common; but if there be, thofe concerned in it deferve exemplary punifhment. The only way (Mr Twining fays) to efcape this adulterated tea, is never to purchafe from thofe who offer their teas to fale at lower prices than genuine teas can be afforded; but to purchafe them only from perfons of character.

addition to its value; for whatever affords rational pleafure to the mind, will always contribute to bodily health.

In this country teas are generally divided into three kinds of green, and five of bohea: The former are, 1. Imperial or bloom tea, with a large loofe leaf, light green colour, and a faint delicate fmell. 2. Hyfon, fo called from the name of the merchant who firft imported it; the leaves of which are clofely curled and fmall, of a green colour, verging to a blue: And, 3. Singlo tea, from the name of the place where it is cultivated. The boheas are, 1. Souchong, which imparts a yellow green colour by infufion. 2. Camho, fo called from the place where it is made; a fragrant tea, with a violet fmell; its infufion pale. 3. Congo, which has a larger leaf than the following, and its infufion fomewhat deeper, refembling common bohea in the colour of the leaf. 4. Pekoe tea; this is known by the appearance of fmall white flowers mixed with it. 5. Common bohea, whofe leaves are of one colour. There are other varieties, particularly a kind of green tea, done up in roundifh balls, called *gunpowder tea*.

Tea-Tree of New Zealand, is a fpecies of myrtle, of which an infufion was drunk by Captain Cook's people in their voyages round the world. Its leaves were finely aromatic, aftringent, and had a particular pleafant flavour at the firft infufion; but this went off at the next filling up of the tea pot, and a great degree of bitternefs was then extracted; for which reafon it was never fuffered to be twice infufed. In a fine foil in thick forefts this tree grows to a confiderable fize; fometimes 30 or 40 feet in height, and one foot in diameter. On a hilly and dry expofure it degenerates into a fhrub of five or fix inches; but its ufual fize is about eight or ten feet high, and three inches in diameter. In that cafe its ftem is irregular and unequal, dividing very foon into branches, which rife at acute angles, and only bear leaves and flowers at top. The flowers are white, and very ornamental to the whole plant.

Mr White, in his Journal of a Voyage to New South Wales, mentions a fhrub which he calls a *tea-tree*, merely from its being ufed by the convicts as a fuccedaneum for tea; for he had not feen the flower, nor did he know to what genus it belonged. It is a creeping kind of a vine, running to a great extent along the ground; the ftalk flender; the leaf not fo large as the common bay leaf; the tafte fweet, exactly like the liquorice root of the fhops.

TEACHERS, perfons employed in conducting the education of the young.

We will venture to fay, that there is no clafs of men to whom a nation is fo much indebted as to thofe employed in inftructing the young: For if it be education that forms the only diftinction between the civilized and the favage, much certainly is due to thofe who devote themfelves to the office of inftruction. It muft be the duty therefore of every ftate to take care that proper encouragement be given to thofe who undertake this office. There ought to be fuch a falary as would render it an object of ambition to men of abilities and learning, or at leaft as would keep the teacher refpectable. In Scotland, the office of a fchoolmafter was formerly much more lucrative than at prefent, and moft of that clafs had received liberal education; and this is the reafon why the common people in Scotland have been famous, even to a proverb, for their learning. But at prefent the falary of a country fchoolmafter, independent of fees for fcholars, is not greater than a ploughman can earn, being feldom more than L. . : 6 : 8, the confequence of which is, that this, which is in fact an honourable, becaufe an ufeful profeffion, is now finking into contempt. It is no longer an object to a man of learning; and we muft foon be fatisfied with fchoolmafters that can read, write, and caft accounts, a little better than the loweft of the people, or who from fome natural deformity are unable to exercife a trade. And what in this cafe muft become of the minds of the common people? They muft be totally uncultivated.

We have obferved a great difference between the cultivation of the common people in one part of Scotland compared with another; and we have found, that wherever a fchoolmafter is looked upon as a mean profeffion, there is fcarcely a duly qualified perfon to be found to undertake the office; and in thofe places the common people are lamentably ignorant. In other places again, where the fchoolmafter is confidered as one of the principal perfons in the parifh, there men of a liberal education, young divines, and preachers, do not think themfelves difgraced by exercifing this profeffion; and there the common people fhow a degree of acutenefs, knowledge, and obfervation, and poffefs fuch polifhed manners, as raife them very high above thofe of their own rank in other parts of the country.

Many and keen have been the debates about a reform of government of late years; but little attention has been paid to the formation of the minds of the common people, who conftitute the greater part of the nation; of courfe they are ready to join the ftandard of every feditious demagogue who founds the alarm of oppreffion; and fhould they at length be roufed, their cruelty and barbarity, like the common people of France, would be exactly in proportion to their ignorance and want of principle.

We are willing to hope, then, that the government and the monied men of the nation, who alone have property to lofe and money to beftow, will at length find it to be their intereft to patronize fchoolmafters.

TEAL, in ornithology. See Anas.

TEARS, a lymph or aqueous humour, which is limpid, and a little faltifh: it is feparated from the arterial blood by the lachrymal glands and fmall glandulous grains on the infide of the eyelids.

TEASELS, a plant cultivated in the weft of England for the ufe of clothiers. See Dipsacus.

TEBETH, the tenth month of the Jewifh ecclefiaftical year, and fourth of the civil. It anfwers to our month of December.

TECKLENBURG, a town of Germany, in the circle of Weftphalia, capital of a county of the fame name, with a caftle built on a hill. It was bought by the king of Pruffia in 1707. E. Long. 8. 2. N. Lat. 52. 20.

TECHNICAL, expreffes fomewhat relating to arts or fciences: in this fenfe we fay technical terms. It is alfo particularly applied to a kind of verfes wherein are contained the rules or precepts of any art, thus digefted to help the memory to retain them; an example whereof may be feen in the article Memory.

TECTONA, in botany; a genus of plants belonging to the clafs of *pentandria*, and order of *monogynia*. The ftigma is dentate; the fruit a dry fpongy plum within an inflated calyx; and the nucleus is trilocular. There is only one fpecies, the *grandis*, Indian oak, or teak wood, which is a native of India.

TE deum, the name of a celebrated hymn, ufed in the Chriftian church, and fo called becaufe it begins with thefe words, *Te Deum laudamus*, We praife thee, O God. It is fung in the Romifh church with great pomp and folemnity upon the gaining of a victory, or other happy event; and is believed to be the compofition of St Ambrose bifhop of *Milan*.

TEES, a river which rifes on the confines of Cumberland,

land, and running eastward, divides the county of Durham from Yorkshire, and falls into the German sea below Stockton.

TEETH, the bones placed in the jaws for chewing food, that it may be the more easily digested in the stomach. The anatomical structure of these has already been described under ANATOMY and COMPARATIVE ANATOMY. The diseases to which they are liable, as well as the most successful remedies for removing them, are fully detailed under MEDICINE and SURGERY, to which we refer the reader.

Much attention has been paid to the beauty and preservation of the teeth among most nations. The Romans rubbed and washed them with great care; and when they lost them, supplied their place with artificial teeth made of ivory; and sometimes, when loose, bound them with gold. Ligatures of wire have been found to hurt the natural teeth with which the artificial are connected: whereas silken twist cannot affect them to any considerable degree for several years.

Guilleman gives us the composition of a paste for making artificial teeth, which shall never grow yellow: the composition is white wax granulated, and melted with a little gum elemi, adding powder of white mastich, coral, and pearl.

When several teeth are out in the same place, it is best to make a set, or the number wanted, out of one piece, all adhering together, which may be fastened to the two next of the sound or natural teeth. And even a whole set of artificial teeth may be made for one or both jaws, so well fitted to admit of the necessary motions, and so conveniently retained in the proper situation by means of springs, that they will answer every purpose of natural teeth, and may be taken out, cleaned, and replaced, by the patient himself with great ease.

The common trick of mountebanks and other such practitioners, is to use various washes for teeth, the sudden effects of which, in cleaning and whitening the teeth, surprise and please people; but the effects are very pernicious. All the strong acid spirits will do this. As good a mixture as any thing can be, on this occasion, is the following: take plantane-water an ounce, honey of roses two drams, muriatic acid ten drops; mix the whole together, and rub the teeth with a piece of linen rag dipped in this every day till they are whitened. The mouth ought to be well washed with cold water after the use of this or any other acid liquor; and indeed the best of all teeth washes is cold water, with or without a little salt; the constant use of this will keep them clean and white, and prevent them from aching.

After all the numerous cures which have been proposed for preventing the toothach, we will venture to recommend the keeping the teeth clean as the most efficacious, and avoiding every kind of hot food, especially hot liquids, as tea, &c. They who are constantly using powders generally destroy their teeth altogether, as the valetudinarian does his health.

TEETHING in children. See MEDICINE.

TEFF, a kind of grain, sown all over Abyssinia, from which is made the bread commonly used throughout the country. We have no description of this plant but from Mr Bruce, who says that it is herbaceous; and that from a number of weak leaves surrounding the root proceeds a stalk of about 28 inches in length, not perfectly straight, smooth, but jointed or knotted at particular distances. This stalk is not much thicker than that of a carnation or jellyflower. About eight inches from the top, a head is formed of a number of small branches, upon which it carries the fruit and flowers; the latter of which is small, of a crimson colour, and scarcely perceptible by the naked eye but from the opposition of that colour. The pistil is divided into two, seemingly attached to the germ of the fruit, and has at each end small capillaments forming a brush. The stamina are three in number; two on the lower side of the pistil, and one on the upper. These are each of them crowned with two oval stigmata, at first green, but after crimson. The fruit is formed in a capsula, consisting of two conical hollow leaves, which, when closed, seems to compose a small conical pod, pointed at the top. The fruit or seed is oblong, and is not so large as the head of the smallest pin; yet it is very prolific, and produces these seeds in such quantity as to yield a very abundant crop in the quantity of meal. Teff, Tefflis.

Our author, from the similarity of the names, conjectures it to be the *tipha* mentioned, but not described, by Pliny: but this conjecture, which he acknowledges to be unsupported, is of very little importance.

There are three kinds of meal made from teff, of which the best (he says) is as white as flour, exceedingly light, and easily digested: the second is of a browner colour; and the last, which is the food of soldiers and servants, is nearly black. This variety he imagines to arise entirely from the difference of soils in which the seeds are sown, and the different degrees of moisture to which the plant is exposed when growing. The manner of making the meal or flour into bread is by taking a broad earthen jar, and having made a lump of it with water, they put it into an earthen jar at some distance from the fire, where it remains till it begins to ferment or turn sour; they then bake it into cakes of a circular form, and about two feet in diameter: it is of a spungy soft quality, and not a disagreeable sourish taste. Two of these cakes a-day, and a coarse cotton cloth once a-year, are the wages of a common servant.

At their banquets of raw meat, the flesh being cut in small bits, is wrapt up in pieces of this bread, with a proportion of fossil salt and Cayenne pepper. Before the company sit down to eat, a number of these cakes of different qualities are placed one upon the other, in the same manner as our plates, and the principal people sitting first down, eat the white teff; the second or coarser sort serves the second rate people that succeed them, and the third is for the servants. Every man, when he is done, dries or wipes his fingers upon the bread which he is to leave for his successor, for they have no towels; and this is one of the most beastly customs among them.

Of this teff bread the natives make a liquor, by a process which our author describes in the following words: The bread, when well toasted, is broken into small pieces, which are put into a large jar, and have warm water poured upon them. It is then set by the fire, and frequently stirred for several days, the mouth of the jar being close covered. After being allowed to settle three or four days, it acquires a sourish taste, and is what they call *bouza*, or the common beer of the country. The bouza in Atbara is made in the same manner, only instead of teff, cakes of barley-meal are employed. Both are very bad liquors, but the worst is that made of barley.

TEFFLIS, or TIFFLIS, a town of Asia, in Georgia, one of the seven nations between the Black Sea and the Caspian. It is the capital of that country, the place of residence of its sovereign, and is called by the inhabitants *Thilis-Cabar*, "warm town," from the warm baths in its neighbourhood. Though its circumference does not exceed two English miles, it contains 20,000 inhabitants, of which more than half are Armenians; the remainder are principally Georgians, with some Tartars. According to Major Rennel, it has 20 Armenian and 15 Greek churches, and three mesheds. But Mr Coxe, on the authority of Professor Gui-

Guldenftaedt, ftates the places of worfhip to be one Roman Catholic, 13 Greek, and feven Armenian churches. There are fome magnificent caravanferas, bazars, and palaces in the city, but no mofques; for the Georgians, though living under a Mohammedan government, have always rifen up in arms as often as any attempts have been made to erect fuch places of Mohammedan worfhip. Many of the Romifh miffionaries live here in difguife under the denomination of phyficians, furgeons, and chemifts; and the great cures which they perform procure them much efteem, though they are fometimes expofed to the infults of the people when they attempt to make any profelytes to their church. All the houfes are of ftone, with flat roofs, which ferve, according to the cuftom of the Eaft, as walks for the women. They are neatly built; the rooms are wainfcotted, and the floors fpread with carpets. The ftreets feldom exceed feven feet in breadth; and fome are fo narrow as fcarcely to allow room for a man on horfeback: they are confequently very filthy.

Teflis is a place of confiderable trade, efpecially in furs, which are conveyed hence to Conftantinople by the way of Erzerum. As for the filks of this country, they are bought up on the fpot by the Armenians, and conveyed to Smyrna and other ports of the Mediterranean; but the greateft part is firft fent to Erzerum to be manufactured, the Georgians being very ignorant and unfkilful in that refpect. From hence, likewife, great quantities of a root called *boya* is fent to Erzerum and Indoftan for the ufe of the linen dyers. Here is likewife a foundery, at which are caft a few cannon, mortars, and balls, all of which are very inferior to thofe of the Turks. The gunpowder made here is very good. The Armenians have likewife eftablifhed in this town all the manufactures carried on by their countrymen in Perfia: the moft flourifhing is that of printed linens. Teflis is feated on the river Kur, at the foot of a mountain; and on the fouth fide of it ftands a large caftle or fortrefs, built by the Turks in 1576, when they made themfelves mafters of the city and country, under the command of the famous Muftapha Pacha. It is 125 miles weft of Terki. E. Long. 63. 3. N. Lat. 41. 59.

TEGERHY, a principal town in Fezzan, in Africa, about 80 miles fouth-weft of the capital. It collects from its lands little other produce than dates and Indian corn. In this, as in every town in Fezzan, a market for butcher-meat, corn, fruit, and vegetables, is regularly held. Mutton and goats flefh are fold by the quarter without weighing; the ufual price is from 32 to 40 grains of gold-duft, or four or five fhillings Englifh money. The flefh of the camel, which is much more highly valued, is commonly fold at a dearer rate, and is divided into fmaller lots. Agriculture and pafturage feem to be the principal occupations.

TEGUMENT, any thing that furrounds or covers another.

TEIND in Scots law. See LAW, N° clxx.

Commiffion of TEINDS. See COMMISSION.

TEINTS, and SEMITEINTS, in painting, denote the feveral colours ufed in a picture, confidered as more or lefs high, bright, deep, thin, or weakened and diminifhed, &c. to give the proper relievo, foftnefs, or diftance, &c. of the feveral objects.

TELEGRAPH (derived from τηλε and γραφω), is the name very properly given to an inftrument, by means of which information may be almoft inftantaneoufly conveyed to a confiderable diftance.

The telegraph, though it has been generally known and ufed by the moderns only for a few years, is by no means a modern invention. There is reafon to believe that amongft the Greeks there was fome fort of telegraph in ufe. The burning of Troy was certainly known in Greece very foon after it happened, and before any perfon had returned from thence. Now that was altogether fo tedious a piece of bufinefs, that conjecture never could have fupplied the place of information. A Greek play begins with a fcene, in which a watchman defcends from the top of a tower in Greece, and gives the information that Troy was taken. "I have been looking out there ten years (fays he) to fee when that would happen, and this night it is done." Of the antiquity of a mode of conveying intelligence quickly to a great diftance, this is certainly a proof.

The Chinefe, when they fend couriers on the great canal, or when any great man travels there, make fignals by fire from one day's journey to another, to have every thing prepared; and moft of the barbarous nations ufed formerly to give the alarm of war by fires lighted on the hills or rifing grounds.

Polybius calls the different inftruments ufed by the ancients for communicating information πυρσια, *pyrsia*, becaufe the fignals were always made by means of fire. At firft they communicated information of events merely by torches; but this method was of little ufe, becaufe it was neceffary before-hand to fix the meaning of every particular fignal. Now as events are exceedingly various, it was impoffible to exprefs the greater number of them by any premeditated contrivance. It was eafy, for inftance, to exprefs by fignals that a fleet had arrived at fuch a place, becaufe this had been forefeen, and fignals accordingly had been agreed upon to denote it; but an unexpected revolt, a murder, and fuch accidents, as happen but too often, and require an immediate remedy, could not be communicated by fuch fignals; becaufe to forefee them was impoffible.

Æneas, a contemporary of Ariftotle, who wrote a treatife on the duties of a general, endeavoured to correct thofe imperfections, but by no means fucceeded. "Thofe (fays he) who would give fignals to one another upon affairs of importance, muft firft prepare two veffels of earth, exactly equal in breadth and depth; and they need be but four feet and a half deep, and a foot and a half wide. They then muft take pieces of cork, proportioned to the mouth of thefe veffels, but not quite fo wide, that they may be let down with eafe to the bottom of thefe veffels. They next fix in the middle of this cork a ftick, which muft be of equal fize in both thefe veffels. This ftick muft be divided exactly and diftinctly, by fpaces of three inches each, in order that fuch events as generally happen in war may be writ on them. For example, on one of thefe fpaces the following words may be writ: 'A BODY OF HORSE ARE MARCHED INTO THE COUNTRY.' On another, 'A BODY OF INFANTRY, heavily armed, are arrived hither.' On a third, 'INFANTRY LIGHTLY ARMED.' On a fourth, 'HORSE AND FOOT.' On another, 'SHIPS,' then 'PROVISIONS;' and fo on till all the events which may probably happen in the war that is carrying on are writ down in thefe intervals.

This being done, each of the two veffels muft have a little tube or cock of equal bignefs, to let out the water in equal proportion. Then the two veffels muft be filled with water; the pieces of cork, with their fticks thruft through them, muft be laid upon them, and the cocks muft be opened. Now, it is plain, that as thefe veffels are equal, the corks will fink, and the fticks defcend lower in the veffels, in proportion as they empty themfelves. But to be more certain of this exactnefs, it will be proper to make the experiment firft, and to examine whether all things correfpond and agree together, by an uniform execution on both fides. When they are well affured of this, the two veffels muft be carried to the two places where the fignals are to be made and

h and obferved: water is poured in, and the corks and fticks are put in the veffels. When any of the events which are written on the fticks fhall happen, a torch or other light is raifed, which muft be held aloft till fuch time as another is raifed by the party to whom it is directed. (This firft fignal is only to give notice that both parties are ready and attentive). Then the torch or other light muft be taken away, and the cocks fet open. When the interval, that is, that part of the ftick where the event of which notice is to be given or written, fhall be fallen to a level with the veffels, then the man who gives the fignal lifts up his torch; and on the other fide, the correfpondent fignal-maker immediately turns the cock of his veffel, and looks at what is writ on that part of the ftick which touches the mouth of the veffel: on which occafion, if every thing has been executed exactly and equally on both fides, both will read the fame thing."

This method was defective, becaufe it could not convey any other intelligence except what was written on the fticks, and even that not particularly enough. With regard to all unforefeen events, it was quite ufelefs.

A new method was invented by Cleoxenus (others fay by Democlitus), and very much improved by Polybius, as he himfelf informs us. He defcribes this method as follows: Take the letters of the (Greek) alphabet, and divide them into five parts, each of which will confift of five letters, except the laft divifion, which will have only four. Let thefe be fixed on a board in five columns. The man who is to give the fignals is then to begin by holding up two torches, which he is to keep aloft till the other party has alfo fhown two. This is only to fhow that both fides are ready. Thefe firft torches are then withdrawn. Both parties are provided with boards, on which the letters are difpofed as formerly defcribed. The perfon then who gives the fignal is to hold up torches on the left to point out to the other party from what column he fhall take the letters as they are pointed out to him. If it is to be from the firft column, he holds up one torch; if from the fecond, two; and fo on for the others. He is then to hold up torches on the right, to denote the particular letter of the column that is to be taken. All this muft have been agreed on before-hand. The man who gives the fignals muft have an inftrument ([illegible]), confifting of two tubes, and fo placed as that, by looking through one of them, he can fee only the right fide, and through the other only the left, of him who is to anfwer. The board muft be fet up near this inftrument; and the ftation on the right and left muft be furrounded with a wall ([illegible]) ten feet broad, and about the height of a man, that the torches raifed above it may give a clear and ftrong light, and that when taken down they may be completely concealed. Let us now fuppofe that this information is to be communicated—*A number of the auxiliaries, about a hundred, have gone over to the enemy.* In the firft place, words muft be chofen that will convey the information in the feweft letters poffible; as, *A hundred Cretans have deferted*, [illegible]. Having written down this fentence, it is conveyed in this manner. The firft letter is a κ, which is in the fecond column; two torches are therefore to be raifed on the left hand to inform the perfon who receives the fignals to look into that particular column. Then five torches are to be held up on the right, to mark the letter *k*, which is the laft in the column. Then four torches are to be held up on the left to point out the ρ *(r)*, which is in the fourth column, and two on the right to fhow that it is the fecond letter of that column. The other letters are pointed out in the fame manner.—Such was the *pyrfia* or telegraph recommended by Polybius.

But neither this nor any other method mentioned by the ancients feems ever to have been brought into general ufe; nor does it appear that the moderns had thought of fuch a machine as a *telegraph* till the year 1663, when the Marquis of Worcefter, in his CENTURY OF INVENTIONS, affirmed that he had difcovered "a method by which, at a window, as far as eye can difcover black from white, a man may hold difcourfe with his correfpondent, without noife made or notice taken; being according to occafion given, or means afforded, *ex re nata*, and no need of provifion before hand; though much better if forefeen, and courfe taken by mutual content of parties." This could be done only by means of a telegraph, which in the next fentence is declared to have been rendered fo perfect, that by means of it the correfpondence could be carried on "by night as well as by day, though as dark as pitch is black." Telegraph.

About 40 years afterwards M. Amontons propofed a new telegraph. His method was this: Let there be people placed in feveral ftations, at fuch a diftance from one another, that by the help of a telefcope a man in one ftation may fee a fignal made in the next before him: he muft immediately make the fame fignal, that it may be feen by perfons in the ftation next after him, who are to communicate it to thofe in the following ftation, and fo on. Thefe fignals may be as letters of the alphabet, or as a cipher, underftood only by the two perfons who are in the diftant places, and not by thofe who make the fignals. The perfon in the fecond ftation making the fignal to the perfon in the third the very moment he fees it in the firft, the news may be carried to the greateft diftance in as little time as is neceffary to make the fignals in the firft ftation. The diftance of the feveral ftations, which muft be as few as poffible, is meafured by the reach of a telefcope. Amontons tried this method in a fmall tract of land before feveral perfons of the higheft rank at the court of France.

It was not, however, till the French revolution that the telegraph was applied to ufeful purpofes. Whether M. Chappe, who is faid to have invented the telegraph firft ufed by the French about the end of 1793, knew any thing of Amontons's invention or not, it is impoffible to fay; but his telegraph was conftructed on principles nearly fimilar. The manner of ufing this telegraph was as follows: At the firft ftation, which was on the roof of the palace of the Louvre at Paris, M. Chappe, the inventor, received in writing, from the committee of public welfare, the words to be fent to Lifle, near which the French army at that time was. An upright poft was erected on the Louvre, at the top of which were two tranfverfe arms, moveable in all directions by a fingle piece of mechanifm, and with inconceivable rapidity. He invented a number of pofitions for thefe arms, which ftood as figns for the letters of the alphabet; and thefe, for the greater celerity and fimplicity, he reduced in number as much as poffible. The grammarian will eafily conceive that fixteen figns may amply fupply all the letters of the alphabet, fince fome letters may be omitted not only without detriment but with advantage. Thefe figns, as they were arbitrary, could be changed every week; fo that the fign of B for one day might be the fign of M the next; and it was only neceffary that the perfons at the extremities fhould know the key. The intermediate operators were only inftructed generally in thefe fixteen fignals; which were fo diftinct, fo marked, fo different the one from the other, that they were eafily remembered. The conftruction of the machine was fuch, that each fignal was uniformly given in precifely the fame manner at all times: It did not depend on the operator's manual fkill; and the pofition of the arm could never, for any one fignal, be a degree higher or a degree lower, its movement being regulated mechanically.

M. Chappe having received at the Louvre the fentence to

Telegraph. to be conveyed, gave a known signal to the second station, which was Mont Martre, to prepare. At each station there was a watch tower, where telescopes were fixed, and the person on watch gave the signal of preparation which he had received, and this communicated successively through all the line, which brought them all into a state of readiness. The person at Mont Martre then received, letter by letter, the sentence from the Louvre, which he repeated with his own machine; and this was again repeated from the next height, with inconceivable rapidity, to the final station at Lisle.

English Review, June 1796. The first description of the telegraph was brought from Paris to Frankfort on the Maine by a former member of the parliament of Bourdeaux, who had seen that which was erected on the mountain of Belville. As given by Dr Hutton from some of the English papers, it is as follows. AA is a beam or mast of wood placed upright on a rising ground (fig. 1. Plate DII.), which is about 15 or 16 feet high. BB is a beam or balance moving upon the centre AA. This balance-beam may be placed vertically or horizontally, or any how inclined, by means of strong cords, which are fixed to the wheel D, on the edge of which is a double groove to receive the two cords. This balance is about 11 or 12 feet long, and nine inches broad, having at the ends two pieces of wood CC, which likewise turn upon angles by means of four other cords that pass through the axis of the main balance, otherwise the balance would derange the cords; the pieces C are each about three feet long, and may be placed either to the right or left, straight or square, with the balance-beam. By means of these three the combination of movement is very extensive, remarkably simple, and easy to perform. Below is a small wooden gouge or hut, in which a person is employed to observe the movements of the machine. In the mountain nearest to this another person is to repeat these movements, and a third to write them down. The time taken up for each movement is 20 seconds; of which the motion alone is four seconds, the other 16 the machine is stationary. Two working models of this instrument were executed at Frankfort, and sent by Mr W. Playfair to the Duke of York; and hence the plan and alphabet of the machine came to England.

Various experiments were in consequence tried upon telegraphs in this country; and one was soon after set up by government in a chain of stations from the admiralty-office to the sea coast. It consists of six octagon boards, each of which is poised upon an axis in a frame, in such a manner that it can be either placed vertically, so as to appear with its full size to the observer at the nearest station, as in fig. 2. or it becomes invisible to him by being placed horizontally, as in fig. 3. so that the narrow edge alone is exposed, which narrow edge is from a distance invisible. Fig. 2. is a representation of this telegraph, with the parts all shut, and the machine ready to work. T, in the officer's cabin, is the telescope pointed to the next station. Fig. 3. is a representation of the machine not at work, and with the ports all open. The opening of the first port (fig. 2.) expresses *a*, the second *b*, the third *c*, the fourth *d*, the fifth *e*, and the sixth *f*, &c.

Six boards make 36 changes, by the most plain and simple mode of working; and they will make many more if more were necessary: but as the real superiority of the telegraph over all other modes of making signals consists in its making letters, we do not think that more changes than the letters of the alphabet, and the ten arithmetical ciphers, are necessary; but, on the contrary, that those who work the telegraphs should avoid communicating by words or signs agreed upon to express sentences; for that is the sure method never to become expert at sending unexpected intelligence accurately.

This telegraph is without doubt made up of the best number of combinations possible; five boards would be insufficient, and seven would be useless. It has been objected to it, however, that its form is too clumsy to admit of its being raised to any considerable height above the building on which it stands; and that it cannot be made to change its direction, and consequently cannot be seen but from one particular point.

Several other telegraphs have been proposed to remedy these defects, and perhaps others to which the instrument is still liable. The dial-plate of a clock would make an excellent telegraph, as it might exhibit 144 signs so as to be visible at a great distance. A telegraph on this principle, with only six divisions instead of twelve, would be simple and cheap, and might be raised 20 or 30 feet high above the building without any difficulty: it might be supported on one post, and therefore turn round, and the contrast of colours would always be the same.

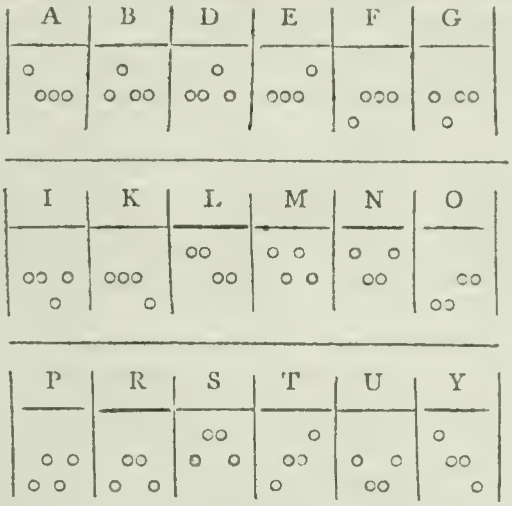
Sup... A very ingenious improvement of the telegraph has been proposed in the Gentleman's Magazine. It consists of a semicircle, to be properly elevated, and fixed perpendicularly on a strong stand. The radius 12 feet; the semicircle consequently somewhat more than 36. This to be divided into 24 parts. Each of these will therefore comprise a space of 18 inches, and an arch of 7° 30′ on the circumference. These 24 divisions to be occupied by as many circular apertures of six inches diameter; which will leave a clear space of six inches on each side between the apertures. These apertures, beginning from the left, to denote the letters of the alphabet, omitting K, J consonant, V, X, and Q, as useless for this purpose. There are then 21 letters. The four other spaces are reserved for signals. The instrument to have an index moveable by a windlass on the centre of the semicircle, and having two tops, according as it is to be used in the day or night; one, a circular top of lacquered iron or copper, of equal diameter with the apertures (and which consequently will eclipse any of them against which it rests); the other, a spear or arrow-shaped top, black, and highly polished, which, in standing before any of the apertures in the day-time, will be distinctly visible. In the night, the apertures to be reduced by a diaphragm fitting close to each, so as to leave an aperture of not more than two inches diameter. The diaphragm to be of well-polished tin; the inner rim lacquered black half an inch. All the apertures to be illuminated, when the instrument is used in the night time, by small lamps; to which, if necessary, according to circumstances, convex lenses may be added, fitted into each diaphragm, by which the light may be powerfully concentrated and increased. Over each aperture one of the five prismatic colours least likely to be mistaken (the remaining two being less distinguishable, and not wanted, are best omitted) to be painted; and, in their natural order, on a width of eighteen inches and a depth of four, red, orange, yellow, green, blue; or, still to heighten the contrast, and render immediately successive apertures more distinguishable, red, green, orange, blue, yellow. The whole inner circle beneath and between the apertures to be painted black.

When the instrument is to be used, the index to be set to the signal apertures on the right. All the apertures to be covered or dark when it begins to be used, except that which is to give the signal. A signal gun to be fired to apprise the observer. If the index is set to the first aperture, it will denote that words are to be expressed; if to the second, that figures; if to the third, that the figures cease; and that the intelligence is carried on in words. When figures are to be expressed, the alternate apertures from the left are taken in their order, to denote from 1 to 10 inclusively;

Telegraph.

fively; the fecond from the right denotes 100; the fifth 1000. This order, and thefe intervals, are taken to prevent any confufion in fo peculiarly important an article of the intelligence to be conveyed.

Perhaps, however, none of the telegraphs hitherto offered to the public exceeds the following, either in fimplicity, cheapnefs, or facility in working, and it might perhaps, with a few trifling additions, be made exceedingly diftinct. It is thus defcribed in the Repertory of Arts and Manufactures: For a nocturnal telegraph, let there be four large patent reflectors, lying on the fame plane, parallel to the horizon, placed on the top of an obfervatory. Let each of thefe reflectors be capable, by means of two winches, either of elevation or depreffion to a certain degree. By elevating or depreffing one or two of the reflectors, eighteen very diftinct arrangements may be produced, as the following fcheme will explain (A).



For the fake of example, the above arrangements are made to anfwer to the moft neceffary letters of the alphabet; but alterations may be made at will, and a greater number of changes produced, without any addition to the reflectors. In the firft obfervatory there need only be a fet of *fingle* reflectors; but in the others each reflector fhould be double, fo as to face both the preceding and fubfequent obfervatory; and each obfervatory fhould be furnifhed with two telefcopes. The proper diameter of the reflectors, and their diftance from each other, will be afcertained by experience.

To convert this machine into a diurnal telegraph, nothing more is neceffary than to infert, in the place of the reflectors, gilt balls, or any other confpicuous bodies.

Were telegraphs brought to fo great a degree of perfection, that they could convey information fpeedily and diftinctly; were they fo much fimplified, that they could be conftructed and maintained at little expence—the advantages which would refult from their ufe are almoft inconceivable. Not to fpeak of the fpeed with which information could be communicated and orders given in time of war, by means of which misfortunes might be prevented or inftantly repaired, difficulties removed, and difputes precluded, and by means of which the whole kingdom could be prepared in an inftant to oppofe an invading enemy; it might be ufed by commercial men to convey a commiffion cheaper and fpeedier than an exprefs can travel. The capitals of diftant nations might be united by chains of pofts, and the fettling of thofe difputes which at prefent take up months or years might then be accomplifhed in as many hours. An eftablifhment of telegraphs might then be made like that of the poft; and inftead of being an expence, it would produce a revenue. Until telegraphs are employed to convey information that occurs very frequently, the perfons who are ftationed to work them will never become expert, and confequently will neither be expeditious nor accurate, though, with practice, there is no doubt but they will attain both in a degree of perfection of which we can as yet have but little conception.

Telegraph, Telemachus.

TELEMACHUS, the fon of Ulyffes and Penelope, was ftill in the cradle when his father went with the reft of the Greeks to the Trojan war. At the end of this celebrated war, Telemachus, anxious to fee his father, went to feek him; and as the place of his refidence, and the caufe of his long abfence, were then unknown, he vifited the court of Menelaus and Neftor to obtain information. He afterwards returned to Ithaca, where the fuitors of his mother Penelope had confpired to murder him, but he avoided their fnares; and by means of Minerva he difcovered his father, who had arrived in the ifland two days before him, and was then in the houfe of Eumæus. With this faithful fervant and Ulyffes Telemachus concerted how to deliver his mother from the importunities of her fuitors, and it was effected with great fuccefs. After the death of his father, Telemachus went to the ifland of Ææa, where he married Circe, or, according to others, Caffiphone the daughter of Circe, by whom he had a fon called *Latinus*. He fome time after had the misfortune to kill his mother-in-law Circe, and fled to Italy, where he founded Clufium. Telemachus was accompanied in his vifit to Neftor and Menelaus by the goddefs of wifdom under the form of Mentor. It is faid that, when a child, Telemachus fell into the fea, and that a dolphin brought him fafe to fhore, after he had remained fome time under water. From this circumftance Ulyffes had the figure of a dolphin engraved on the feal which he wore on his ring.

From thefe ftories, collected from Homer and the other poets of antiquity, the celebrated Fenelon archbifhop of Cambray took the idea of his well-known *Adventures of Telemachus*; which, though not compofed in verfe, is juftly intitled to be efteemed a poem. "The plan of the work (fays Dr Blair) is in general well contrived; and is deficient neither in epic grandeur nor unity of object. The author has entered with much felicity into the fpirit and ideas of the ancient poets, particularly into the ancient mythology, which retains more dignity, and makes a better figure in his hands than in thofe of any other modern poet. His defcriptions are rich and beautiful; efpecially of the fofter and calmer fcenes, for which the genius of Fenelon was beft fuited; fuch as the incidents of paftoral life, the pleafures of virtue, or a country flourifhing in peace. There is an inimitable fweetnefs and tendernefs in feveral of the pictures of this kind which he has given:" and his meafured profe, which is remarkably harmonious, gives the ftyle nearly as much elevation as the French language is capable of fupporting even in regular verfe.

Lectures on Rhetoric and the Belles Lettres.

According to the fame eminent critic, "the beft executed part of the work is the firft fix books, in which Telemachus recounts his adventures to Calypfo. The narration throughout them is lively and interefting. Afterwards, efpecially in the laft twelve books, it becomes more tedious and languid; and in the warlike adventures which are attempted,

(A) Each reflector, after every arrangement, muft be reftored to its place.

Telephium Telescope

tempted, there is a great defect of vigour. The chief objection against this work being classed with epic poems, arises from the minute details of virtuous policy, into which the author in some places enters; and from the discourses and instructions of Mentor, which recur upon us too often, and too much in the ftrain of common-place morality. Though these were well suited to the main design of the author, which was to form the mind of a young prince, yet they seem not congruous to the nature of epic poetry; the object of which is to improve us by means of actions, characters, and fentiments, rather than by delivering professed and formal inftruction."

TELEPHIUM, TRUE ORPINE, in botany: A genus of plants belonging to the class of *pentandria*, and order of *trigynia;* and in the natural fyftem ranging under the 54th order, *Mifcellaneæ.* The calyx is pentaphyllous; there are five petals, which are inferted into the receptacle; the capfule is unilocular and trivalvular. There are two fpecies, the *imperati* and *oppositifolia*.

TELESCOPE, an optical inftrument for viewing diftant objects; fo named by compounding the Greek words τηλε *far off*, and σκοπεω *to look at* or *contemplate*. This name is commonly appropriated to the larger fizes of the inftrument, while the fmaller are called PERSPECTIVE-GLASSES, SPY-GLASSES, OPERA-GLASSES. A particular kind, which is thought to be much brighter than the reft, is called a NIGHT GLASS.

To what has been faid already with refpect to the inventor of this moft noble and ufeful inftrument in the article OPTICS, we may add the two following claims.

Mr Leonhard Digges, a gentleman of the laft century of great and various knowledge, pofitively afferts in his *Stratoticos*, and in another work, that his father, a military gentleman, had an inftrument which he ufed in the field, by which he could bring diftant objects near, and could know a man at the diftance of three miles. He fays, that when his father was at home he had often looked through it, and could diftinguifh the waving of the trees on the oppofite fide of the Severn. Mr Digges refided in the neighbourhood of Briftol.

Francis Fontana, in his *Celeftial Obfervations*, publifhed at Naples in 1646, fays, that he was affured by a Mr Hardy, advocate of the parliament of Paris, a perfon of great learning and undoubted integrity, that on the death of his father, there was found among his things an old tube, by which diftant objects were diftinctly feen; and that it was of a date long prior to the telefcope lately invented, and had been kept by him as a fecret.

It is not at all improbable, that curious people, handling fpectacle glaffes, of which there were by this time great varieties, both convex and concave, and amufing themfelves with their magnifying power and the fingular effects which they produced in the appearances of things, might fometimes chance fo to place them as to produce diftinct and enlarged vifion. We know perfectly, from the table and fcheme which Sirturus has given us of the tools or difhes in which the fpectacle-makers fafhioned their glaffes, that they had convex lenfes formed to fpheres of 24 inches diameter, and of 11 inferior fizes. He has given us a fcheme of a fet which he got leave to meafure belonging to a fpectacle-maker of the name of *Rogette* at Corunna in Spain; and he fays that this man had tools of the fame fizes for concave glaffes. It alfo appears, that it was a general practice (of which we do not know the precife purpofe) to ufe a convex and concave glafs together. If any perfon fhould chance to put together a 24-inch convex and a 12-inch concave (wrought on both fides) at the diftance of 6 inches, he would have diftinct vifion, and the object would appear of double fize. Concaves of 6 inches were not uncommon, and one fuch combined with the convex of 24, at the diftance of 9 inches, would have diftinct vifion, and objects would be quadrupled in diameter. When fuch a thing occurred, it was natural to keep it as a curiofity, although the *rationale* of its operation was not in the leaft underftood. We doubt not but that this happened much oftener than in thefe two inftances. The chief wonder is, that it was not frequent, and taken notice of by fome writer. It is pretty plain that Galileo's firft telefcope was of this kind, made up of fuch fpectacle-glaffes as he could procure; for it magnified only three times in diameter: a thing eafily procured by fuch glaffes as he could find with every fpectacle-maker. And he could not but obferve, in his trials of their glaffes, that the deeper concaves and flatter convexes he employed, he produced the greater amplification; and then he would find himfelf obliged to provide a tool not ufed by the fpectacle-makers, viz. either a much flatter tool for a convex furface, or a much fmaller fphere for a concave: and, notwithftanding his telling us that it was by reflecting on the nature of refraction, and without any inftruction, we are perfuaded that he proceeded in this very way. His next telefcope magnified but five times. Now the flighteft acquaintance with the obvious laws of refraction would have directed him at once to a very fmall and deep concave, which would have been much eafier made, and have magnified more. But he groped his way with fuch fpectacle-glaffes as he could get, till he at laft made tools for very flat object-glaffes and very deep eye-glaffes, and produced a telefcope which magnified about 25 times. Sirturus faw it, and took the meafures of it. He afterwards faw a fcheme of it which Galileo had fent to a German prince at Infpruch, who had it drawn (that is, the circles for the tools) on a table in his gallery. The object-glafs was a plano-convex, a portion of a fphere, of 24 inches diameter; the eye-glafs was a double concave of 2 inches diameter: the focal diftances were therefore 24 inches and 1 inch nearly. This muft have been a very lucky operation, for Sirturus fays it was the beft telefcope he had feen; and we know that it requires the very beft work to produce this magnifying power with fuch fmall fpheres. Telefcopes continued to be made in this way for many years; and Galileo, though keenly engaged in the obfervation of Jupiter's fatellites, being candidate for the prize held out by the Dutch for the difcovery of the longitude, and therefore much interefted in the advantage which a convex eye-glafs would have given him, never made them of any other form. Kepler publifhed his Dioptrics in 1611: in which he tells us, all that he or others had difcovered of the law of refraction, viz. that in very fmall obliquities of incidence, the angle of refraction was nearly $\frac{1}{3}$d of the angle of incidence. This was indeed enough to have pointed out, with fufficient exactnefs, the conftruction of every optical inftrument that we are even now poffeffed of; for this proportionality of the angles of incidence and refraction is affumed in the conftruction of the optical figure for all of them; and the deviation from it is ftill confidered as the *refinement* of the art, and was not brought to any rule till 50 years after by Huyghens, and called by him ABERRATION. Yet even the fagacious Kepler feems not to have feen the advantage of any other conftruction of the telefcope; he juft feems to acknowledge the poffibility of it: and we are furprifed to fee writers giving him as the author of the aftronomical telefcope, or even as hinting at its conftruction. It is true, in the laft propofition he fhows how a telefcope may be made *apparently* with a convex eye-glafs; but this is only a frivolous

 fancy;

fancy; for the eye-glaſs is directed to be made convex externally, and a very deep concave on the inſide; ſo that it is, in fact, a meniſcus with the concavity prevalent. In the 86th propoſition, he indeed ſhows that it is poſſible to to place a convex glaſs behind another convex glaſs, that an eye ſhall ſee objects diſtinct, magnified, and inverted; and he ſpeaks very ſagaciouſly on the ſubject. After having ſaid that an eye placed behind the point of union of the firſt glaſs will ſee an object inverted, he ſhows that a ſmall part only will be ſeen; and then he ſhows that a convex glaſs, duly proportioned and properly placed, will ſhow more of it. But in ſhowing this, he ſpeaks in a way which ſhows evidently that he had formed no diſtinct notions of the manner in which this effect would be produced, only ſaying vaguely that the convergency of the ſecond glaſs would counteract the divergency beyond the focus of the firſt. Had he conceived the matter with any tolerable diſtinctneſs, after ſeeing the great advantage of taking in a field greater in almoſt any proportion, he would have eagerly catched at the thought, and enlarged on the immenſe improvement. Had he but drawn one figure of the progreſs of the rays through two convex glaſſes, ſuch as fig. 12. of Pl. CCCLXIV. the whole would have been open to his view.

This ſtep, ſo eaſy and ſo important, was reſerved for Father Scheiner, as has been already obſerved in the article OPTICS; and the conſtruction of this author, together with that of Janſen, are the models on which all refracting teleſcopes are now conſtructed; and in all that relates to their magnifying power, brightneſs, and field of viſion, they may be conſtructed on Kepler's principle, that the angles of refraction are in a certain given proportion to the angles of incidence.

But after Huyghens had applied his elegant geometry to the diſcovery of Snellius, viz. the proportionality, not of the angles, but of the ſines, and had aſcertained the aberrations from the foci of infinitely ſlender pencils, the reaſons were clearly pointed out why there were ſuch narrow limits affixed by nature to the performance of optical inſtruments, in conſequence of the indiſtinctneſs of viſion which reſulted from conſtructions where the magnifying power, the quantity of light, or the field of viſion, were extended beyond certain moderate bounds. The theory of aberrations, which that moſt excellent geometer eſtabliſhed, has enabled us to diminiſh this indiſtinctneſs ariſing from any of theſe cauſes; and this diminution is the ſole aim of all the different conſtructions which have been contrived ſince the days of Galileo and Scheiner.

THE deſcription which has been already given of the various conſtructions of teleſcopes in the article OPTICS, is ſufficient for inſtructing the reader in the general principles of their conſtruction, and with moderate attention will ſhow the manner in which the rays of light proceed, in order to enſure the different circumſtances of amplification, brightneſs, and extent of field, and even diſtinctneſs of viſion, in as far as this depends on the proper intervals between the glaſſes. But it is inſufficient for giving us a knowledge of the improvements which are aimed at in the different departures from the original conſtructions of Galileo and Scheiner, the advantage of the double eye-glaſs of Huyghens, and the quintuple eye-glaſs of Dollond: ſtill more is it inſufficient for ſhowing us why the higheſt degrees of amplification and moſt extenſive field cannot be obtained by the mere proportion of the focal diſtances of the glaſſes, as Kepler had taught. In ſhort, without the Huyghenian doctrine of aberrations, neither can the curious reader learn the limits of their performance, nor the artiſt learn why one teleſcope is better than another, or in what manner to proceed to make a teleſcope differing in any particular from thoſe which he ſervilely copies. Teleſcope.

Although all the improvements in the conſtruction of teleſcopes ſince the publication of Huyghens's Dioptrics have been the productions of this iſland, and although Dr Smith of Cambridge has given the moſt elegant and perſpicuous account of this ſcience that has yet appeared, we do not recollect a performance in the Engliſh language (except the Optics of Emerſon) which will carry the reader beyond the mere ſchoolboy elements of the ſcience, or enable a perſon of mathematical ſkill to underſtand or improve the conſtruction of optical inſtruments. The laſt work on this ſubject of any extent (Dr Prieſtley's Hiſtory of Viſion) is merely a parlour book for the amuſement of half-taught dilettanti, but is totally deficient in the mathematical part, although it is here that the ſcience of optics has her chief claim to pre-eminence, and to the name of a DISCIPLINA ACCURATA. But this would have been *ultra crepidam*; and the author would in all probability have made as poor a figure here as he has done in his attempts to degrade his ſpecies in his Commentaries on the *Vibratiunculæ* of Hartley; motions which neither the author nor his amplificator were able to underſtand or explain. We truſt that our readers, jealous as we are of every thing that ſinks us in the ſcale of nature's works, will pardon this tranſient ejaculation of ſpleen, when our thoughts are called to a ſyſtem which, of *abſolute and unavoidable neceſſity*, makes the DIVINE MIND nothing but a quivering of *that matter* of which it is the AUTHOR and unerring DIRECTOR. *Sed miſſum faciamus.*

We think therefore that we ſhall do the public ſome ſervice, by giving ſuch an account of this *higher branch* of optical ſcience as will at leaſt tend to the complete underſtanding of this noble inſtrument, by which our conceptions of the extent of almighty power, and wiſdom, and beneficence, are ſo wonderfully enlarged. In the proſecution of this we hope that many general rules will emerge, by which artiſts who are not mathematicians may be enabled to conſtruct optical inſtruments with intelligence, and avoid the many blunders and defects which reſult from mere ſervile imitation.

The general aim in the conſtruction of a teleſcope is, to form, by means of mirrors or lenſes, an image of the diſtant object, as large, as bright, and as extenſive as is poſſible, conſiſtently with diſtinctneſs; and then to view the image with a magnifying glaſs in any convenient manner. This gives us an arrangement of our ſubject. We ſhall firſt ſhow the principles of conſtruction of the object-glaſs or mirror, ſo as that it ſhall form an image of the diſtant object with theſe qualities; and then ſhow how to conſtruct the magnifying glaſs or eye-piece, ſo as to preſerve them unimpaired.

This indiſtinctneſs which we wiſh to avoid ariſes from two cauſes; the ſpherical figures of the refracting and reflecting ſurfaces, and the different refrangibility of the differently coloured rays of light. The firſt may be called the SPHERICAL and the ſecond the CHROMATIC indiſtinctneſs; and the deviations from the foci, determined by the elementary theorem (OPTICS, p. 289.), may be called the SPHERICAL and the CHROMATIC aberrations.

The limits of a Work like this will not permit us to give any more of the doctrine of aberrations than is abſolutely neceſſary for the conſtruction of achromatic teleſcopes; and we muſt refer the reader for a general view of the whole to Euler's *Dioptrics*, and other works of that kind. Dr Smith has given as much as was neceſſary for the compariſon of the merits of different glaſſes of ſimilar conſtruction, and this in a very plain and elegant manner.

We ſhall begin with the aberration of colour, becauſe it is the moſt ſimple.

Telescope.

Let white or compounded light fall perpendicularly on the flat side PQ (fig. 1.) of a plano-convex lens PVQ, whose axis is CV and vertex V. The white ray *p*P falling on the extremity of the lens is dispersed by refraction at the point P of the spherical surface, and the red ray goes to the point *r* of the axis, and the violet ray to the point *v*. In like manner the white ray *q*Q is dispersed by refraction at Q, the red ray going to *r*, and the violet to *v*. The red ray P*r* crosses the violet ray Q*v* in a point D, and Q*r* crosses P*v* in a point E; and the whole light refracted and dispersed by the circumference, whose diameter is PQ, passes through the circular area, whose diameter is DE. Supposing that the lens is of such a form that it would collect red rays, refracted by its whole surface in the point *r*, and violet in the point *v*; then it is evident that the whole light which occupies the surface of the lens will pass through this little circle, whose diameter is DE. Therefore white light issuing from a point so distant that the rays may be considered as parallel, will not be collected in another point or focus, but will be dispersed over the surface of that little circle; which is therefore called the *circle of chromatic dispersion*; and the radiant point will be represented by this circle. The neighbouring points are in like manner represented by circles; and these circles encroaching on and mixing with each other, must occasion haziness or confusion, and render the picture indistinct. This indistinctness will be greater in the proportion of the number of circles which are in this manner mixed together. This will be in the proportion of the room that is for them; that is, in proportion to the area of the circle, or in the duplicate proportion of its diameter. Our first business therefore is, to obtain measures of this diameter, and to mark the connection between it and the aperture and focal distance of the lens.

Let *i* be to *r* as the sine of incidence in glass to the sine of refraction of the red rays; and let *i* be to *v* as the sine of incidence to the sine of refraction of the violet rays. Then we say, that when the aperture PQ is moderate, $v-r : v+r-2i = \mathrm{DE} : \mathrm{PQ}$, very nearly. For let DE, which is evidently perpendicular to V*r*, meet the parallel incident rays in K and L and the radii of the spherical surface in G and H. It is plain that GPK is equal to the angle of incidence on the posterior or spherical surface of the lens; and GP*r* and GP*v* are the angles of refraction of the red and the violet rays; and that GK, GD, and GE, are very nearly as the sines of those angles, because the angles are supposed to be small. We may therefore institute this proportion $\mathrm{DE} : \mathrm{KD} = v-r : r-i$; then, by doubling the consequents $\mathrm{DE} : 2\mathrm{KD} = v-r : 2r-2i$. Also $\mathrm{DE} : 2\mathrm{KD} + \mathrm{DE} = v-r : 2r-2i+v-r, = v-r : r+v-2i$. But $2\mathrm{KD} + \mathrm{DE}$ is equal to KL or PQ. Therefore we have $\mathrm{DE} : \mathrm{PQ} = v-r : r+v-2i$. *Q. E. D.*

Cor. 1. Sir Isaac Newton, by most accurate observation, found, that in common glass the sines of refraction of the red and violet rays were 77 and 78 where the sine of incidence was 50. Hence it follows, that $v-r$ is to $v+r-2i$ as 1 to 55; and that the diameter of the smallest circle of dispersion is $\frac{1}{55}$th part of that of the lens.

2. In like manner may be determined the circle of dispersion that will comprehend the rays of any particular colour or set of colours. Thus all the orange and yellow will pass through a circle whose diameter is $\frac{1}{250}$th of that of the lens.

3. In different surfaces, or plano-convex lenses, the angles of aberration *r*P*v* are as the breadth PQ directly, and as the focal distance VF inversely; because any angle DPE is as its subtense DE directly and radius DP inversely. *N. B.* we call VF the focal distance, because at this distance, or at the point F, the light is most of all constipated. If we examine the focal distance by holding the lens to the sun, we judge it to be where the light is drawn into the smallest spot.

When we reflect that a lens of 5½ inches in diameter has a circle of dispersion $\frac{1}{10}$th of an inch in diameter, we are surprised that it produces any picture of an object that can be distinguished. We should not expect greater distinctness from such a lens than would be produced in a camera obscura without a lens, by simply admitting the light through a hole of $\frac{1}{10}$th of an inch in diameter. This, we know, would be very hazy and confused. But when we remark the superior vivacity of the yellow and orange light in comparison with the rest, we may believe that the effect produced by the confusion of the other colours will be much less sensible. But a stronger reason is, that the light is much denser in the middle of the circle of dispersion, and is exceedingly faint towards the margin. This, however, must not be taken for granted; and we must know distinctly the manner in which the light of different colours is distributed over the circle of chromatic dispersion, before we pretend to pronounce on the immense difference between the indistinctness arising from colour and that arising from the spherical figure. We think this the more necessary, because the illustrious discoverer of the chromatic aberration has made a great mistake in the comparison, because he did not consider the distribution of the light in the circle of spherical dispersion. It is therefore proper to investigate the chromatic distribution of the light with the same care that we bestowed on the spherical dispersion in OPTICS, n° 251. &c.; and we shall then see that the superiority of the reflecting telescope is incomparably less than Newton imagined it to be.

Therefore let EB (fig. 2.) represent a plano-convex lens, of which C is the centre and C*r* the axis. Let us suppose it to have no spherical aberration, but to collect rays occupying its whole surface to single points in the axis. Let a beam of white or compounded light fall perpendicularly on its plane surface. The rays will be so refracted by its curved surface, that the extreme red rays will be collected at *r*, the extreme violet rays at *w*, and those of intermediate refrangibility at intermediate points, *o*, *y*, *g*, *b*, *p*, *v*, of the line *r w*, which is nearly $\frac{1}{28}$th of *r*C. The extreme red and violet rays will cross each other at A and D; and AD will be a section or diameter of the circle of chromatic dispersion, and will be about $\frac{1}{55}$th of EB. We may suppose *wr* to be bisected in *b*, because *wb* is to *br* very nearly in the ratio of equality (for $rb : r\mathrm{C} = b\mathrm{A} : c\mathrm{E}, = b\mathrm{A} : c\mathrm{B}, = wb : w\mathrm{C}$). The line *rw* will be a kind of prismatic spectrum, red from *r* to *o*, orange-coloured from *o* to *y*, yellow from *y* to *g*, green from *g* to *b*, blue from *b* to *p*, purple from *p* to *v*, and violet from *v* to *w*.

The light in its compound state must be supposed uniformly dense as it falls upon the lens; and the same must be said of the rays of any particular colour. Newton supposes also, that when a white ray, such as *e*E, is dispersed into its component coloured rays by refraction at E, it is uniformly spread over the angle DEA. This supposition is indeed gratuitous; but we have no argument to the contrary, and may therefore consider it as just. The consequence is, that each point *w*, *v*, *p*, *b*, &c. of the spectrum is not only equally luminous, but also illuminates uniformly its corresponding portion of AD: that is to say, the coating (so to term it) of any particular colour, such as purple, from the point *p*, is uniformly dense in every part of AD on which it falls. In like manner, the colouring of yellow, intercepted by a part of AD in its passage to the point *y*, is uniformly dense in all its parts. But the density of the different colours in AD is extremely different: for since the radiation in *w* is equally dense with that in *p*, the density of the violet colouring, which radiates from *w*, and is spread

spread over the whole of AD, must be much less than the density of the purple colouring, which radiates from f, and occupies only a part of AD round the circle b. These densities must be very nearly in the inverse proportion of wb^2 to pb^2.

Hence we see, that the central point b will be very intensely illuminated by the blue radiating from $p\,b$ and the green intercepted from bg. It will be more faintly illuminated by the purple radiating from vp, and the yellow intercepted from gy; and still more faintly by the violet from wv, and the orange and red intercepted from yr. The whole colouring will be a white, tending a little to yellowness. The accurate proportion of these colourings may be computed from our knowledge of the position of the points o, y, g, &c. But this is of little moment. It is of more consequence to be able to determine the proportion of the total intensity of the light in b to its intensity in any other point I.

For this purpose draw rIR, IwW, meeting the lens in R and W. The point I receives none of the light which passes through the space RW: for it is evident that bI : CR $= b$A : CE, $=$ 1 : 55, and that CR $=$ CW; and therefore, since all the light incident on EB passes through AB, all the light incident on RW passes through Ii (bi being made $= b$I). Draw oIO, yIY, gIG, IpP, IvV. It is plain, that I receives red light from RO, orange from OY, yellow from YG, green from GE, a little blue from BP, purple from PV, and violet from VW. It therefore wants some of the green and of the blue.

That we may judge of the intensity of these colours at I, suppose the lens covered with paper pierced with a small hole at G. The green light only will pass through I; the other colours will pass between I and b, or between I and A, according as they are more or less refrangible than the particular green at I. This particular colour converges to g, and therefore will illuminate a small spot round I, where it will be as much denser than it is at G as this spot is smaller than the hole at G. The natural density at G, therefore, will be to the increased density at I, as $g\mathrm{I}^2$ to $g\mathrm{G}^2$, or as gb^2 to $g\mathrm{C}^2$, or as $b\mathrm{I}^2$ to CG^2. In like manner, the natural density of the purple coming to I through an equal hole at P will be to the increased density at I as $b\mathrm{I}^2$ to CP^2. And thus it appears, that the intensity of the differently coloured illuminations of *any* point of the circle of dispersion, is inversely proportional to the square of the distance from the centre of the lens to the point of its surface through which the colouring light comes to this point of the circle of dispersion. This circumstance will give us a very easy, and, we think, an elegant solution of the question.

Bisect CE in F, and draw FL perpendicular to CE, making it equal to CF. Through the point L describe the hyperbola KLN of the second order, that is, having the ordinates EK, FL, RN, &c. inversely proportional to the squares of the abscissæ CE, CF, CR, &c.; so that FL : RN $= \frac{1}{\mathrm{CF}^2} : \frac{1}{\mathrm{CR}^2}$, or $= \mathrm{CR}^2 : \mathrm{CF}^2$, &c. It is evident that these ordinates are proportional to the densities of the severally coloured lights which go from them to any points whatever of the circle of dispersion.

Now the total density of the light at I depends both on the density of each particular colour and on the number of colours which fall on it. The ordinates of this hyperbola determine the first; and the space ER measures the number of colours which fall on I, because it receives light from the whole of ER, and of its equal BW. Therefore, if ordinates be drawn from any point of ER, their sum will be as the whole light which goes to I; that is, the total density of the light at I will be proportional to the area NREK. Now it is known that CE$\times$EK is equal to the infinitely extended area lying beyond EK; and CR$\times$RN is equal to the infinitely extended area lying beyond RN. Therefore the area NREK is equal to CR$\times$RN$-$CE$\times$EK. But RN and EK are respectively equal to $\frac{\mathrm{CF}^3}{\mathrm{CR}^2}$ and $\frac{\mathrm{CF}^3}{\mathrm{CE}^2}$. Therefore the density at I is proportional to $\mathrm{CF}^3 \times \left(\frac{\mathrm{CR}}{\mathrm{CR}^2} - \frac{\mathrm{CE}}{\mathrm{CE}^2}\right)$, $= \mathrm{CF}^3 \times \left(\frac{1}{\mathrm{CR}} - \frac{1}{\mathrm{CE}}\right)$, $= \mathrm{CF}^3 \times \frac{\mathrm{CE}-\mathrm{CR}}{\mathrm{CE}\times\mathrm{CR}}$, $= \mathrm{CF}^3 \times \frac{\mathrm{ER}}{\mathrm{CE}\times\mathrm{CR}}$, $= \frac{\mathrm{CF}^3}{\mathrm{CE}} \times \frac{\mathrm{ER}}{\mathrm{CR}}$. But because CF is $\frac{1}{2}$ of CE, $\frac{\mathrm{CF}^3}{\mathrm{CE}}$ is $= \frac{\mathrm{CF}^3}{2\mathrm{CF}}$, $= \frac{\mathrm{CF}^2}{2}$, a constant quantity. Therefore the density of the light at I is proportional to $\frac{\mathrm{ER}}{\mathrm{CR}}$, or to $\frac{\mathrm{AI}}{b\mathrm{I}}$, because the points R and I are similarly situated in EC and Ab.

Farther, if the semi-aperture CE of the lens be called 1, $\frac{\mathrm{CF}^2}{2}$ is $= \frac{1}{8}$, and the density at I is $= \frac{\mathrm{AI}}{8b\mathrm{I}}$.

Here it is proper to observe, that since the point R has the same situation in the diameter EB that the point I has in the diameter AD of the circle of dispersion, the circle described on EB may be conceived as the magnified representation of the circle of dispersion. The point F, for instance, represents the point f in the circle of dispersion, which bisects the radius bA; and f receives no light from any part of the lens which is nearer the centre than F, being illuminated only by the light which comes through EF and its opposite BF. The same may be said of every other point.

In like manner, the density of the light in f, the middle between b and A, is measured by $\frac{\mathrm{EF}}{\mathrm{CF}}$, which is $= \frac{\mathrm{EF}}{\mathrm{EF}}$, or 1. This makes the density at this point a proper standard of comparison. The density there is to the density at I as 1 to $\frac{\mathrm{AI}}{b\mathrm{I}}$, or as bI to AI; and this is the simplest mode of comparison. The density half way from the centre of the circle of dispersion is to the density at any point I as bI to IA.

Lastly, through L describe the common rectangular hyperbola kLn, meeting the ordinates of the former in k, L, and n: and draw kh parallel to EC, cutting the ordinates in g, f, r, &c. Then CR : CE $=$ Ek : Rn, and CR : CE $-$ CR $=$ Ek : R$n-$Ek, or CR : RE $=$ Ek : rn, and bI : IA $=$ Ek : rn. And thus we have a very simple expression of the density in any point of the circle of dispersion. Let the point be anywhere, as at I. Divide the lens in R as AD is divided in I, and then rn is as the density in I.

These two measures were given by Newton; the first in his *Treatise de Mundi Systemat.*, and the last in his *Optics*; but both without demonstration.

If the hyperbola kLn be made to revolve round the axis CQ, it will generate a solid spindle, which will measure the whole quantity of light which passes through different portions of the circle of dispersion. Thus the solid produced by the revolution of Lkf will measure all the light which occupies the outer part of the circle of dispersion lying without the middle of the radius. This space is $\frac{3}{4}$ths of the whole circle; but the quantity of light is but $\frac{1}{4}$th of the whole.

A still more simple expression of the whole quantity of light passing through different portions of the circle of chromatic dispersion may now be obtained as follows:

It has been demonstrated, that the density of the light at

I is as $\frac{AI}{\ell I}$, or as $\frac{ER}{CR}$. Suppose the figure to turn round the axis. I or R describe circumferences of circles; and the whole light passing through this circumference is as the circumference, or as the radius, and as the density jointly. It is therefore as $\frac{ER}{CR} \times CR$, that is, as ER. Draw any straight line E*m*, cutting RN in *s*, and any other ordinate FL in *x*R*s*. The whole light which illuminates the circumference described by I is to the whole light which illuminates the centre *b* as ER to EC, or as R*s* to C*m*. In like manner, the whole light which illuminates the circumference described by the point *f* in the circle of dispersion is to the whole light which illuminates the centre *b*, as F*x* to C*m*. The lines C*m*, RS, F*x*, are therefore proportional to the whole light which illuminates the corresponding circumferences in the circle of dispersion. Therefore the whole light which falls on the circle whose radius is *b*I, will be represented by the trapezium in CRS; and the whole light which falls on the ring described by IA, will be represented by the triangle E*s*R; and so of any other portions.

By considering the figure, we see that the distribution of the light is exceedingly unequal. Round the margin it has no sensible density; while its density in the very centre is incomparably greater than in any other point, being expressed by the asymptote of a hyperbola. Also the circle described with the radius $\frac{Ab}{2}$ contains $\frac{1}{2}$ths of the whole light. No wonder then that the confusion caused by the mixture of these circles of dispersion is less than one should expect; besides, it is evident that the most lively or impressive colours occupy the middle of the spectrum, and are there much denser than the rest. The margin is covered with an illumination of deep red and violet, neither of which colours are brilliant. The margin will be of a dark claret colour. The centre revives all the colours, but in a proportion of intensity greatly different from that in the common prismatic spectrum, because the radiant points L, *p*, *b*, *g*, &c. by which it is illuminated, are at such different distances from it. It will be white; but we apprehend not a pure white, being greatly overcharged with the middle colours.

These considerations show that the coloured fringes, which are observed to border very luminous objects seen on a dark ground through optical instruments, do not proceed from the object-glass of a telescope or microscope, but from an improper construction of the eye-glasses. The chromatic dispersion would produce fringes of a different colour, when they produce any at all, and the colours would be differently disposed. But this dispersion by the object-glass can hardly produce any fringes: its effect is a general and almost uniform mixture of circles all over the field, which produces an uniform haziness, as if the object were viewed at an improper distance, or out of its focus, as we vulgarly express it.

We may at present form a good guess at the limit which this cause puts to the performance of a telescope. A point of a very distant object is represented, in the picture formed by the object-glass, by a little circle, whose diameter is at least $\frac{1}{100}$ th of the aperture of the object-glass, making a very full allowance for the superior brilliancy and density of the central light. We look at this picture with a magnifying eye-glass. This magnifies the picture of the point. If it amplify it to such a degree as to make it an object individually distinguishable, the confusion is then sensible. Now this can be computed. An object subtending one minute of a degree is distinguished by the dullest eye, even although it be a dark object on a bright ground. Let us therefore suppose a telescope, the object-glass of which is of six feet focal distance, and one inch aperture. The diameter of the circle of chromatic dispersion will be [illegible]th of an inch, which subtends at the centre of the object-glass an angle of about $9\frac{1}{2}$ seconds. This, when magnified six times by an eye-glass, would become a distinguishable object; and a telescope of this length would be indistinct if it magnified more than six times, if a point were thus spread out into a spot of uniform intensity. But the spot is much less intense about its margin. It is found experimentally that a piece of engraving, having fine cross hatches, is not sensibly indistinct till brought so far from the limits of perfectly distinct vision, that this indistinctness amounts to 6′ or 5′ in breadth.—Therefore such a telescope will be sensibly distinct when it magnifies 36 times; and this is very agreeable to experience.

We come, in the second place, to the more arduous task of ascertaining the error arising from the spherical figure of the surfaces employed in optical instruments.—Suffice it to say, before we begin, that although geometers have exhibited other forms of lenses which are totally exempt from this error, they cannot be executed by the artist; and we are therefore restricted to the employment of spherical surfaces.

Of all the determinations which have been given of spherical aberration, that by Dr Smith, in his Optics, which is an improvement of the fundamental theorem of that most elegant geometer Huyghens, is the most perspicuous and palpable. Some others are more concise, and much better fitted for after use, and will therefore be employed by us in the prosecution of this article. But they do not keep in view the optical facts, giving the mind a picture of the progress of the rays, which it can contemplate and discover amidst many modifying circumstances. By ingenious substitutions of analytical symbols, the investigation is rendered expeditious, concise, and certain; but these are not immediate symbols of things, but of operations of the mind; objects sufficiently subtile of themselves, and having no need of substitutions to make us lose sight of the real subject; and thus our occupation degenerates into a process almost without ideas. We shall therefore set out with Dr Smith's fundamental Theorem.

1. *In Reflections.*

Let AVB (fig. 3.) be a concave spherical mirror, of which C is the centre, V the vertex, CV the axis, and F the focus of an infinitely slender pencil of parallel rays passing through the centre. Let the ray *a*A, parallel to the axis, be reflected in AG, crossing the central ray CV in *f*. Let AP be the sine of the semi-aperture AV, AD its tangent, and CD its secant.

The aberration F*f* from the principal focus of central rays is equal to $\frac{1}{2}$ of the excess VD of the secant above the radius, or very near equal to $\frac{1}{4}$ of VP, the versed sine of the semi-aperture.

For because AD is perpendicular to CA, the points C, A, D, are in a circle, of which CD is the diameter; and because A*f* is equal to C*f*, by reason of the equality of the angles *f*AC, *f*CA, and CA*a*, *f* is the centre of the circle through C, A, D, and *f*D is $= \frac{1}{2}$ CD. But FC is $= \frac{1}{2}$ CV. Therefore F*f* is $\frac{1}{2}$ of VD.

But because DV : VP $=$ DC : VC, and DC is very little greater than VC when the aperture AB is moderate, DV is very little greater than VP, and F*f* is very nearly equal to $\frac{1}{2}$ of VP.

Cor. 1. The longitudinal aberration is $= \frac{AV^2}{4\,CV}$, for PV is very nearly $= \frac{AV^2}{2\,CV}$.

Cor. 2. The lateral aberration FG is $= \frac{AV^3}{2\,CV^2}$. For $FG : Ff = AP : Pf, = AV : \frac{1}{2}CV$ nearly, and therefore $FG = \frac{AV^2}{4\,CV} \times \frac{2}{CV}, = \frac{AV^3}{2\,CV^2}$.

2. *In Refractions.*

Let AVB (fig. 4. A or B) be a ſpherical ſurface ſeparating two refracting ſubſtances, C the centre, V the vertex, AV the ſemi aperture, AP its ſine, PV its verſed ſine, and F the focus of parallel rays infinitely near to the axis. Let the extreme ray aA, parallel to the axis, be refracted into AG, croſſing CF in f, which is therefore the focus of extreme parallel rays.

The rectangle of the ſine of incidence, by the difference of the ſines of incidence and refraction, is to the ſquare of the ſine of refraction, as the verſed ſine of the ſemi-aperture is to the longitudinal abberration of the extreme rays.

Call the ſine of incidence i, the ſine of refraction r, and their difference d.

Join CA, and about the centre f deſcribe the arch AD.

The angle ACV is equal to the angle of incidence, and CAf is the angle of refraction. Then, ſince the ſine of incidence is to the ſine of refraction as VF to CF, or as Af to Cf, that is, as Df to Cf, we have

$$CF : FV = Cf : fD$$

by converſion $\quad CF : CV = Cf : CD$

altern. conver. $\quad CF - Cf : CV - CD = CF : CV$

or $\quad Ff : VD = CF : CV, = r : d.$

Now $PV = \frac{AP^2}{CP + CV}, = \frac{AP^2}{2\,CV}$ nearly, and $PD = \frac{AP^2}{fP + fV} = \frac{AP^2}{2\,fV}$ nearly, $= \frac{AP^2}{2\,FV}$ nearly. Therefore $PV : PD = FV : CV$, and $DV : PV = CF : FV$ nearly.

We had above $\quad Ff : VD = r : d$;

and now $\quad VD : PV = CF : FV, = r : i$;

therefore $\quad Ff : PV = r^2 : di$,

and $Ff = \frac{r^2}{di} \times PV$. *Q. E. D.*

The abberration will be different according as the refraction is made towards or from the perpendicular; that is, according as r is leſs or greater than i. They are in the ratio of $\frac{r^2}{di}$ to $\frac{i^2}{dr}$, or of r^3 to i^3. The abberration therefore is always much diminiſhed when the refraction is made from a rare into a denſe medium. The proportion of the ſines for air and glaſs is nearly that of 3 to 2. When the light is refracted into the glaſs, the abberration is nearly $\frac{4}{3}$ of PV; and when the light paſſes out of glaſs into air, it is about $\frac{9}{2}$ of PV.

Cor. 1. $Ff = \frac{r^2}{di} \times \frac{AP^2}{2CV}$ nearly, and it is alſo $= \frac{r^2}{d^2} \times \frac{AP^2}{2FV}$, becauſe $PV = \frac{AP^2}{2CV}$ nearly, and $i : d = FV : CV$.

Cor. 2. Becauſe $fP : PA = Ff : FG$
or $FV : AV = Ff : FG$ nearly,

we have FG, the lateral abberration, $= Ff \times \frac{AV}{FV}, = \frac{r^2}{d^2} \times \frac{AV^3}{2FV^2}, = \frac{r^2}{i^2} \times \frac{AV^3}{2CV^2}$.

Cor. 3. Becauſe the angle FAf is proportional to $\frac{FG}{FV}$ very nearly, we have the angular abberration $FAf = \frac{r^2}{d^2} \times \frac{AV^3}{FV^3} = \frac{r^2}{i^2} \times \frac{AV^3}{2CV^3}$.

In general, the longitudinal aberrations from the focus of central parallel rays are as the ſquares of the apertures directly, and as the focal diſtances inverſely; and the lateral aberrations are as the cubes of the apertures directly, and the ſquares of the focal diſtances inverſely; and the angular aberrations are as the cubes of the aperture directly, and the cubes of the focal diſtances inverſely. Teleſcope.

The reader muſt have obſerved, that to ſimplify the inveſtigation, ſome ſmall errors are admitted. PV and PD are not in the exact proportion that we aſſumed them, nor is Df equal to FV. But in the ſmall apertures which ſuffice for optical inſtruments, theſe errors may be diſregarded.

This ſpherical aberration produces an indiſtinctneſs of viſion, in the ſame manner as the chromatic aberration does, *viz.* by ſpreading out every mathematical point of the object into a little ſpot in its picture; which ſpots, by mixing with each other, confuſe the whole. We muſt now determine the diameter of the circle of diffuſion, as we did in the caſe of chromatic diſperſion.

Let a ray $\beta\alpha$ (fig. 5.) be refracted on the other ſide of the axis, into $\alpha H \varphi$, cutting AfG in H, and draw the perpendicular EH. Call AV a, αV α, Vf (or VF, or $V\varphi$, which in this compariſon may be taken as equal) $= f$, $Ff = b$, and $fE = x$. Plate ...

$AV^2 : \alpha V^2 = Ff : F\varphi$ (already demonſtrated) and $F\varphi = \frac{\alpha^2}{a^2}b$, and $Ff - F\varphi$, (or $f\varphi$) $= b - \frac{\alpha^2}{a^2}b, = \frac{a^2b - \alpha^2 b}{a^2}, = \frac{b}{a^2} \times a^2 - \alpha^2, = \frac{b}{a^2} \times \overline{a + \alpha} \times \overline{a - \alpha}$. Alſo $Pf : PA = fE : EH$, or $f : a = x : \frac{ax}{f}, = EH$. And $P\pi : P\varphi = EH : E\varphi$, or $\alpha : f = \frac{ax}{f} : \frac{ax}{\alpha}, = E\varphi$. Therefore $f\varphi = \frac{ax}{\alpha} + x, = \frac{\overline{a + \alpha}\,x}{\alpha}, = \frac{x}{\alpha} \times \overline{a + \alpha}$. Therefore $\frac{x}{\alpha} \times \overline{a + \alpha} = \frac{b}{a^2} \times \overline{a + \alpha} \times \overline{a - \alpha}$, and $\frac{x}{\alpha} = \frac{b}{a^2} \times \overline{a - \alpha}$, and $x = \frac{b}{a^2} \times \alpha\,(a - \alpha)$. Therefore x is greateſt when $\alpha \times \overline{a - \alpha}$ is greateſt; that is, when $\alpha = \frac{1}{2}a$. Therefore EH is greateſt when $P\pi$ is equal to the half of AP. When this is the caſe, we have at the ſame time $\frac{b}{a^2} \times \alpha\,(a - \alpha) = \frac{b}{a^2} \times \frac{1}{4}a^2$, and $x = \frac{1}{4}b$, or $EH = \frac{1}{4}FG$. That is, the diameter of the circle of aberration through which the whole of the refracted light muſt paſs, is $\frac{1}{4}$ of the diameter of the circle of aberration at the focus of parallel central rays. In the chromatic aberration it was $\frac{1}{2}$; ſo that in this reſpect the ſpherical aberration does not create ſo great confuſion as the chromatic.

We are now able to compare them, ſince we have now the meaſure of both the circles of aberration.

It has not been found poſſible to give more than four inches of aperture to an object glaſs of 100 feet focal diſtance, ſo as to preſerve ſufficient diſtinctneſs. If we compute the diameter of the circle EH correſponding to this aperture, we ſhall find it not much to exceed $\frac{1}{120,000}$ of an inch. If we reſtrict the circle of chromatic diſperſion to $\frac{1}{250}$ of the aperture, which is hardly the fifth part of the whole diſperſion in it, it is $\frac{1}{62\frac{1}{2}}$ of an inch, and is about 1900 times greater than the other.

The circle of ſpherical aberration of a plano convex lens, with the plane ſide next the diſtant object, is equal to the circle of chromatic diſperſion when the ſemi-aperture is about

Telescope about 15′: For we faw formerly that EH is $\frac{1}{4}$ of FG, and that FG is $= \frac{r^2}{i^2} \frac{AP^3}{2AC^2}$, and therefore $EG = \frac{r^2}{i^2} \times \frac{AP^3}{8AC^2}$. This being made $= \frac{AP}{55}$, gives us $AP = \sqrt{\frac{8i^2 AC^2}{55r^2}}$, which is nearly $\frac{AC}{4}$, and correfponds to an aperture of 30° diameter, if r be to i as 3 to 2.

Sir Ifaac Newton was therefore well entitled to fay, that it was quite needlefs to attempt figures which fhould have lefs aberration than fpherical ones, while the confufion produced by the chromatic difperfion remained uncorrected. Since the indiftinctnefs is as the fquares of the diameters of the circles of aberration, the difproportion is quite beyond our imagination, even when Newton has made fuch a liberal allowance to the chromatic difperfion. But it muft be acknowledged, that he has not attended to the diftribution of the light in the circle of fpherical aberration, and has haftily fuppofed it to be like the diftribution of the coloured light, indefinitely rare in the margin, and denfer in the centre.

We are indebted to Father Bofcovich for the elegant determination of this diftribution, which we have given in the article OPTICS. From this it appears, that the light in the margin of the circle of fpherical aberration, inftead of being incomparably rarer than in the fpaces between it and the centre, is incomparably denfer. The indiftinctnefs therefore produced by the interfection of thefe luminous circumferences is vaftly great, and increafes the whole indiftinctnefs exceedingly. By a grofs calculation which we made, it appears to be increafed at leaft 500 times. The proportional indiftinctnefs therefore, inftead of being 1900^2 to 1, is only $\frac{1900^2}{500}$, or nearly 7220 to 1; a proportion ftill fufficiently great to warrant Newton's preference of the reflecting telefcope of his invention. And we may now obferve, that the reflecting telefcope has even a great advantage over a refracting one of the fame focal diftance, with refpect to its fpherical aberration: For we have feen (*Cor.* 2.) that the lateral aberration is $\frac{r^2}{i^2} \frac{AV^3}{2CV^2}$. This for a plano-convex glafs is nearly $\frac{9}{4} \frac{AV^3}{2CV^2}$. And the diameter of the circle of aberration is one-fourth of this, or $\frac{9}{16} \times \frac{AV^3}{2CV^2}$. In like manner, the lateral aberration of a concave mirror is $\frac{AV^3}{2CV^2}$; and the diameter of the circle of difperfion is $\frac{AV^3}{8CV^2}$; and therefore if the furfaces were portions of the fame fphere, the diameter of the circle of aberration of refracted rays would be to that of the circle of aberration of reflected rays as $\frac{9}{16}$ to $\frac{1}{4}$, or as 9 to 4. But when the refracting and reflecting furfaces, in the pofition here confidered, have the fame focal diftance, the radius of the refracting furface is four times that of the reflecting furface. The proportion of the diameters of the circles of fpherical aberration is that of 9×4^2 to 4, or of 144 to 4, or 36 to 1. The diftinctnefs therefore of the reflector is 36×36, or 1296 times greater than that of a plano-convex lens (placed with the plane fide next the diftant object) of the fame breadth and focal diftance, and will therefore admit of a much greater magnifying power. This comparifon is indeed made in circumftances moft favourable to the reflector, becaufe this is the very worft pofition of a plano-convex lens. But we have not as yet learned the aberration in any other pofition. In another pofition the refraction and confequent aberration of both furfaces are complicated.

Before we proceed to the confideration of this very difficult fubject, we may deduce from what has been already demonftrated feveral general rules and maxims in the conftruction of telefcopes, which will explain (to fuch readers as do not wifh to enter more deeply into the fubject), and juftify the proportion which long practice of the beft artifts has fanctioned.

Indiftinctnefs proceeds from the commixture of the circles of aberration on the retina of the eye: For any one *fenfible* point of the retina, being the centre of a circle of aberration, will at once be affected by the admixture of the rays of as many different pencils of light as there are fenfible points in the area of that circle, and will convey to the mind a mixed fenfation of as many vifible points of the object. This number will be as the area of the circle of aberrations, whatever be the fize of a fenfible point of the retina. Now in vifion with telefcopes, the diameter of the circle of aberration on the retina is as the *apparent* magnitude of the diameter of the correfponding circle in the focus of the eye-glafs; that is, as the angle fubtended by this diameter at the centre of the eye-glafs; that is, as the diameter itfelf directly, and as the focal diftance of the eye-glafs inverfely. And the area of that circle on the retina is as the area of the circle in the focus of the eye glafs directly, and as the fquare of the focal diftance of the eye-glafs inverfely. And this is the meafure of the apparent indiftinctnefs.

Cor. In all forts of telefcopes, and alfo in compound microfcopes, an object is feen equally diftinct when the focal diftance of the eye-glaffes are proportional to the diameters of the circles of aberration in the focus of the object-glafs.

Here we do not confider the trifling alteration which well conftructed eye-glaffes may add to the indiftinctnefs of the firft image.

In refracting telefcopes, the apparent indiftinctnefs is as the area of the object-glafs directly, and as the fquare of the focal diftance of the eye-glafs inverfely. For it has been fhown, that the area of the circle of difperfion is as the area of the object-glafs, and that the fpherical aberration is infignificant when compared with this.

Therefore, to make reflecting telefcopes equally diftinct, the diameter of the object-glafs muft be proportional to the focal diftance of the eye-glafs.

But in reflecting telefcopes, the indiftinctnefs is as the fixth power of the aperture of the object-glafs directly, and as the fourth power of the focal diftance of the object-glafs and fquare of the focal diftance of the eye-glafs inverfely. This is evident from the dimenfions of the circle of aberration, which was found proportional to $\frac{AV^3}{CV^2}$.

Therefore, to have them equally diftinct, the cubes of the apertures muft be proportional to the fquares of the focal diftance multiplied by the focal diftance of the eye-glafs.

By thefe rules, and a ftandard telefcope of approved goodnefs, an artift can always proportion the parts of any inftrument he wifhes to conftruct. Mr Huyghens made one, of which the object-glafs had 30 feet focal diftance and three inches diameter. The eye-glafs had 3,3 inches focal diftance. And its performance was found fuperior to any which he had feen; nor did this appear owing to any chance goodnefs of the object-glafs, becaufe he found others equally good which were conftructed on fimilar proportions. This has therefore been adopted as a ftandard.

It does not at firft appear how there can be any difficu-

ty in this matter, becaufe we can always diminifh the aperture of the object-glafs or fpeculum till the circle of aberration is as fmall as we pleafe. But by diminifhing this aperture, we diminifh the light in the duplicate ratio of the aperture. Whatever be the aperture, the brightnefs is diminifhed by the magnifying power, which fpreads the light over a greater furface in the bottom of the eye. The apparent brightnefs muft be as the fquare of the aperture of the telefcope directly, and the fquare of the amplification of the diameter of an object inverfely. Objects therefore will be feen equally bright if the apertures of the telefcopes be as the focal diftances of the object-glaffes directly, and the focal diftances of the fingle eye-glafs (or eye-glafs equivalent to the eye-piece) inverfely. Therefore, to have telefcopes equally diftinct and equally bright, we muft combine thefe proportions with the former. It is needlefs to go farther into this fubject, becaufe the conftruction of refracting telefcopes has been fo materially changed by the correction of the chromatic aberration, that there can hardly be given any proportion between the object-glafs and eye glaffes. Every thing now depends on the degree in which we can correct the aberrations of the object-glafs. We have been able fo far to diminifh the chromatic aberration, that we can give very great apertures without its becoming fenfible. But this is attended with fo great an increafe of the aberration of figure, that this laft becomes a fenfible quality. A lens which has 30° for its femi aperture, has a circle of aberration equal to its chromatic aberration. Fortunately we can derive from the very method of contrary refractions which we employ for removing the chromatic aberration, a correction of the other. We are indebted for this contrivance alfo to the illuftrious Newton.

We call this Newton's contrivance, becaufe he was the firft who propofed a conftruction of an object-glafs in which the aberration was corrected by the contrary aberrations of glafs and water.

Huyghens had indeed fuppofed, that our all-wife Creator had employed in the eyes of animals many refractions in place of one, in order to make the vifion more diftinct; and the invidious detractors from Newton's fame have catched at this vague conjecture as an indication of his knowledge of the poffibility of deftroying the aberration of figure by contrary refractions. But this is very ill-founded. Huyghens has acquired fufficient reputation by his theory of aberrations. The fcope of his writing in the paffage alluded to, is to fhow that, by dividing any intended refraction into parts, and producing a certain convergence to or divergence from the axis of an optical inftrument by means of two or three lenfes inftead of one, we diminifh the aberrations four or nine times. This conjecture about the eye was therefore in the natural train of his thoughts. But he did not think of deftroying the aberration altogether by oppofite refractions. Newton, in 1669, fays, that opticians need not trouble themfelves about giving figures to their glaffes other than fpherical. If this figure were all the obftacle to the improvement of telefcopes, he could fhow them a conftruction of an object-glafs having fpherical furfaces where the aberration is deftroyed; and accordingly gives the conftruction of one compofed of glafs and water, in which this is done completely by means of contrary refractions.

The general principle is this: When the radiant point R (fig. 5. B), or focus of incident rays, and its conjugate focus F of refracted central rays, are on oppofite fides of the refracting furface or lens V, the conjugate focus f of marginal rays is nearer to R than F is. But when the focus of incident rays R′ lies on the fame fide with its conjugate focus F′ for central rays, R′f is greater than R′F′.

Now fig. 5. C reprefents the contrivance for deftroying the colour produced at F, the principal focus of the convex lens V, of crown glafs, by means of the contrary refraction of the concave lens v of flint glafs. The incident parallel rays are made to converge to F by the firft lens. This convergence is diminifhed, but not entirely deftroyed, by the concave lens v, and the focus is formed in F. F and F therefore are conjugate foci of the concave lens. If F be the focus of V for central rays, the marginal rays will be collected at fome point f nearer to the lens. If F be now confidered as the focus of light incident on the centre of v, and F be the conjugate focus, the marginal ray p F would be refracted to fome point f lying beyond F. Therefore the marginal ray pf may be refracted to F, if the aberration of the concave be properly adjufted to that of the convex.

This brings us to the moft difficult part of our fubject, the compounded aberrations of different furfaces. Our limits will not give us room for treating this in the fame elementary and perfpicuous manner that we employed for a fingle furface. We muft try to do it in a compendious way, which will admit at once the different furfaces and the different refractive powers of different fubftances. This muft naturally render the procefs more complicated; but we hope to treat the fubject in a way eafily comprehended by any perfon moderately acquainted with common algebra; and we truft that our attempt will be favourably received by an indulgent public, as it is (as far as we know) the only differtation in our language on the conftruction of achromatic inftruments. We cannot but exprefs our furprife at this indifference about an invention which has done fo much honour to our country, and which now conftitutes a very lucrative branch of its manufacture. Our artifts infinitely furpafs all the performances of foreigners in this branch, and fupply the markets of Europe without any competition; yet it is from the writings on the continent that they derive their fcientific inftruction, and particularly from the differtations of Clairaut, who has wonderfully fimplified the analyfis of optical propofitions. We fhall freely borrow from him, and from the writings of Abbé Bofcovich, who has confiderably improved the firft views of Clairaut. We recommend the originals to the curious reader. Clairaut's differtations are to be found in the Memoirs of the Academy of Paris, 1756, &c.; thofe of Bofcovich in the Memoirs of the Academy of Bologna, and in his five volumes of *Opufcula*, publifhed at Baffano in 1785. To thefe may be added D'Alembert and Euler. The only thing in our language is the tranflation of a very imperfect work by Scherfer.

Lemma 1. In the right-angled triangle MXS (fig. 6.), of which one fide MX is very fmall in comparifon of either of the others; the excefs of the hypothenufe MS, above the fide XS, is very neary equal to $\frac{MX^2}{2MS}$ or to $\frac{MX^2}{2XS}$. For if about the centre S, with the radius SM, we defcribe the femicircle AMO, we have $AX \times XO = MX^2$. Now $AX = MS - SX$, and XO, is nearly equal to 2 MS or 2 XS; on the other hand, MS is nearly equal to $XS + \frac{MX^2}{2XS}$; and in like manner MG is nearly equal to $\frac{MX^2}{2XG} + XG$, and MH is nearly equal to $\frac{MX^2}{2XH} + XH$.

Prop. I. Let the ray m M, incident on the fpherical furface AM, converge to G; that is, let G be the focus of inci-

incident rays. It is required to find the focus F of refracted rays?

Let m expreſs the ratio of the ſine of incidence and refraction; that is, let m be to 1 as the ſine of incidence to the ſine of refraction in the ſubſtance of the ſphere.

Then - MG : GS = ſin. MSH . ſin. SMG,
and - m : 1 = ſin. SMG : ſin. SMH;
therefore $m \times$ MG : GS = ſin. MSH : ſin. SMH.
Now S, MSH : S, SMH = MH : HS. Therefore, finally,
m. MG : GS = MH : HS.

Now let MS, the radius of the refracting ſurface, be called a. Let AG, the diſtance of the focus of incident rays from the ſurface, be called r. And let AH, the focal diſtance of refracted rays, be called x. Laſtly, let the ſine MX of the ſemi-aperture be called e. Obſerve, too, that a, r, x, are to be conſidered as poſitive quantities, when AS, AG, AH, lie from the ſurface in the direction in which the light is ſuppoſed to move. If therefore the refracting ſurface be concave, that is, having the centre on that ſide from which the light comes; or if the incident rays are divergent, or the refracted rays are divergent; then a, r, x, are negative quantities.

It is plain that HS$=x-a$; GS$=r-a$; alſo AX$=\frac{e^2}{2a}$ nearly. HX $=a-\frac{e^2}{2a}$. GX $=r-\frac{e^2}{2a}$. Now add to HX and to GX their differences from MH and MG, which (by the Lemma) are $\frac{e^2}{2x}$ and $\frac{e^2}{2r}$. We get MH $=x-\frac{e^2}{2a}+\frac{e^2}{2x}$, and MG $=r-\frac{e^2}{2a}+\frac{e^2}{2r}$. In order to ſhorten our notation, make $k=\frac{1}{a}-\frac{1}{r}$. This will make MG $=r-\frac{ke^2}{2}$.

Now ſubſtitute theſe values in the final analogy at the top of this column, viz. MH : HS $=m$. MG : GS; it becomes $x-\frac{e^2}{2a}+\frac{e^2}{2x} : x-a = mr-\frac{mke^2}{2} : r-a$ (or ark), becauſe $k=\frac{r-a}{ar}$, and $ark=r-a$. Now multiply the extreme and mean terms of this analogy. It is evident that it muſt give us an equation which will give us a value of x or AH, the quantity ſought.

But this equation is quadratic. We may avoid the ſolution by an approximation which is ſufficiently accurate, by ſubſtituting for x in the fraction $\frac{e^2}{2x}$ (which is very ſmall in all caſes of optical inſtruments), an approximate value very eaſily obtained, and very near the truth. This is the focal diſtance of an infinitely ſlender pencil of rays converging to G. This we know by the common optical theorem to be $\frac{amr}{m-1\,r\pm a}$. Let this be called φ; if we ſubſtitute k in place of $\frac{1}{a}-\frac{1}{r}$, this value of φ becomes $=\frac{am}{m-ak}$.

This gives us, by the by, an eaſily remembered expreſſion (and beautifully ſimple) of the refracted focus of an infinitely ſlender pencil, correſponding to any diſtance r of the radiant point. For ſince $\varphi=\frac{am}{m-ak}$, $\frac{1}{\varphi}$ muſt be $=\frac{m-ak}{am}$, $=\frac{m}{am}-\frac{ak}{am}$, $=\frac{1}{a}-\frac{k}{m}$. We may even expreſs it more ſimply, by expanding k, and it becomes $\frac{1}{\varphi}=\frac{1}{a}-\frac{1}{ma}-\frac{1}{mr}$.

Now put this value of $\frac{1}{\varphi}$ in place of the $\frac{1}{x}$ in the analogy employed above. The firſt term of the analogy becomes $x-\frac{e^2}{2a}+\frac{e^2}{2a}-\frac{ke^2}{2m}$, or $x-\frac{ke^2}{2m}$. The analogy now becomes $x-\frac{ke^2}{2m} : x\,a = mr-\frac{mke^2}{2} : ark$. Hence we obtain the linear equation $mrx-\frac{mke^2x}{2}-mra+\frac{mkae^2}{2}=arkx-\frac{arke^2}{2m}$; from which we finally deduce

$$x=\frac{mra-\frac{1}{2}make^2-\frac{ar^2k^2e^2}{2m}}{mr-ark-\frac{1}{2}mke^2}$$

We may ſimplify this greatly by attending to the elementary theorem in fluxions, that the fraction $\frac{x+\dot{x}}{y+\dot{y}}$ differs from the fraction $\frac{x}{y}$ by the quantity $\frac{y\dot{x}-x\dot{y}}{y^2}$; this being the fluxion of $\frac{x}{y}$. Therefore $\frac{x+\dot{x}}{y+\dot{y}}=\frac{x}{y}+\frac{y\dot{x}-x\dot{y}}{y^2}$. Now the preceding formula is nearly in this ſituation. It may be written thus; $\frac{mra\quad\left(-\frac{1}{2}make^2-\frac{ar^2k^2e^2}{2m}\right)}{mr-ark\quad-\frac{1}{2}mke^2}$, when the laſt terms of the numerator and denominator are very ſmall in compariſon with the firſt, and may be conſidered as the $\dot{x}$ and $\dot{y}$, while mra is the x, and $mr-ark$ is the y. Treating it in this way, it may be ſtated thus:

$$x=\frac{mra}{mr-ark}+\frac{(mra)\frac{1}{2}mke^2-(mr-ark)\left(\frac{1}{2}mkae^2+\frac{ar^2k^2e^2}{2m}\right)}{r^2(m-ak)^2}$$

$$\text{or } x=\frac{mra}{r(m-ak)}+\frac{(mra)mk-(mr-ark)\left(mka+\frac{ark^2}{m}\right)}{r^2(m-ak)^2}\times\frac{1}{2}e^2.$$

The firſt term $\frac{mra}{r(m-ak)}$, or $\frac{ma}{m-ak}$, is evidently $=\varphi$, the focal diſtance of an infinitely ſlender pencil. Therefore the aberration is expreſſed by the ſecond term, which we muſt endeavour to ſimplify.

If we now perform the multiplications indicated by $-(mr-ark)\times\left(mka-\frac{ark^2}{m}\right)$, it is plain that $-mr\times mka$ deſtroys the firſt term $mra\times mk$ of the numerator of our ſmall fraction, and there remains of this numerator $\left(ma^2rk^2-ar^2k^2+\frac{a^2r^2k^3}{m}\right)\frac{1}{2}e^2$, which is equal to $m^2a^2\left(\frac{rk^2}{m}-\frac{r^2k^2}{m^2a}+\frac{r^2k^3}{m^3}\right)\frac{1}{2}e^2$.

The denominator was $r^2(m-ak)^2$, and the fraction now becomes $\frac{m^2a^2}{(m-ak)^2}\left(\frac{k^2}{mr}-\frac{k^2}{m^2a}+\frac{k^3}{m^3}\right)\frac{1}{2}e^2$, which is evidently $=\varphi^2\left(\frac{k^2}{mr}-\frac{k^2}{m^2a}+\frac{k^3}{m^3}\right)\frac{e^2}{2}$. Now recollect that $k=\frac{1}{a}-\frac{1}{r}$. Therefore $\frac{k^3}{m^2}=\frac{k^2}{m^2}\left(\frac{1}{a}-\frac{1}{r}\right)=\frac{k^2}{m^2a}-\frac{k^2}{m^2r}$. Therefore, inſtead of $-\frac{k^2}{m^2a}$, write $\frac{-k^3}{m^2}-\frac{k^2}{m^2r}$, and we get the fraction $\varphi^2\left(\frac{k^3}{m^3}-\frac{k^3}{m^2}-\frac{k^2}{m^2r}+\frac{k^2}{mr}\right)\frac{e^2}{2}=\varphi^2\left(\frac{k^3}{m}-\frac{mk^3}{m^3}-\right.$

mk^2

Telescope.

$-\frac{mk^2}{m^3r}+\frac{m^2k^2}{m^3r}\Big)\frac{e^2}{2}$, which is equal to $\rho^2\frac{1-m}{m^3}\left(k^3-\frac{mk^2}{r}\right)\frac{e^2}{2}$, and finally to $-\rho^2\frac{m-1}{m^3}\left(k^3-\frac{mk^2}{r}\right)\frac{e^2}{2}$.

Therefore the focal diftance of refracted rays is $x=\rho-\rho^2\frac{m-1}{m^3}\left(k^3-\frac{mk^2}{r}\right)\frac{e^2}{2}$.

This confifts of two parts. The firft ρ is the focal diftance of an infinitely flender pencil of central rays, and the other $-\rho^2\frac{m-1}{m^3}\left(k^3-\frac{mk^2}{r}\right)\frac{e^2}{2}$ is the aberration arifing from the fpherical figure of the refracting furface.

Our formula has thus at laft put on a very fimple form, and is vaftly preferable to Dr Smith's for practice.

This aberration is evidently proportional to the fquare of the femi-aperture, and to the fquare of the diftance ρ: but, in order to obtain this fimplicity, feveral quantities were neglected. The affumption of the equality of AX to $\frac{e^2}{2a}$ is the firft fource of error. A much more accurate value of it would have been $\frac{2ae^2}{4a^2+e^2}$, for it is really $=\frac{e^2}{2a-\text{AX}}$. If for AX we fubftitute its approximated value $\frac{e^2}{2a}$, we fhould have $\text{AX}=\frac{e^2}{2a-\frac{e^2}{2a}}$, $=\frac{2ae^2}{4a^2-e^2}$. To have ufed this value would not have much complicated the calculus; but it did not occur to us till we had finifhed the inveftigation, and it would have required the whole to be changed. The operation in page 346. col. 2. par. 2. is another fource of error. But thefe errors are very inconfiderable when the aperture is moderate. They increafe for the moft part with an increafe of aperture, but not in the proportion of any regular function of it; fo that we cannot improve the formula by any manageable procefs, and muft be contented with it. The errors are precifely the fame with thofe of Dr Smith's theorem, and indeed with thofe of any that we have feen, which are not vaftly more complicated.

As this is to be frequently combined with fubfequent operations, we fhorten the expreffion by putting δ for $\frac{m-1}{m^3}\left(k^3-\frac{mk^2}{r}\right)\frac{e^2}{2}$. Then $\rho^2\delta$ will exprefs the aberration of the firft refraction from the focal diftance of an infinitely flender pencil; and now the focal diftance of refracted rays is $f=\rho-\rho^2\delta$.

If the incident rays are parallel, r becomes infinite, and $\delta=\frac{m-1}{m^3}k^3\frac{e^2}{2}$. But in this cafe k becomes $=\frac{1}{a}$, and $\frac{1}{\rho}=\frac{m-1}{ma}$, and $\rho=\frac{ma}{m-1}$, and $\rho^2\delta$ becomes $\frac{m^2a^2}{(m-1)^2}\times\frac{m-1}{m^3}\times\frac{1}{a^3}\times\frac{e^2}{2}$, $=\frac{e^2}{2(m-1)ma}$. This is the aberration of extreme parallel rays.

We muft now add the refraction of another furface.

Lemma 2. If the focal diftance AG be changed by a fmall quantity Gg, the focal diftance AH will alfo be changed by a fmall quantity Hh, and we fhall have

$$m\cdot\text{AG}^2:\text{AH}^2=\text{G}g:\text{H}h.$$

Draw Mg, Mh, and the perpendiculars Gi, Hk. Then, becaufe the fines of the angles of incidence are in a conftant ratio to the fines of the angles of refraction, and the increments of thefe fmall angles are proportional to the increments of the fines, thefe increments of the angles are in the fame conftant ratio. Therefore,

We have the angle CMg to HMh as m to 1.

Now Gg : Gi = AG : AM,
and Gi : hk = $m\cdot$AG : HA,
and hk : Hh = MA : AH:
therefore Gg : Hh = $m\cdot\text{AG}^2:\text{AH}^2$.

The eafieft and moft perfpicuous method for obtaining the aberration of rays twice refracted, will be to confider the firft refraction as not having any aberration, and determine the aberration of the fecond refraction. Then conceive the focus of the firft refraction as fhifted by the aberration. This will produce a change in the focal diftance of the fecond refraction, which may be determined by this Lemma.

Prop. II. Let AM, BN (fig. 7.) be two fpherical furfaces, including a refracting fubftance, and having their centres C and c in the line AG. Let the ray aA pafs through the centres, which it will do without refraction. Let another ray mM, tending to G, be refracted by the firft furface into MH, cutting the fecond furface in N, where it is farther refracted into NI. It is required to determine the focal diftance BI?

It is plain that the fine of incidence on the fecond furface is to the fine of refraction into the furrounding air as 1 to m. Alfo BI may be determined in relation to BH, by means of BH, Nx, Bc, and $\frac{1}{m}$, in the fame way that AH was determined in relation to AG, by means of AG, MX, AC, and m.

Let the radius of the fecond furface be b, and let e ftill exprefs the femi-aperture, (becaufe it hardly differs from Nx). Alfo let α be the thicknefs of the lens. Then obferve, that the focal diftance of the rays refracted by the firft furface, (neglecting the thicknefs of the lens and the aberration of the firft furface), is the diftance of the radiant point for the fecond refraction, or is the focal diftance of rays incident on the fecond furface. In place of r therefore we muft take ρ; and as we made $k=\frac{1}{a}-\frac{1}{r}$, in order to abbreviate the calculus, let us now make $l=\frac{1}{b}-\frac{1}{\rho}$; and make $\frac{1}{f}=\frac{1}{b}-m\,l$, as we made $\frac{1}{\rho}=\frac{1}{a}-\frac{k}{m}$. Laftly, in place of $\delta=\frac{m-1}{m^3}\left(k^3-\frac{mk^2}{r}\right)\frac{e^2}{2}$, make $\delta'=\left(\frac{1}{m}-1\right)m^3\left(l^3-\frac{l^2}{m\rho}\right)\frac{e^2}{2}$, $=-\frac{m-1}{m}\left(m^2l^3-\frac{m^2l^2}{\rho}\right)\frac{e^2}{2}$.

Thus we have got an expreffion fimilar to the other; and the focal diftance BI, after two refractions, becomes $\text{BI}=f-f^2\delta'$.

But this is on the fuppofition that BH is equal to ρ, whereas it is really $\rho-\rho^2\delta-\alpha$. This muft occafion a change in the value juft now obtained of BI. The fource of the change is twofold. 1ft, Becaufe, in the value $\frac{1}{b}-\frac{1}{\rho}$, we muft put $\frac{1}{b}-\frac{1}{\rho-\rho^2\delta-\alpha}$, and becaufe we muft do the fame in the fraction $\frac{m^2l^2}{\rho}$. In the fecond place, when the value of BH is diminifhed by the quantity $\rho^2\delta+\alpha$, BI will fuffer a change in the proportion determined by the 2d Lemma. The firft difference may fafely be neglected, becaufe the value of δ is very fmall, by reafon of the coefficient $\frac{e^2}{2}$ being very fmall, and alfo becaufe the variation bears a very fmall ratio to the quantity itfelf, when the true value of ρ

 differs

differs but little from that of the quantity for which it is employed. The chief change in BI is that which is determined by the Lemma. Therefore take from BI the variation of BH, multiplied by $\frac{m\,\mathrm{BI}^2}{\mathrm{BH}^2}$, which is very nearly $= \frac{m\,f^2}{\varphi^2}$. The product of this multiplication is $m\,f^2\,\vartheta + \frac{m\,f^2\,\alpha}{\varphi^2}$. This being taken from f, leaves us for the value of BI $f - \frac{f^2\,m\,\alpha}{\varphi^2} - f^2\,(m\,\vartheta + \vartheta')$.

In this value f is the focal distance of an infinitely slender pencil of rays twice refracted by a lens having no thickness, $\alpha\frac{m\,f^2}{\varphi^2}$ is the shortening occasioned by the thickness, and $f^2\,(m\,\vartheta + \vartheta')$ is the effect of the two aberrations arising from the aperture.

It will be convenient, for several collateral purposes, to exterminate from these formulæ the quantities k, l, and φ. For this purpose make $\frac{1}{n} = \frac{1}{a} - \frac{1}{b}$. We have already $k = \frac{1}{a} - \frac{1}{r}$; and $\frac{1}{\varphi} = \frac{1}{a} - \frac{1}{m\,a} + \frac{1}{m\,r}$; and $l = \frac{1}{b} - \frac{1}{\varphi}, = \frac{1}{b} - \frac{1}{a} + \frac{1}{m\,a} - \frac{1}{m\,r}$. Now for $\frac{1}{b} - \frac{1}{a}$ write $-\frac{1}{n}$, and we get $l = \frac{1}{m\,a} - \frac{1}{m\,r} - \frac{1}{n}$. Therefore $\frac{1}{f} = \frac{1}{b} - m\,l$ (by construction, page 347. Prop. II.) becomes $= \frac{1}{b} - \frac{1}{a} + \frac{1}{r} + \frac{m}{n}, = \frac{m}{n} + \frac{1}{r} - \frac{1}{n}, = \frac{m-1}{n} + \frac{1}{r}$.

This last value of $\frac{1}{f}$ (the reciprocal of the focus of a slender pencil twice refracted), viz. $\frac{m-1}{n} + \frac{1}{r}$, is the simplest that can be imagined, and makes n as a substitute for $\frac{1}{a} - \frac{1}{b}$; a most useful symbol, as we shall frequently find in the sequel. It also gives a very simple expression of the focal distance of parallel rays, which we may call the principal focal distance of the lens, and distinguish it in future by the symbol p; for the expression $\frac{1}{f} = \frac{m-1}{n} + \frac{1}{r}$, becomes $\frac{1}{p} = \frac{m-1}{n}$ when the incident light is parallel. And this gives us another very simple and useful measure of f; for $\frac{1}{f}$ becomes $= \frac{1}{p} + \frac{1}{r}$. These equations $\frac{1}{f} = \frac{m-1}{n} + \frac{1}{r}$, $\frac{1}{p} = \frac{m-1}{n}$, and $\frac{1}{f} = \frac{1}{p} + \frac{1}{r}$, deserve therefore to be made very familiar to the mind.

We may also take notice of another property of n. It is half the radius of an isosceles lens, which is equivalent to the lens whose radii are a and b: for suppose the lens to be isosceles, that is, $a = b$; then $n = \frac{1}{a} - \frac{1}{a}$. Now the second a is negative if the first be positive, or positive if the first be negative. Therefore $\frac{1}{a} - \frac{1}{b} = \frac{1+b}{a^2} = \frac{a+a}{a^2} = \frac{2}{a}$, and $\frac{1}{n} = \frac{2}{a}$, and $n = \frac{a}{2}$. Now the focal distance of this lens is $\frac{m-1}{n}$, and so is that of the other, and they are equivalent.

But, to proceed with our investigation, recollect that we had $\vartheta = \frac{m-1}{m^3}\left(k^3 - \frac{m\,k^2}{r}\right)\frac{e^2}{2}$. Therefore $m\,\vartheta = \frac{m-1}{m}\left(\frac{k^3}{m} - \frac{k^2}{r}\right)\frac{e^2}{2}$. And ϑ' was $= \frac{m-1}{m}\left(-m^3\,l^3 + \frac{m\,l^2}{\varphi}\right)\frac{e^2}{2}$. Therefore $m\,\vartheta + \vartheta'$, the aberration (neglecting the thickness of the lens) is $f^2\,\frac{m-1}{m}\left(\frac{k^3}{m} - \frac{k^2}{r} - m^3\,l^3 + \frac{m\,l^2}{\varphi}\right)\frac{e^2}{2}$.

If we now write for k, l, and φ, their values as determined above, performing all the necessary multiplications, and arrange the terms in such a manner as to collect in one sum the coefficients of a, n, and r, we shall find 4 terms for the value of $m\,\vartheta$, and 10 for the value of ϑ'. The 4 are destroyed by as many with contrary signs in the value of ϑ', and there remain 6 terms to express the value of $m\,\vartheta + \vartheta'$, which we shall express by one symbol q; and the equation stands thus:

$$q = \frac{m-1}{m}\left(\frac{m^3}{n^3} - \frac{2m^2+m}{a\,n^2} + \frac{m+2}{a^2\,n} + \frac{3m^2+m}{r\,n^2} - \frac{4m+4}{a\,r\,n} + \frac{3m+2}{r^2\,n}\right)\frac{e^2}{2}.$$

The focal distance therefore of rays twice refracted, reckoned from the last surface, or BI, corrected for aberration, and for the thickness of the lens, is $f - f^2\frac{m\,\alpha}{\varphi^2} - f^2\,q$, consisting of three parts, viz. f, the focal distance of central rays; $f^2\,\frac{m\,\alpha}{\varphi^2}$, the correction for the thickness of the lens; and $f^2\,q$, the aberration.

The formula in the 2d par. of this col. appears very complex, but is of very easy management, requiring only the preparation of the simple numbers which form the numerators of the fractions included in the parenthesis. When the incident rays are parallel, the terms vanish which have r in the denominator, so that only the three first terms are used.

We might here point out the cases which reduce the aberration expressed in the formula last referred to, to nothing; but as they can scarcely occur in the object-glass of a telescope, we omit it for the present, and proceed to the combination of two or more lenses.

Lemma 3. If AG be changed by a small quantity G g, BI suffers a change I i, and G g : I i = AG² : BI². For it is well known that the small angles GM g and IN i are equal; and therefore their subtenses G k, I n are proportional to MG, NI, or to AG, AI nearly, when the aperture is moderate. Therefore we have (nearly)

G k : I n : AG : BI
I n : I i = AM : BI
G g : G k = AG : AM
Therefore G g : I i = AG² : BI²

Prop. III. To determine the focal distance of rays refracted by two lenses placed near to each other on a common axis.

Let AM, BN (fig. 8.) be the surfaces of the first lense, and CO, DP be the surfaces of the second, and let β be the thickness of the second lens, and δ the interval between them. Let the radius of the anterior surface of the second lens be a', and the radius of its posterior surface be b'. Let m' be to 1 as the sine of incidence to the sine of refraction in the substance of the second lens. Lastly, let p' be the principal focal distance of the second lens. Let the extreme or marginal ray meet the axis in L after passing thro' both lenses, so that DL is the ultimate focal distance, reckoned from the last surface.

It is plain that DL may be determined by means of a', b', m', p', and CI, in the same manner that BI was determined by means of a, b, m, p, and AG.

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The value of BI is $f - m\alpha\frac{f^2}{\rho^2} - f^2 q$. Take from this the interval δ, and we have $CI = f - m\alpha\frac{f^2}{\rho^2} - \delta - f^2 q$. Let the small part $- m\alpha\frac{f^2}{\rho^2} - \delta - f^2 q$ be neglected for the present, and let CI be supposed $= f$. As we formed ρ, f, and q, by means of a, b, m, n, and r, let us now form ρ', f', and q', for the second lens, by means of a', b', m', n', $\left(=\frac{1}{a'}-\frac{1}{b'}\right)$, and r'. ρ' will be the focal distance of a slender pencil refracted by the first surface, f' will be the focal distance of this pencil after two refractions, and q' will be the coefficient of the aberration, neglecting the thickness and interval of the lenses.

Proceeding in this way, DL will be $= f' - m'\alpha'\frac{f'^2}{\rho'^2} - f'^2 q'$. But because CI is really less than f, by the quantity $m\alpha\frac{f^2}{\rho^2} + \delta + f^2 q'$, we must (by Lemma 3.) subtract the product of this quantity, multiplied by $\frac{DL^2}{BI^2}$, (which is nearly $\frac{f'^2}{f^2}$), from $f' - m'\alpha'\frac{f'^2}{\rho'^2} - f'^2 q'$.

By this process we shall have

$$DL = f' - f'^2\left(\frac{m\alpha}{\rho^2} + \frac{\delta}{f^2} + \frac{m'\alpha'}{\rho'^2}\right) - f'^2(q+q').$$

The first term f' of this value of DI is the focal distance of a slender pencil of central rays refracted by both lenses, neglecting their thickness and distance; the second term, $-f'^2\left(\frac{m\alpha}{\rho^2} + \frac{\delta}{f^2} + \frac{m'\alpha'}{\rho'^2}\right)$ is the correction necessary for these circumstances; and the third term, $-f'^2(q+q')$, is the correction for the aperture $2e$. And it is evident that q' is a formula precisely similar to q, containing the same number of terms, and differing only by the m', a', n', and r', employed in place of m, a, n, and r.

It is also evident, that if there be a third lens, we shall obtain its focal distance by a process precisely similar to that by which we obtained DL; and so on for any number of lenses.

Thus have we obtained formulæ by which the foci of rays are determined in the most general terms; and in such a manner as shall point out the connection of the curvatures, thicknesses, and distances of the lenses, with their spherical aberrations, and with the final aberration of the compound lens, and give the aberrations in separate symbols, so that we can treat them by themselves, and subject them to any conditions which may enable us to correct one of them by another.

We also see in general, that the correction for the thickness and distance of the lenses are exhibited in terms which involve only the focal distances of central rays, and have very little influence on the aberrations, and still less on the ratio of the aberrations of the different lenses. This is a most convenient circumstance; for we may neglect them while we are determining q and q', and in determining the ratio of the focal distances of the several lenses, on which the correction of the chromatic aberration chiefly depends. Therefore, in the construction of a compound lens for uniting the different colours, we may neglect this correction for the thickness and distance till the end of the process. When we apply it, we shall find that it chiefly affects the final focal distance, making it somewhat longer, but has hardly any influence either on the chromatic or spherical aberration. We do not hesitate to say, that the final formulæ here given are abundantly accurate, while they are vastly more manageable than those employed by Euler or D'Alembert. We have calculated trigonometrically the progress of the rays through one of the glasses, which will be given as an example, giving it a very extravagant aperture, that the errors of the formulæ might be very remarkable. We found the real aberration exceed the aberration assigned by the formula by no more than $\frac{1}{30}$th part, a difference which is quite insignificant. The process here given derives its simplicity from the frequent occurrence of harmonic proportions in all optical theorems. This enabled Mr Clairaut to employ the reciprocals of the radii and distances with so much simplicity and generality. Telescope.

We consider it as another advantage of Mr Clairaut's method, that it gives, by the way, formulæ for the more ordinary questions in optics, which are of wonderful simplicity, and most easily remembered. The chief problems in the elementary construction of optical instruments relate to the focal distances of central rays. This determines the focal distances and arrangement of the glasses. All the rest may be called the refinement of optics; teaching us how to avoid or correct the indistinctness, the colours, and the distortions, which are produced in the images formed by these simple constructions. We shall mention a few of these formulæ which occur in our process, and tend greatly to abbreviate it when managed by an experienced analyst.

Let m be to 1 as the sine of incidence to the sine of refraction; let a and b be the radii of the anterior and posterior surfaces of a lens; let r be the distance of the radiant point, or the focus of incident central rays, and f the distance of the conjugate focus; and let p be the principal focal distance of the lens, or the focal distance of parallel rays. Make $\frac{1}{n}$ equal to $\frac{1}{a} - \frac{1}{b}$; let the same letters a', b', r', &c. express the same things for a second lens; and a'', b'', r'', &c. express them for a third; and so on. Then we have

$$\frac{1}{f} = \frac{m-1}{n} + \frac{1}{r};\quad \frac{1}{f'} = \frac{m'-1}{n'} + \frac{1}{r'};\quad \frac{1}{f''} = \frac{m''-1}{n''} + \frac{1}{r''}, \text{ \&c.}$$

Therefore when the incident light is parallel, and r infinite, we have $\frac{1}{p} = \frac{m-1}{n}$; $\frac{1}{p'} = \frac{m'-1}{n'}$; $\frac{1}{p''} = \frac{m''-1}{n''}$, &c.

And when several lenses are contiguous, so that their intervals may be neglected, and therefore $\frac{1}{f}$, belonging to the first lens, becomes $\frac{1}{r'}$, belonging to the second, we have

$$1.\ \frac{1}{f} = \frac{1}{r'}, = \frac{m-1}{n} + \frac{1}{r}, = \frac{1}{p} + \frac{1}{r}.$$

$$2.\ \frac{1}{f'} = \frac{1}{r''}, = \frac{m'-1}{n'} + \frac{m-1}{n} + \frac{1}{r}, = \frac{1}{p'} + \frac{1}{p} + \frac{1}{r}.$$

$$3.\ \frac{1}{f''} = \frac{m''-1}{n''} + \frac{m'-1}{n'} + \frac{m-1}{n} + \frac{1}{r}, = \frac{1}{p''} + \frac{1}{p'} + \frac{1}{p} + \frac{1}{r}.$$

Nothing can be more easily remembered than these formulæ, how numerous soever the glasses may be.

Having thus obtained the necessary analysis and formula, it now remains to apply them to the construction of achromatic lenses; in which it fortunately happens, that the employment of several surfaces, in order to produce the union of the differently refrangible rays, enables us at the same time to employ them for correcting each other's spherical aberration.

In the article Optics we gave a general notion of the principle on which we may proceed in our endeavours to unite the differently refrangible rays. A white or compounded ray is separated by refraction into its component coloured rays, and they are diffused over a small angular space. Thus it appears, that the glass used by Sir Isaac Newton

Newton in his experiments caused a white ray, which was incident on its posterior surface in an angle of 30°, in such a manner that the extreme red ray emerged into air, making an angle of 50° 21½ with the perpendicular; the extreme violet ray emerged in an angle of 51° 15½; and the ray which was in the confines of green and blue, emerged in an angle of 50° 48½. If the sine of the angle 30° of incidence be called 0,5, which it really is, the sine of the emergence of the red ray will be 0,77; that of the violet ray will be 0,78; and that of the intermediate ray will be 0,77½, an exact mean between the two extremes. This ray may therefore be called the mean refrangible ray, and the ratio of 77½ to 50, or of 1,55 to 1, will very properly express the mean refraction of this glass; and we have for this glass $m = 1,55$. The sine of refraction, being measured on a scale, of which the sine of incidence occupies 100 parts, will be 154 for the red ray, 155 for the mean ray, and 156 for the violet ray. This number, or its ratio to unity, is commonly taken to represent the refractive power of the glass. There is some impropriety in this, unless we consider ratios as measured by their logarithms: for if m be 1, the substance does not refract at all. The refractive power can be properly measured only by the refraction which it produces; that is, by the change which it makes in the direction of the light, or the angle contained between the incident and refracted rays. If two substances produce such deviations always in one proportion, we should then say that their refractive powers are in that proportion. This is not true in any substances; but the sines of the angles, contained between the refracted ray and the perpendicular, are always in one proportion when the angle of incidence in both substances is the same. This being a cognizable function of the real refraction, has therefore been assumed as the only convenient measure of the refractive powers. Although it is not strictly just, it answers extremely well in the most usual cases in optical instruments: the refractions are moderate; and the sines are very nearly as the angles contained between the rays and the perpendicular; and the real angles of refraction, or deflections of the rays, are almost exactly proportional to $m - 1$. The most natural and obvious measure of the refractive powers would therefore be $m - 1$. But this would embarrass some very frequent calculations; and we therefore find it best, on the whole, to take m itself for the measure of the refractive power.

The separation of the red, violet, and intervening rays, has been called *dispersion*; and although this arises merely from a difference of the refractive power in respect of the different rays, it is convenient to distinguish this particular modification of the refractive power by a name, and we call it the Dispersive Power of the refracting substance.

It is susceptible of degrees; for a piece of flint-glass will refract the light so that when the sine of refraction of the red ray is 77, the sine of the refraction of the violet ray is nearly 78½, or if the sine of refraction of the red ray, measured on a particular scale, is 1,54, the sine of refraction of the violet ray is 1,57. The dispersion of this substance, being measured by the difference of the extreme sines of refraction, is greater than the dispersion of the other glass, in the proportion of 3 to 2.

But this alone is not a sufficient measure of the absolute dispersive power of a substance. Although the ratio of 1,54 to 1,56 remains constant, whatever the real magnitude of the refractions of common glass may be, and though we therefore say that its dispersive power is constant, we know, that by increasing the incidence and the refraction, the absolute dispersion is also increased. Another substance shows the same properties, and in a particular case may produce the same dispersion; yet it has not for this sole reason the same dispersive power. If indeed the incidence and the refraction of the mean ray be also the same, the dispersive power cannot be said to differ: but if the incidence and the refraction of the mean ray be less, the dispersive power must be considered as greater, though the actual dispersion be the same; because if we increase the incidence till it becomes equal to that in the common glass, the dispersion will now be increased. The proper way of conceiving the dispersion therefore is, to consider it as a portion of the whole refraction; and if we find a substance making the same dispersion with half the general refraction, we must say that the dispersive quality is double; because by making the refraction equal, the dispersion will really be double.

If therefore we take m as a symbol of the separation of the extreme rays from the middle ray, $\frac{m}{m-1}$ is the natural measure of the dispersive power. We shall express this in the Leibnitzian notation, thus $\frac{dm}{m-1}$, that we may avoid the indistinctness which the Newtonian notation would occasion when m is changed for m' or m''.

It is not unusual for optical writers to take the whole separation of the red and violet rays for the measure of the dispersive power, and to compare this with the refracting power with respect to one of the extreme rays. But it is surely better to consider the mean refraction as the measure of the refracting power: and the deviation of either of the extremes from this mean is a proper enough measure of the dispersion, being always half of it. It is attended with this convenience, that being introduced into our computations as a quantity infinitely small, and treated as such for the case of computation, while it is really a quantity of sensible magnitude; the errors arising from this supposition are diminished greatly, by taking one half of the deviation and comparing it with the mean refraction. This method has, however, this inconvenience, that it does not exhibit at once the refractive power in all substances respecting any particular colour of light; for it is not the ray of any particular colour that suffers the mean refraction. In common glass it is the ray which is in the confines of the yellow and blue; in flint glass it is nearly the middle blue ray; and in other substances it is a different ray. These circumstances appear plainly in the different proportions of the colours of the prismatic spectrum exhibited by different substances. This will be considered afterwards, being a great bar to the perfection of achromatic instruments.

The way in which an achromatic lens is constructed is, to make use of a contrary refraction of a second lens to destroy the dispersion or spherical aberration of the first.

The first purpose will be answered if $\frac{dm}{n}$ be equal to $-\frac{dm'}{n}$. For, in order that the different coloured rays may be collected into one point by two lenses, it is only necessary that $\frac{1}{f'}$, the reciprocal of the focal distance of rays refracted by both, may be the same for the extreme and mean rays, that is, that $\frac{m + dm - 1}{n} + \frac{m' + dm' - 1}{n'} + \frac{1}{r}$ be of the same value with $\frac{m-1}{n} + \frac{m'-1}{n} + \frac{1}{r}$, which must happen if $\frac{dm}{n} + \frac{dm'}{n}$ be $= 0$, or $\frac{dm}{n} = -\frac{dm'}{n}$. This may be seen in another way, more comprehensible by such as are not versant in these discussions. In or-

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der that the extreme colours which are separated by the first lens may be rendered parallel by the second; we have shown already that n and n' are proportional to the radii of the equivalent isosceles lenses, being the halves of these radii. They are therefore (in these small refractions) inversely proportional to the angles formed by the surfaces at the edges of the lenses. n' may therefore be taken for the angle of the first lens, and n for that of the second. Now the small refraction by a prism, whose angle (also small) is n, is $\overline{m-1} \times n$. The dispersive power being now substituted for the refractive power, we have for this refraction of the prism $dm \times n'$. This must be destroyed by the opposite refraction of the other prism $dm' \times n$. Therefore $dm \times n' = dm' \times n$, or $\frac{dm}{n} = -\frac{dm'}{n'}$. In like manner, this effect will be produced by three lenses if $\frac{dm}{n} + \frac{dm'}{n'} + \frac{dm''}{n''}$ be $= 0$, &c.

Lastly, the errors arising from the spherical figure, which we expressed by $-R^2 (q+q')$ will be corrected if $q+q'$ be $= 0$. We are therefore to discover the adjustments of the quantities employed in the preceding formulæ, which will insure these conditions. It will render the process more perspicuous, if we collect into one view the significations of our various symbols, and the principal equations which we are to employ.

1. The ratios to unity of the sines of mean incidence in the different media are - m, m', m''

2. The ratio of the differences of the sines of the extremes - - - $\frac{dm}{dm'}, = u$.

3. The ratio $\frac{m-1}{m'-1}$ - - $= c$.

4. The radii of the surfaces $a, b; a', b'; a'', b''$.

5. The principal focal distances, or the focal distances of parallel central rays, - - p, p', p''.

6. The focal distance of the compound lens P.

7. The distance of the radiant point, or of the focus of incident rays on each lens r, r', r''.

8. The focal distance of the rays refracted by each lens - - - f, f', f''.

9. The focal distance of rays refracted by the compound lens - - F.

10. The half breadth of the lens e.

Also the following subsidiary values:

1. $\frac{1}{n} = \frac{1}{a} - \frac{1}{b}$; $\frac{1}{n'} = \frac{1}{a'} - \frac{1}{b'}$; $\frac{1}{n''} = \frac{1}{a''} - \frac{1}{b''}$.

2. $q = \frac{m-1}{m}\left(\frac{m^3}{n^3} - \frac{2m^2+m}{an^2} + \frac{m+2}{a^2 n} + \frac{3m^2+m}{rn^2} - \frac{4(m+1)}{arn} + \frac{3m+2}{r^2 n}\right)\frac{e^2}{2}$. And q' and q'' must be formed in the same manner from m', a', n', r'; and from m'', a'', n'', r'', as q is formed from m, a, n, r.

3. Also, because in the case of an object-glass, r is infinitely great, the last term $\frac{1}{r}$ in all the values of $\frac{1}{f}, \frac{1}{f'}, \frac{1}{f''}, \frac{1}{r'}, \frac{1}{r''}$, will vanish, and we shall also have $F = P$.

Therefore in a double object-glass $\frac{1}{P} = \frac{m'-1}{n'} + \frac{m-1}{n}, = \frac{1}{p} + \frac{1}{p'}$.

And in a triple object-glass $\frac{1}{P} = \frac{m''-1}{n''} + \frac{m'-1}{n'} + \frac{m-1}{n}, = \frac{1}{p''} + \frac{1}{p'} + \frac{1}{p}$.

Also, in a double object-glass, the correction of spherical aberration requires $q+q' = 0$.

And a triple object-glass requires $q+q'+q'' = 0$. For the whole error is multiplied by F^2, and by $\frac{1}{2}e^2$; and therefore the equation which corrects this error may be divided by $F^2 \frac{1}{2} e^2$.

This equation in the preceding column, 11th line from the bottom, giving the value of q, q', q'', may be much simplified as follows: In the first place, they may be divided by m, m', or m'', by applying them properly to the terms within the parenthesis, and expunging them from the denominator of the general factors $\frac{m-1}{m}, \frac{m'-1}{m'}, \frac{m''-1}{m''}$. This does not alter the values of q, q', and q''. In the second place the whole equations may be afterwards divided by $m'-1$. This will give the values of $\frac{q}{m'-1}, \frac{q'}{m'-1}$, and $\frac{q''}{m'-1}$, which will still be equal to nothing if $q+q'+q''$ be equal to nothing.

This division reduces the general factor $\frac{m'-1}{m'}$ of q' to $\frac{1}{m'}$. And in the equation for q we obtain, in place of the general factor $\frac{m-1}{m}$, the factor $\frac{m-1}{m'-1}$, or c. This will also be the factor of the value of q'' when the third lens is of the same substance with the first, as is generally the case. And, in the third place, since the rays incident on the first lens are parallel, all the terms vanish from the value of q in which $\frac{1}{r}$ is found, and there remain only the three first, viz. $\frac{m^3}{n^3} - \frac{2m^2+m}{an^2} + \frac{m+2}{a^2 n}$.

Performing these operations, we have

$$\frac{q}{m'-1} = c\left(\frac{m^2}{n^3} - \frac{2m+1}{an^2} + \frac{m+2}{m a^2 n}\right)\frac{e^2}{2}$$

$$\frac{q'}{m-1} = \left(\frac{m'^2}{n'^3} - \frac{2m'+1}{a'n'^2} + \frac{m'+2}{m'a'^2 n'} + \frac{3m'+1}{r'n'^2} - \frac{4(m'+1)}{m'a'r'n'} + \frac{3m'+2}{m'r'^2 n'}\right)\frac{e^2}{2}$$

$$\frac{q''}{m-1} = c\left(\frac{m^2}{n''^3} - \frac{2m+1}{a''n''^2} + \frac{m+2}{m a''^2 n''} + \frac{3m+1}{r''n''^2} + \frac{4(m+1)}{m a'' r'' n''} + \frac{3m+2}{m r''^2 n''}\right)\frac{e^2}{2}$$

Let us now apply this investigation to the construction of an object-glass; and we shall begin with a double lens.

Construction of a Double Achromatic Object-glass.

Here we have to determine four radii a, b, a', and b'. Make $n = 1$. This greatly simplifies the calculus, by exterminating it from all the denominators. This gives for the equation $\frac{dm}{n} + \frac{dm'}{n'} = 0$, the equation $dm + \frac{dm'}{n'} = 0$, or $dm = -\frac{dm'}{n'}$, and $\frac{1}{n'} = -\frac{dm}{dm'}, = -u$. Also we have r', the focal distance of the light incident on the second lens, the same with the principal focal distance p of the first lens (neglecting the interval, if any). Now $\frac{1}{p} = \frac{m-1}{n}$, which in the present case is $= m-1$. Also $\frac{1}{p'}$ is $= -u\ (m'-1)$, and $\frac{1}{P} = m-1-u\ (m'-1) = u'$.

Make these substitutions in the values of $\frac{q}{m-1}$ and $\frac{q'}{m-1}$, and we obtain the following equation:

cm

$$c m^2 - \frac{c(2m+1)}{a} + \frac{c(m+2)}{m a^2} - u^3 m'^2 - \frac{u^2(2m'+1)}{a'} - \frac{u(m'+2)}{m' a'^2} + u^2(3m'+1)(m-1) + \frac{4u(m'+1)(m-1)}{m a'} - \frac{u(3m'+2)(m-1)^2}{m} = 0.$$

Arrange these terms in order, according as they are factors of $\frac{1}{a^2}$, $\frac{1}{a}$, $\frac{1}{a'^2}$, $\frac{1}{a'}$, or independent quantities. It puts on this form:

$$\frac{c(m+2)}{m} \times \frac{1}{a^2} - c(2m+1) \times \frac{1}{a} - \frac{u(m'+2)}{m'} \times \frac{1}{a'^2} - \left(u^2(2m'+1) - \frac{4u(m'+1)(m-1)}{m}\right) \times \frac{1}{a'} + c m^2 + u^2(3m'+1)(m-1) - u^3 m'^2 - \frac{u(3m'+2)(m-1)^2}{m} = 0.$$

Let A be the coefficient of $\frac{1}{a^2}$, B that of $\frac{1}{a}$, C that of $\frac{1}{a'^2}$, D that of $\frac{1}{a'}$, and E the sum of the independent quantity; that is, let A be $= \frac{c(m+2)}{m}$, B $= c(2m+1)$, C $= \frac{u(m'+2)}{m'}$, D $= u^2(2m'+2) - \frac{4u(m+1)(m-1)}{m}$, and E $= c m^2 + u^2(3m'+1)(m-1) - u^3 m'^2 - \frac{u(3m+2)(m-1)^2}{m'}$

Our final equation becomes

$$\frac{A}{a^2} - \frac{B}{a} - \frac{C}{a'^2} - \frac{D}{a'} + E = 0.$$

The coefficients of this equation and the independent quantity are all known, from our knowledge of m, m' dm, dm; and we are to find the values of a and a', and from them and $n = 1$ to find the values of b and b'.

But it is evidently an indeterminate equation, because there are two unknown quantities; so that there may be an infinity of solutions. It must be rendered determinate by means of some other conditions to which it may be subjected. These conditions must depend on some other circumstances which may direct our choice.

One circumstance occurs to us which we think of very great consequence. In the passage of light from one substance to another, there is always a considerable portion reflected from the posterior surface of the first and from the anterior surface of the last; and this reflection is more copious in proportion to the refraction. This loss of light will therefore be diminished by making the internal surfaces of the lenses to coincide; that is, by making $b = a'$. This will be attended with another advantage. If we put between the glasses a substance of nearly the same refracting power, we shall not only completely prevent this loss of light, but we shall greatly diminish the errors which arise from an imperfect polish of the surfaces. We have tried this, and find the effect very surprising. The lens being polished immediately after the figure has been given it, and while it was almost impervious to light by reason of its roughness, which was still sensible to the naked eye, performed as well as when finished in the finest manner.

N. B. This condition, by taking away one refraction, obliges us to increase those which remain, and therefore increases the spherical aberrations. And since our formulæ do not fully remove those (by reason of the small quantities neglected in the process), it is uncertain whether this condition be the most eligible. We have, however, no direct argument to the contrary.

Let us see what determination this gives us.

In this case $\frac{1}{a'} = \frac{1}{b}$, $= \frac{1}{a} - 1$. For because $\frac{1}{n} = \frac{1}{a} - \frac{1}{b}$ and $n = 1$, we have $1 + \frac{1}{b} = \frac{1}{a}$, and $\frac{1}{b} = \frac{1}{a} - 1$. Therefore $\frac{1}{a'^2} = \frac{1}{a^2} - \frac{2}{a} + 1$. Therefore, in our final equation, put $\frac{1}{a^2} - \frac{2}{a} + 1$ in place of $\frac{1}{a'^2}$, and $\frac{1}{a} - 1$ in place of $\frac{1}{a'}$, and it becomes $\frac{A-C}{a^2} - \frac{B+D-2C}{a} + E + D - C = 0$.

Thus have we arrived at a common affected quadratic equation, where $\frac{1}{a}$ is the unknown quantity. It has the common form $p x^2 + q x + r = 0$, where p is $=$ A$-$C, q is equal to 2C$-$B$-$D, r is equal to E$+$D$-$C, and x is equal to $\frac{1}{a}$.

Divide the equation by p, and we have $x^2 + \frac{q}{p} x + \frac{r}{p} = 0$. Make $s = \frac{q}{p}$ and $t = \frac{r}{p}$, and we have $x^2 + s x + t = 0$. This gives us finally $\frac{1}{a}$, or $x = -\frac{1}{2} s \pm \sqrt{\frac{1}{4} s^2 - t}$.

This value of $\frac{1}{a}$ is taken from a scale of which the unit is half the radius of the isosceles lens which is equivalent to the first lens, or has the same focal distance with it. We must then find (on the same scale) the value of b, *viz.* $\frac{1}{a} - 1$, which is also the value of a'. Having obtained a', we must find b' by means of the equation $\frac{1}{n'} = \frac{1}{a'} - \frac{1}{b'}$ and therefore $\frac{1}{b'} = \frac{1}{a'} - \frac{1}{n'}$. But $\frac{1}{n'} = u$. Therefore $\frac{1}{b'} = \frac{1}{a'} + u$, $= \frac{1}{a} + u - 1$.

Thus is our object glass constructed; and we must determine its focal distance, or its reciprocal $\frac{1}{P}$. This is $= m - 1 - u(m' - 1)$.

All these radii and distances are measured on a scale of which n is the unit. But it is more convenient to measure every thing by the focal distance of the compound object-glass. This gives us the proportion which all the distances bear to it. Therefore, calling P unity, in order to obtain $\frac{1}{a}$ on this scale, we have only to state the analogy $m - 1 - u(m' - 1) : 1 = \frac{1}{a} : \frac{1}{A}$, and A is the radius of our first surface measured on a scale of which P is the unit.

If, in the formula which expresses the final equation for $\frac{1}{a}$, the value of t should be positive, and greater than $\frac{1}{4} s^2$, the equation has imaginary roots; and it is not possible with the glasses employed, and the conditions assumed, to correct both the chromatic and spherical aberrations.

If t is negative and equal to $\frac{1}{4} s^2$, the radical part of the value is $= 0$, and $\frac{1}{a} = -\frac{1}{2} s$. But if it be negative or positive, but less than $\frac{1}{4} s^2$, the equation has two real roots, which will give two constructions. That is to be preferred which gives the smallest curvature of the surfaces; because, since in our formulæ which determine the spherical aberration some quantities are neglected, these quantities are always

Telescope. ways greater when a large arch (that is, an arch of many degrees) is employed. No radius should be admitted which is much less than $\frac{1}{4}$ of the focal distance.

All this process will be made plain and easy by an example.

Very careful experiments have shown, that in common crown-glass the sine of incidence is to the sine of refraction as 1,526 is to 1, and that in the generality of flint-glass it is as 1,604 to 1. Also that $\frac{dm}{dm'} = 0,6054 = u$. Therefore $m - 1 = 0,526$; $m' - 1 = 0,604$; $c = \frac{m-1}{m'-1}$, $= 0,87086$. By these numbers we can compute the coefficients of our final equation. We shall find them as follows:

$$\begin{aligned} A &= 2,012 \\ B &= 3.529 \\ C &= 1,360 \\ D &= -0,526 \\ E &= 1,8659 \end{aligned}$$

The general equation (p. 352. l. 17.), when subjected to the assumed coincidence of the internal surfaces, is $\frac{A-C}{a^2} - \frac{B+D-2C}{a} + E + D - C = 0$. $A - C$ is $= 0,652$; $B + D - 2C$ is $= 0,283$; and $E + D - C$ is $= -0,020$; and the equation with numerical coefficients is $\frac{0,652}{a^2} - \frac{0,283}{a} - 0,020 = 0$, which corresponds to the equation $px^2 + qx + r = 0$. We must now make $s = \frac{q}{p}$, $= \frac{0,283}{0,652}$, $= 0,434$, and $t = \frac{r}{p}$, $= \frac{0,02}{0,652}$, $= 0.0307$. This gives us the final quadratic equation $\frac{1}{a^2} - \frac{0,434}{a} - 0,0307 = 0$. To solve this, we have $-\frac{1}{2}s = 0\ 217$, and $\frac{1}{4}s^2 - 0,0471$. From this take t, which is $= -0,0307$ (that is, to 0,0471 add 0,0307), and we obtain 0,0778, the square root of which is $= 0,2789$. Therefore, finally, $\frac{1}{a} = 0,2170 \pm 0,2789$, which is either 0,4959 or $-0,0619$. It is plain that the first must be preferred, because the second gives a negative radius, or makes the first surface of the crown-glass concave. Now as the convergence of the rays is to be produced by the crown-glass, the other surface must become very convex, and occasion great errors in the computed aberration. We therefore retain 0,4959 for the value of $\frac{1}{a}$, and a is $= \frac{1}{0,4959}$, $= 2,0166$.

To obtain b, use the equation $\frac{1}{b} = \frac{1}{a} - 1$, which gives $\frac{1}{b} = -0,5041$, and therefore a convex surface. b is therefore $= \frac{1}{0,5041}$, $= 1,9837$.

a' is the same with b, and $\frac{1}{a'} = -0,5041$.

To obtain b', use the equation $\frac{1}{b'} = \frac{1}{a'} + u$. Now $u = 0,6054$, and $\frac{1}{a'} = -0,5041$. The sum of these is 0,1013; and since it is positive, the surface is concave. $b' = \frac{1}{,1013} = 9,872$.

Lastly, $\frac{1}{P} = m - 1 - u\,(m' - 1) = 0,1603$, and $P = \frac{1}{0,1603}$, $= 6,2383$.

Now to obtain all the measures in terms of the focal distance P, we have only to divide the measures already found by 6,2383, and the quotients are the measures wanted.

$$\begin{aligned} \text{Therefore } a &= \frac{2,0166}{6,2383} = 0,32325 \\ b &= \frac{1,9837}{6,2383} = -0,31798 \\ a' &= \quad - \quad - \quad = -0,31798 \\ b' &= \frac{9,872}{6,2383} = \quad 1,5825 \\ P &= \quad - \quad\quad 1. \end{aligned}$$

If it be intended that the focal distance of the object-glass shall be any number n of inches or feet, we have only to multiply each of the above radii by n, and we have their lengths in inches or feet.

Thus we have completed the investigation of the construction of a double object-glass. Although this was intricate, the final result is abundantly simple for practice, especially with the assistance of logarithms. The only troublesome thing is the preparation of the numerical coefficients A, B, C, D, E of the final equation. Strict attention must also be paid to the positive and negative signs of the quantities employed.

We might propose other conditions. Thus it is natural to prefer for the first or crown-glass lens such a form as shall give it the smallest possible aberration. This will require a small aberration of the flint-glass to correct it. But a little reflection will convince us that this form will not be good. The focal distance of the crown-glass must not exceed one-third of that of the compound glass; these two being nearly in the proportion of $dm' - dm$ to dm'. Therefore if this form be adopted, and a be made about $\frac{1}{6}$th of b, it will not exceed $\frac{1}{5}$th of P. Therefore, although we may produce a most accurate union of the central and marginal rays by opposite aberrations, there will be a considerable aberration of some rays which are between the centre and the margin.

It is absolutely impossible to collect into one point the whole rays (though the very remotest rays are united with the central rays), except in a very particular case, which cannot obtain in an object-glass; and the small quantities which are neglected in the formula which we have given for the spherical aberration, produce errors which do not follow any proportion of the aperture which can be expressed by an equation of a manageable form. When the aperture is very large, it is better not to correct the aberration for the whole aperture, but for about $\frac{5}{6}$ths of it. When the rays corresponding to this distance are made to coincide with the central rays by means of apposite aberrations, the rays which are beyond this distance will be united with some of those which are nearer to the centre, and the whole diffusion will be considerably diminished. Dr Smith has illustrated this in a very perspicuous manner in his theory of his Catoptric Microscope.

But although we cannot adopt this form of an object-glass, there may be other considerations which may lead us to prefer some particular form of the crown glass, or of the flint-glass. We shall therefore adapt our general equation $\frac{A}{a^2} - \frac{B}{a} - \frac{C}{a'^2} - \frac{D}{a'} + E = 0$ to this condition.

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Therefore let b express this fixed ratio of the two radii of the crown-glass, making $\frac{a}{b} = b$ (remembering always that a is positive and b negative in the case of a double convex, and b is a negative number).

With this condition we have $\frac{1}{b} = \frac{b}{a}$. But when we make n the unit of our formula of aberration, $\frac{1}{b} = \frac{1}{a} - 1$. Therefore $1 = \frac{1}{a} - \frac{b}{a}$, and $\frac{1}{a} = \frac{1}{1-b}$. Now substitute this for $\frac{1}{a}$ in the general equation, and change all the signs (which still preserves it $= 0$), and we obtain

$$\frac{C}{a'^2} + \frac{D}{a'} - E - \frac{A}{(1-b)^2} + \frac{B}{1-b} = 0$$

By this equation we are to find $\frac{1}{a'}$, or the radius of the anterior surface of the flint-glass. The equation is of this form $p x^2 + q x + r = 0$, and we must again make $s = \frac{q}{p}$, and $t = \frac{r}{p}$. Therefore $s = \frac{D}{C}$, and $t = \frac{1}{C} \times \left(\frac{B}{1-b} - \frac{A}{(1-b)^2} - E\right)$. Then, finally,

$$\frac{1}{a'} = -\tfrac{1}{2} s \pm \sqrt{\tfrac{1}{4} s^2 - t}.$$

It may be worth while to take a particular case of this condition. Suppose the crown-glass to be of equal convexities on both sides. This has some advantages: We can tell with precision whether the curvatures are precisely equal, by measuring the focal distance of rays reflected back from its posterior surface. These distances will be precisely equal. Now it is of the utmost importance in the construction of an object-glass which is to correct the spherical aberration, that the forms be precisely such as are required by our formulae.

In this case of a lens equally convex on both sides $\frac{1}{a}$ is $= -\frac{1}{b'} = \frac{1}{2}$. Substitute this value for $\frac{1}{a}$ in the general equation $\frac{A}{a^2} - \frac{B}{a} - \frac{C}{a'^2} - \frac{D}{a'} + E = 0$, and then $\frac{A}{a^2} = \frac{A}{4}$; $\frac{B}{a}$ becomes $\frac{B}{2}$. Now change all the signs, and we have $\frac{C}{a'^2} + \frac{D}{a'} - E - \frac{A}{4} + \frac{B}{2} = 0$, by which we are to find a'. This in numbers is $\frac{1,360}{a'^2} - \frac{0,526}{a'} - 0,6044 = 0$. Then $s = \frac{-0,526}{1,360} = 0,3867$, and $t = \frac{-0.6044}{1,360} = -0,4444$. Then $-\frac{1}{2} s = 0,1933$; $\frac{1}{4} s^2 = 0,0374$; and $\sqrt{\frac{1}{4} S^2 - t} = \pm 0,6941$; so that $\frac{1}{a'} = 0,1933 \pm 0,6941$. This gives two real roots, viz. 0,8874, and $-0,5008$. If we take the first, we shall have a convex anterior surface for the flint-glass, and consequently a very deep concave for the posterior surface. We therefore take the second or negative root $-0,5008$.

We find $\frac{1}{b'}$, as before, by the equation $\frac{1}{b'} = \frac{1}{a'} + u$, $= 0,1046$, which will give a large value of b'.

We had $\frac{1}{a} = \frac{1}{2}$

and $\frac{1}{b} = -\frac{1}{2}$

and $\frac{1}{P}$ is the same as in the former case, viz. 0,1603.

Having all these reciprocals, we may find a, b, a', b', and P; and then dividing them by P, we obtain finally

$$\begin{aligned} a &= 0,3206 \\ b &= -0,3206 \\ a' &= -0,3201 \\ b' &= 1,533 \\ P &= 1, \end{aligned}$$

By comparing this object-glass with the former, we may remark, that diminishing a a little increases b, and in this respect improves the lens. It indeed has diminished b', but this being already considerable, no inconvenience attends this diminution. But we learn, at the same time, that the advantage may be very small; for we cannot diminish a much more, without making it as small as the smallest radius of the object-glass. This proportion is therefore very near the maximum, or best possible; and we know that in such cases, even considerable changes in the radii will make but small changes in the result: for these reasons we are disposed to give a strong preference to the first construction, on account of the other advantages which we showed to attend it.

As another example, we may take a case which is very nearly the general practice of the London artists. The radius of curvature for the anterior surface of the convex crown-glass is ⅚ths of the radius of the posterior surface, so that $b = \frac{5}{6}$. This being introduced into the determinate equation, gives

$$\begin{aligned} a &= 0,2938 \qquad & a' &= -0,3443 \\ b &= -0,3526 \qquad & b &= 1,1474 \end{aligned}$$

As another condition, we may suppose that the second or flint-glass is of a determined form.

This case is solved much in the same manner as the former. Taking b to represent the ratio of a' and b', we have $\frac{1}{a'} = \frac{1}{1-b}$. This value being substituted in the general equation $\frac{A}{a^2} - \frac{B}{a} - \frac{C}{a'^2} - \frac{D}{a} + E = 0$, gives us $\frac{A}{a^2} - \frac{B}{a} + E - \frac{C}{(1-b)^2} - \frac{D}{1-b} = 0$. This gives for the final equation $x^2 + s x + t = 0$, $s = \frac{B}{A}$, and $t = \frac{1}{A} \times \left(E - \frac{C}{(1-b)^2} - \frac{D}{1-b}\right)$ and $\frac{1}{a} = -\frac{1}{2} s \pm \sqrt{\frac{1}{4} s^2 - t}$.

We might here take the particular case of the flint-glass being equally concave on both sides. Then, because $\frac{1}{n'} = -u$, and in the case of equal concavities $\frac{2}{a'} = \frac{1}{n'}$, $= -u$, it is sufficient to put $-\frac{1}{2} u$ for $\frac{1}{a'}$. This being done, the equation becomes $\frac{A}{a} - \frac{B}{a} \frac{C u^2}{4} + \frac{D u}{2} + E = 0$. This gives $s = \frac{B}{A}$, and $t = \frac{1}{A} \times \left(\frac{4 D u - 2 C u^2}{8} + E\right)$.

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We imagine that these cases are sufficient for shewing the management of the general equation; and the example of the numerical solution of the first case affords instances of the only niceties which occur in the process, viz. the proper employment of the positive and negative quantities.

We have oftener than once observed, that the formula is not perfectly accurate, and that in very large apertures errors will remain. It is proper therefore, when we have obtained the form of a compound object glass, to calculate trigonometrically the progress of the light through it; and if we find a considerable aberration, either chromatic or spherical, remaining, we must make such changes in the curvatures as will correct them. We have done this for the first example; and we find, that if the focal distance of the compound object-glass be 100 inches, there remains of the spherical aberration nearly [illegible]th of an inch, and the aberration of colour is over corrected above [illegible]th of an inch. The first aberration has been diminished about 6 times, and the other about 30 times. Both of the remaining errors will be diminished by increasing the radius of the inner surfaces. This will diminish the aberration of the crown-glass, and will diminish the dispersion of the flint more than that of the crown. But indeed the remaining error is hardly worth our notice.

It is evident to any person conversant with optical discussions, that we shall improve the correction of the spherical aberration by diminishing the refractions. If we employ two lenses for producing the convergency of the rays to a real focus, we shall reduce the aberration to $\frac{1}{4}$th. Therefore a better achromatic glass will be formed of three lenses, two of which are convex and of crown-glass. The refraction being thus divided between them, the aberrations are lessened. There is no occasion to employ two concave lenses of flint-glass; there is even an advantage in using one. The aberration being considerable, less of it will serve for correcting the aberration of the crown-glass, and therefore such a form may be selected as has little aberration. Some light is indeed lost by these two additional surfaces; but this is much more than compensated by the greater apertures which we can venture to give when the curvature of the surface is so much diminished. We proceed therefore to

The Construction of a Triple Achromatic Object-glass.

It is plain that there are more conditions to be assumed before we can render this a determinate problem, and that the investigation must be more intricate. At the same time, it must give us a much greater variety of constructions, in consequence of our having more conditions necessary for giving the equation this determinate form. Our limits will not allow us to give a full account of all that may be done in this method. We shall therefore content ourselves with giving one case, which will sufficiently point out the method of proceeding. We shall then give the results in some other eligible cases, as rules to artists by which they may construct such glasses.

Let the first and second glasses be of equal curvatures on both sides; the first being a double convex of crown-glass, and the second a double concave of flint-glass.

Still making n the unit of our calculus, we have in the first place $a = -b, = -a', = b'$. Therefore $\frac{1}{a'} - \frac{1}{b'} = -\left(\frac{1}{a} - \frac{1}{b}\right)$, or $\frac{1}{n'} = -\frac{1}{n} = -1$. Therefore the equation $\frac{dm}{n} + \frac{dm'}{n} + \frac{dm''}{n} = 0$ becomes $u - 1 + \frac{u}{n'} = 0$, or $\frac{1}{n} = \frac{1}{u} - 1$. Let us call this value u'.

We have $\frac{1}{p} = m - 1$; $\frac{1}{p'} = -(m' - 1)$; $\frac{1}{p''} = u'(m - 1)$; $\frac{1}{P} = \frac{1}{p} + \frac{1}{p'} + \frac{1}{p''}, = m - m' + u'(m - 1)$. And if we make $m' - m = C$, we shall have $\frac{1}{P} = -C, + u'(m - 1)$. Also $\frac{1}{r} = m - 1$; $\frac{1}{r'} = m - 1 - (m' - 1), = m - m', = -C'$.

The equality of the two curvatures of each lens gives $\frac{1}{a} = \frac{1}{2n}$. Therefore $\frac{1}{a} = -\frac{1}{b}, = -\frac{1}{a'}, = \frac{1}{b'}, = \frac{1}{2}$; and $\frac{1}{b''} = \frac{1}{a} - \frac{1}{n'}, = \frac{1}{a''} - u'$.

Substituting these values in the equation (p. 351. col. 2. par. 5.), we obtain the three formulæ,

$$1. \quad - \quad cm^2 - \tfrac{1}{2}c(2m+1) + \frac{c(m+2)}{4m}$$

$$2. \; -m'^2 + \tfrac{1}{2}(2m'+1) - \frac{m'+2}{4m} + (3m'+1)(m-1) - \frac{2(m'+1)(m-1)}{m'} - \frac{(3m'+2)(m-1)^2}{m'}$$

$$3. \; cu'3m^2 - \frac{cu'^2(2m+1)}{a} + \frac{cu'(m+2)}{ma^2} - cc'u'^2(3m+1) + \frac{4cc'u'(m+1)}{ma''} + \frac{cc'^2u'(3m+2)}{m} = 0.$$

Now arrange these quantities according as they are coefficients of $\frac{1}{a^2}$ and of $\frac{1}{a}$, or independent quantities. Let the coefficient of $\frac{1}{a''^2}$ be A, that of $\frac{1}{a''}$ be B, and the independent quantity be C, we have

$A = \frac{cu'(m+2)}{m}$; $B = cu'^2(2m+1) - \frac{4cc'u'(m+1)}{m}$, and $C = cm^2 + \frac{c(m+2)}{4m} + \frac{1}{2}(2m'+1) + (3m'+1)(m-1) + cu'^2m^2 + \frac{cc'^2u'(3m+2)}{m} - \frac{1}{2}c(2m+1) - m'^2 - \frac{m'+2}{4m} - \frac{2(m'+1)(m-1)}{m'} - \frac{(3m'+2)(m-1)^2}{m'} - cc'u'^2(3m+1)$.

Our equation now becomes $\frac{A}{a^2} - \frac{B}{a} + C = 0$.

This reduced to numbers, by computing the values of the coefficients, is $\frac{1,312}{a^2} - \frac{1,2[illegible]}{a} - 0,3257 = 0$.

This, divided by 1,312, gives $s = -0,92$; and $t = -0,2482$; $-\frac{1}{2}s = 0,46$; $\frac{1}{4}s^2 = 0,2116$; and $\sqrt{\frac{1}{4}s^2 - t} = \pm 0,6781$.

And, finally, $\frac{1}{a} = 0,46 \pm 0,6781$.

This has two roots, viz. 0,2181 and $-$ 1,1381. The last would give a very small radius, and is therefore rejected.

Now, proceeding with this value of $\frac{1}{a}$ and the $\frac{1}{n}$, we get the other radius b'', and then, by means of u', we get the other radius which is common to the four surfaces.

Then, by $\frac{1}{P} = \frac{1}{p'} - c'$, we get the value of P.

The radii being all on the scale of which n is the unit, they must be divided by P to obtain their value on the scale which has P for its unit. This will give us

$$a = -b, = -a', = b', = 0,530$$
$$a = \quad 1,215$$
$$b' = \quad -0,3046$$
$$P = \quad 1.$$

This is not a very good form, because the last surface has too great curvature.

We thought it worth while to compute the curvatures for a case where the internal surfaces of the lenses coincide, in order to obtain the advantages mentioned on a former occasion. The form is as follows:

The middle lens is a double concave of flint-glass; the last lens is of crown-glass, and has equal curvatures on both sides. The following table contains the dimensions of the glasses for a variety of focal distances. The first column contains the focal distances in inches; the second contains the radii of the first surface in inches; the third contains the radii of the posterior surface of the first lens and anterior surface of the second; and the fourth column has the radii of the three remaining surfaces.

P	a	b, a'	b, a', b''
12	9,25	6,17	12,75
24	18,33	12,25	25,5
36	27,33	18,25	38,17
48	36,42	24,33	50,92
60	45,42	30,33	63,58
72	54,5	36,42	76,33
84	63,5	42,5	89,
96	72,6	48,5	101,75
108	81,7	54,58	114,42
120	90,7	60,58	127,17

We have had an opportunity of trying glasses of this construction, and found them equal to any of the same length, although executed by an artist by no means excellent in his profession as a glass-grinder. This very circumstance gave us the opportunity of seeing the good effects of interposing a transparent substance between the glasses. We put some clear turpentine varnish between them, which completely prevented all reflection from the internal surfaces. Accordingly these telescopes were surprisingly bright; and although the remaining faults left by the first grinding was very perceptible by the naked eye before the glasses were put together, yet when joined in this manner it entirely disappeared, even when the glasses were viewed with a deep magnifier.

The aperture of an object-glass of this construction of 30 inches focal distance was [illegible] inches, which is considerably more than any of Mr Dollond's that we have seen.

If we should think it of advantage to make all the three lenses isosceles, that is, equally curved on both surfaces, the general equation will give the following radii:

$$a = +0,639 \qquad a' = -0,5285 \qquad a'' = +0,6413$$
$$b = -0,639 \qquad b' = +0,5285 \qquad b'' = -0,6413$$

This seems a good form, having large radii.

Should we choose to have the two crown-glass lenses isosceles and equal, we must make

$$a = +0,6412 \qquad a' = -0,5227 \qquad a'' = +0,6412$$
$$b = -0,6412 \qquad b' = +0,5367 \qquad b'' = -0,6412$$

This form hardly differs from the last.

Our readers will recollect that all these forms proceed on certain measures of the refractive and dispersive powers of the substances employed, which are expressed by m, m', dm, and dm'; and we may be assured that the formulæ are sufficiently exact, by the comparison (which we have made in one of the cases) of the result of the formula and the trigonometrical calculation of the progress of the rays. The error was but $\frac{1}{8}$th of the whole, ten times less than another error, which unavoidably remains, and will be considered presently. These measures of refraction and dispersion were carefully taken; but there is great diversity, particularly in the flint-glass. We are well informed that the manufacture of this article has considerably changed of late years, and that it is in general less refractive and less dispersive than formerly. This must evidently make a change in the forms of achromatic glasses. The proportion of the focal distance of the crown-glasses to that of the flint must be increased, and this will occasion a change in the curvatures, which shall correct the spherical aberration. We examined with great care a parcel of flint-glass which an artist of this city got lately for the purpose of making achromatic object-glasses, and also some very white crown-glass made in Leith; and we obtained the following measures:

$$m = 1,529 \qquad \frac{dm}{dm'} = \frac{142}{219} = 0,64841.$$
$$m = 1,578$$

We computed some forms for triple object-glasses made of these glasses, which we shall subjoin as a specimen of the variations which this change of data will occasion.

If all the three lenses are made isosceles, we have

$$a = +0,796 \qquad a = -0,474 \qquad a'' = +0,502$$
$$b = -0,796 \qquad b' = +0,474 \qquad b' = -0,502$$

Or

$$a = \quad 0,504 \qquad a' = -0,475 \qquad a'' = +0,793$$
$$b = -0,504 \qquad b = \quad 0,475 \qquad b'' = -0,793$$

If the middle lens be isosceles, the two crown-glass lenses may be made of the same form and focal distance, and placed the same way. This will give us

$$a = +0,705 \qquad a = -0,475 \qquad a'' = +0,705$$
$$b = -0,547 \qquad b = +0,475 \qquad b'' = -0,547$$

N. B. This construction allows a much better form, if the measures of refraction and dispersion are the same that we used formerly. For we shall have

$$a = +0,628 \qquad a' = -0,579 \qquad a'' = +0,628$$
$$b = -0,749 \qquad b' = +0,579 \qquad b' = -0,749$$

And this is pretty near the practice of the London opticians.

We may here observe, upon the whole, that an amateur has little chance of succeeding in these attempts. The diversity of glasses, and the uncertainty of the workman's producing the very curvatures which he intends, is so great, that the object-glass turns out different from our expectation. The artist who makes great numbers acquires a pretty certain guess at the remaining error; and having many lenses intended to be of one form, but unavoidably differing a little from it, he tries several of them with the other two, and finding one better than the rest, he makes use of it to complete the set.

The great difficulty in the construction is to find the exact proportion of the dispersive powers of the crown and flint glass. The crown is pretty constant; but there is hardly two pots of flint-glass which have the same dispersive power. Even if constant, it is difficult to measure it accurately; and an error in this greatly affects the instrument, because the focal distances of the lenses must be nearly as their dispersive powers. The method of examining this circumstance, which we found most accurate, was as follows:

The sun's light, or that of a brilliant lamp, passed through a small hole in a board, and fell on another board pierced also with a small hole. Behind this was placed a fine prism A (fig. 10.), which formed a spectrum ROV on a screen pierced with a small hole. Behind this was placed a prism B of the substance under examination. The ray which was refracted by it fell on the wall at D, and the distance of its illumination from that point to C, on which an unrefracted ray would have fallen, was carefully measured. This showed the refraction of that colour. Then, in order that we might be certain that we always compared the refraction of the

the ſame preciſe colour by the different priſms placed at B, we marked the preciſe poſition of the priſm A when the ray of a particular colour fell on the priſm B. This was done by an index AG attached to A, and turning with it, when we cauſed the different colours of the ſpectrum formed by A to fall on B. Having examined one priſm B with reſpect to all the colours in the ſpectrum formed by A, we put another B in its place. Then bringing A to all its former poſitions ſucceſſively, by means of a graduated arch HGK, we were certain that when the index was at the ſame diviſion of the arch it was the very ray which had been made to paſs through the firſt priſm B in a former experiment. We did not ſolicitouſly endeavour to find the very extreme red and violet rays; becauſe, although we did not learn the whole diſperſions of the two priſms, we learned their proportions, which is the circumſtance wanted in the conſtruction of achromatic glaſſes. It is in vain to attempt this by meaſuring the ſpectrums themſelves; for we cannot be certain of ſelecting the very ſame colours for the compariſon, becauſe they ſucceed in an inſenſible gradation.

The intelligent reader will readily obſerve, that we have hitherto proceeded on the ſuppoſition, that when, by means of contrary refractions, we have united the extreme red and violet rays, we have alſo united all the others. But this is quite gratuitous. Sir Iſaac Newton would, however, have made the ſame ſuppoſition; for he imagined that the different colours divided the ſpectrum formed by all ſubſtances in the proportions of a muſical canon. This is a miſtake. When a ſpectrum is formed by a priſm of crown glaſs, and another of preciſely the ſame length is formed by the ſide of it by a priſm of flint-glaſs, the confine between the green and blue will be found preciſely in the middle of the firſt ſpectrum, but in the ſecond it will be conſiderably nearer to the red extremity. In ſhort, different ſubſtances do not diſperſe the colours in the ſame proportion.

The effect of this irrationality (ſo to call it) of diſperſion, will appear plainly, we hope, in the following manner: Let A (fig. 9. A) repreſent a ſpot of white ſolar light falling perpendicularly on a wall. Suppoſe a priſm of common glaſs placed behind the hole through which the light is admitted, with its refracting angle facing the left hand. It will refract the beam of light to the right, and will at the ſame time diſperſe this heterogeneous light into its component rays, carrying the extreme red ray from A to R, the extreme orange from A to O, the extreme yellow from A to Y, &c. and will form the uſual priſmatic ſpectrum ROYGBPVC. If the whole length RC be divided into 1000 parts, we ſhall have (when the whole refraction AR is ſmall) RO very nearly 125, RY = 200, RG = 333, RB = 500, RP = 667, RV = 778, and RC = 1000; this being the proportion obſerved in the differences of the ſines of refraction by Sir Iſaac Newton.

Perhaps a refracting medium may be found ſuch, that a priſm made of it would refract the white light from A, in the upper line of this figure, in ſuch a manner that a ſpectrum R′O′Y′G′B′P′V′C′ ſhall be formed at the ſame diſtance from A′, and of the ſame length, but divided in a different proportion. We do not know that ſuch a medium has been found; but we know that a priſm of flint-glaſs has its refractive and diſperſive powers ſo conſtituted, that if A′H′ be taken about ⅔d of AR, a ſpot of white light, formed by rays falling perpendicularly at H′, will be ſo refracted and diſperſed, that the extreme red ray will be carried from H′ to R′, and the extreme violet from H′ to C′, and the intermediate colours to intermediate points, forming a ſpectrum reſembling the other, but having the colours more conſtipated towards R′, and more dilated towards C; ſo that the ray which the common glaſs carried to the middle point B of the ſpectrum RC is now in a point B′ of the ſpectrum R′C′, conſiderably nearer to R′.

Dr Blair has found, on the other hand, that certain fluids, particularly ſuch as contain the muriatic acid, when formed into a priſm, will refract the light from H″ (in the lower line) ſo as to form a ſpectrum R″C″ equal to RC, and as far removed from A″ as RC is from A, but having the colours more dilated toward R″, and more conſtipated toward C, than is obſerved in RC; ſo that the ray which was carried by the priſm of common glaſs to the middle point B is carried to a point B″, conſiderably nearer to C″.

Let us now ſuppoſe that, inſtead of a white ſpot at A, we have a priſmatic ſpectrum AB (fig. 9. B), and that the priſm of common glaſs is applied as before, immediately behind the priſm which forms the ſpectrum AB. We know that this will be refracted ſidewiſe, and will make a ſpectrum ROYGBPC, inclined to the plane of refraction in an angle of 45°; ſo that drawing the perpendicular RC′, we have RC′ = C′C.

We alſo know that the priſm of flint-glaſs would refract the ſpectrum formed by the firſt priſm on EHF, in ſuch a manner that the red ray will go to R, the violet to C, and the intermediate rays to points *o*, *y*, *g*, *b*, *p*, *v*, ſo ſituated that O′*o* is = R′O′ of the other figure; Y*y* is = R′Y′ of that figure, G*g* = R′G′, &c. Theſe points muſt therefore lie in a curve R*oygbpv*C, which is convex toward the axis RC′.

In like manner we may be aſſured that Dr Blair's fluid will form a ſpectrum R*o′y′g′b′p′v′*C, concave toward R′C.

Let it be obſerved by the way, that this is a very good method for diſcovering whether a medium diſperſes the light in the ſame proportion with the priſm which is employed for forming the firſt ſpectrum AB or EF. It diſperſes in the ſame or in a different proportion, according as the oblique ſpectrum is ſtraight or crooked; and the exact proportion correſponding to each colour is had by meaſuring the ordinates of the curves R*b*C or R*b′*C.

Having formed the oblique ſpectrum RBC by a priſm of common glaſs, we know that an equal priſm of the ſame glaſs, placed in a contrary poſition, will bring back all the rays from the ſpectrum RBC to the ſpectrum AB, laying each colour on its former place.

In like manner, having formed the oblique ſpectrum R*b*C by a priſm of flint-glaſs, we know that another priſm of flint-glaſs, placed in the oppoſite direction, will bring all the rays back to the ſpectrum EHF.

But having formed the oblique ſpectrum RBC by a priſm of common glaſs, if we place the flint-glaſs priſm in the contrary poſition, it will bring the colour R back to E, and the colour C to F; but it will not bring the colour B to H, but to a point *b*, ſuch that B*b* is equal to *b*H, and *b*B to *b*H. In like manner, the other colours will not be brought back to the ſtraight line EHF, but to a curve E*b*F, forming a crooked ſpectrum.

In like manner, the fluids diſcovered by Dr Blair, when employed to bring back the oblique ſpectrum RBC formed by common glaſs, will bring its extremities back to E and F, and form the crooked ſpectrum E*b′*F lying beyond EHF.

This experiment evidently gives us another method for examining the proportionality of the diſperſion of different ſubſtances.

Having, by common glaſs, brought back the oblique ſpectrum formed by common glaſs to its natural place AB, ſuppoſe the original ſpectrum at AB to contract gradually (as Newton has made it do by means of a lens), it is plain that the oblique ſpectrum will alſo contract, and ſo will the

Telescope.

second spectrum at AB; and it will at last coalesce into a white spot. The effect will be equivalent to a gradual compression of the whole figure, by which the parallel lines AF and BC gradually approach, and at last unite.

In like manner, when the oblique spectrum formed by flint-glass is brought back to EHF by a flint-glass prism, and the figure compressed in the same gradual manner, all the colours will coalesce into a white spot.

But when flint-glass is employed to bring back the oblique spectrum formed by common glass, it forms the crooked spectrum E*h*F. Now let the figure be compressed. The curve E*h*F will be doubled down on the line H*h*, and there will be formed a compound spectrum H*h*, quite unlike the common spectrum, being purple or claret coloured at H by the mixture of the extreme red and violet, and green coloured with blue at *h* by the mixture of the green and blue. The third points would in like manner form a spectrum of the same kind on the other side of H.

This is precisely what is observed in achromatic object-glasses made of crown-glass and flint: for the refraction from A to R corresponds to the refraction of the convex crown-glass; and the contrary refraction from R to E corresponds to the contrary refraction of the concave flint-glass, which still leaves a part of the first refraction, producing a convergence to the axis of the telescope. It is found to give a purple or wine coloured focus, and within this a green one, and between them an imperfect white. Dr Blair found, that when the eye glass was drawn out beyond its proper distance, a star was surrounded by a green fringe, by the green end of the spectrum, which crossed each other within the focus; and when the eye-glass was too near the object-glass, the star had a wine coloured fringe. The green rays were ultimately most refracted. *N. B.* We should expect the fringe to be of a blue colour rather than a green. But this is easily explained: The extreme violet rays are very faint, so as hardly to be sensible; therefore when a compound glass is made as achromatic as possible to our senses, in all probability (nay certainly) these almost insensible violet rays are left out, and perhaps the extreme colours which are united are the red and the middle violet rays. This makes the green to be the mean ray, and therefore the most outstanding when the dispersions are not proportional.

Dr Blair very properly calls these spectrums, H*h* and H*b*, *secondary spectrums*, and seems to think that he is the first who has taken notice of them. But Mr Clairault was too accurate a mathematician, and too careful an observer, not to be aware of a circumstance which was of primary consequence to the whole inquiry. He could not but observe that the success rested on this very particular, and that the proportionality of dispersion was indispensably necessary.

This subject was therefore touched on by Clairault; and *fully* discussed by Boscovich, first in his Dissertations published at Vienna in 1759; then in the *Comment. Bononiensis*; and, lastly, in his *Opuscula*, published in 1785. Dr Blair, in his ingenious Dissertation on Achromatic Glasses, read to the Royal Society of Edinburgh in 1793, seems not to have known of the labours of these writers; speaks of it as a new discovery; and exhibits some of the consequences of this principle in a singular point of view, as something very paradoxical and inconsistent with the usually received notions on these subjects. But they are by no means so. We are, however, much indebted to his ingenious researches, and his successful endeavours to find some remedy for this imperfection of achromatic glasses. Some of his contrivances are exceedingly ingenious; but had the Doctor consulted these writers, he would have saved himself a good deal of trouble.

Boscovich shows how to unite the two extremes with the most outstanding colour of the secondary spectrum, by means of a third substance. When we have done this, the aberration occasioned by the secondary spectrums must be prodigiously diminished: for it is evidently equivalent to the union of the points H and *h* of our figure. Whatever cause produces this must diminish the curvature of the arches E*h* and *h*F: but even if these curvatures were not diminished, their greatest ordinates cannot exceed $\frac{1}{4}$th of H*h*; and we may say, without hesitation, that by uniting the mean or most outstanding ray with the two extremes, the remaining dispersion will be much less than the uncorrected colour of Dollond's achromatic glass, as this is less than four times the dispersion of a common object-glass. It must therefore be altogether insensible.

Boscovich asserts, that it is not possible to unite more than two colours by the opposite refraction of two substances, which do not disperse the light in the same proportions. Dr Blair makes light of this assertion, as he finds it made in general terms in the vague and paltry extract made by Priestley from Boscovich in his Essay on the History of Optics; but had he read this author in his own dissertations, he would have seen that he was perfectly right. Dr Blair, however, has hit on a very ingenious and effectual method of producing this union of three colours. In the same way as we correct the dispersion of a concave lens of crown-glass by the opposite dispersion of a concave lens of flint-glass, we may correct the secondary dispersion of an achromatic convex lens by the opposite secondary dispersion of an achromatic concave lens. But the intelligent reader will observe, that this union does not contradict the assertion of Boscovich, because it is *necessarily* produced by means of three refracting substances.

The most essential service which the public has received at the hands of Dr Blair is the discovery of fluid mediums of a proper dispersive power. By composing the lenses of such substances, we are at once freed from the irregularities in the refraction and dispersion of flint-glass, which the chemists have not been able to free it from. In whatever way this glass is made, it consists of parts which differ both in refractive and dispersive power; and when taken up from the pot, these parts mix in threads, which may be disseminated through the mass in any degree of fineness. But they still retain their properties; and when a piece of flint-glass has been formed into a lens, the eye, placed in its focus, sees the whole surface occupied by glistening threads or broader veins running across it. Great rewards have been offered for removing this defect, but hitherto to no purpose. We beg leave to propose the following method: Let the glass be reduced to powder, and then melted with a great proportion of alkaline salt, so as to make a liquor silicum. When precipitated from this by an acid, it must be in a state of very uniform composition. If again melted into glass, we should hope that it would be free from this defect; if not, the case seems to be desperate.

But by using a fluid medium, Dr Blair was freed from all this embarrassment; and he acquired another immense advantage, that of adjusting at pleasure both the refractive and dispersive powers of his lenses. In solid lenses, we do not know whether we have taken the curvatures suited to the refractions till our glass is finished; and if we have mistaken the proportions, all our labour is lost. But when fluids are used, it is enough that we know nearly the refractions. We suit our focal distances to these, and then select our curvatures, so as to remove the aberration of figure, preserving the focal distances. Thus, by properly tempering the fluid mediums, we bring the lens to agree

precisely

precisely with the theory, perfectly achromatic, and the aberration of figure as much corrected as is possible.

Dr Blair examined the refractive and dispersive powers of a great variety of substances, and found great varieties in their actions on the different colours. This is indeed what every well informed naturalist would expect. There is no doubt now among naturalists about the mechanical connection of the phenomena of nature; and all are agreed that the chemical actions of the particles of matter are perfectly like in kind to the action of gravitating bodies; that all these phenomena are the effects of forces like those which we call attractions and repulsions, and which we observe in magnets and electrified bodies; that light is refracted by forces of the same kind, but differing chiefly in the small extent of their sphere of activity. One who views things in this way will expect, that as the actions of the same acid for the different alkalis are different in degree, and as the different acids have also different actions on the same alkali, in like manner different substances differ in their general refractive powers, and also in the proportion of their action on the different colours. Nothing is more unlikely therefore than the proportional dispersion of the different colours by different substances; and it is surprising that this inquiry has been so long delayed. It is hoped that Dr Blair will oblige the public with an account of the experiments which he has made. This will enable others to cooperate in the improvement of achromatic glasses. We cannot derive much knowledge from what he has already published, because it was chiefly with the intention of giving a popular, though not an accurate, view of the subject. The constructions which are there mentioned are not those which he found most effectual, but those which would be most easily understood, or demonstrated by the slight theory which is contained in the dissertation; besides, the manner of expressing the difference of refrangibility, perhaps chosen for its paradoxical appearance, does not give us a clear notion of the characteristic differences of the substances examined. Those rays which are ultimately most deflected from their direction, are said to have become the most refrangible by the combination of different substances, although, in all the particular refractions by which this effect is produced, they are less refracted than the violet light. We can just gather this much, that common glass disperses the rays in such a manner, that the ray which is in the confine of the green and blue occupies the middle of the prismatic spectrum; but in glasses, and many other substances, which are more dispersive, this ray is nearer to the ruddy extremity of the spectrum. While therefore the straight line RC' (Fig. 9. B) terminates the ordinates O o', YY, G g, &c. which represent the dispersion of common glass, the ordinates which express the dispersions of these substances are terminated by a curve passing through R and C', but lying below the line RC'. When therefore parallel heterogeneous light is made to converge to the axis of a convex lens of common glass, as happens at F in fig. 5. C, the light is dispersed, and the violet rays have a shorter focal distance. If we now apply a concave lens of greater dispersive power, the red and violet rays are brought to one focus F; but the green rays, not being so much refracted away from F, are left behind at f, and have now a shorter focal distance. But Dr Blair afterwards found that this was not the case with the muriatic acid, and some solutions in it. He found that the ray which common glass caused to occupy the middle of the spectrum was much nearer to the blue extremity when refracted by these fluids. Therefore a concave lens formed of such fluids which united the red and violet rays in F, refracted the green rays to f.

Having observed this, it was an obvious conjecture, that a mixture of some of these fluids might produce a medium, whose action on the intermediate rays should have the same proportion that is observed on common glass; and that two of them might be found which formed spectra similarly divided, and yet differing sufficiently in dispersive power to enable us to destroy the dispersion by contrary refractions, without destroying the whole refraction. Dr Blair accordingly found a mixture of solutions of ammoniacal and mercurial salts, and also some other substances, which produced dispersions proportional to that of glass, with respect to the different colours.

And thus has the result of this intricate and laborious investigation corresponded to his utmost wishes. He has produced achromatic telescopes which seem as perfect as the thing will admit of; for he has been able to give them such apertures, that the incorrigible aberration arising from the spherical surfaces becomes a sensible quantity, and precludes farther amplification by the eye-glasses. We have examined one of his telescopes: The focal distance of the object-glass did not exceed 17 inches, and the aperture was fully 3½ inches. We viewed some single and double stars and some common objects with this telescope; and found, that in magnifying power, brightness, and distinctness, it was manifestly superior to one of Mr Dollond's of 42 inches focal length. It also gave us an opportunity of admiring the dexterity of the London artists, who could work the glasses with such accuracy. We had most distinct vision of a star with a single eye-piece, which made this telescope magnify more than a hundred times; and we found the field of vision as uniformly distinct as with Dollond's 42 inch telescope magnifying 46 times. The intelligent reader must admire the nice figuring and centering of the very deep eye-glasses which are necessary for this amplification.

It is to be hoped that Dr Blair will extend his views to *glasses* of different compositions, and thus give us object-glasses which are solid; for those composed of fluids have inconveniences which will hinder them from coming into general use, and will confine them to the museums of philosophers. We imagine that antimonial glasses bid fair to answer this purpose, if they could be made free of colour, so as to transmit enough of light. We recommend this dissertation to the careful perusal of our readers. Those who have not made themselves much acquainted with the delicate and abstruse theory of aberrations, will find it exhibited in such a popular form as will enable them to understand its general aim; and the well-informed reader will find many curious indications of inquiries and discoveries yet to be made.

We now proceed to consider the eye-glasses or glasses of telescopes. The proper construction of an eye-piece is not less essential than that of the object-glass. But our limits will not allow us to treat this subject in the same detail. We have already extended this article to a great length, because we do not know of any performance in the English language which will enable our readers to understand the construction of achromatic telescopes; an invention which reflects honour on our country, and has completed the discoveries of our illustrious Newton. Our readers will find abundant information in Dr Smith's Optics concerning the eye-glasses, chiefly deduced from Huyghens's fine theory of aberration (A). At the same time, we must again pay Mr Dollond

(A) While we thus repeatedly speak of the theory of spherical aberration as coming from Mr Huyghens, we must not omit

Telescope. Dollond the merited compliment of saying, that he was the first who made any scientific application of this theory to the compound eye piece for erecting the object. His eye-pieces of five and six glasses are very ingenious reduplications of Huyghens's eye piece of two glasses, and would probably have superseded all others, had not his discovery of achromatic object glasses caused opticians to consider the chromatic aberration with more attention, and pointed out methods of correcting it in the eye-piece without any compound eye glasses. They have found that this may be more conveniently done with four eye-glasses, without sensibly diminishing the advantages which Huyghens showed to result from employing many small refractions instead of a lesser number of great ones. As this is a very curious subject, we shall give enough for making our readers fully acquainted with it, and content ourselves with merely mentioning the principles of the other rules for constructing an eye-piece.

Such readers as are less familiarly acquainted with optical discussions will do well to keep in mind the following consequences of the general focal theorem (OPTICS n° 141. Cor. 5.).

If AB (fig. 10. B) be a lens, R a radiant point or focus of incident rays, and a the focus of parallel rays coming from the opposite side; then,

1. Draw the perpendicular $a\,a'$ to the axis, meeting the incident ray in a', and a' A to the centre of the lens. The refracted ray BF is parallel to a' A: for R a' : a' A (= R a : aA) = RB : BF (= RA : AF), which is the focal theorem.

2. An oblique pencil BPb proceeding from any point P which is not in the axis, is collected to the point f, where the refracted ray BF cuts the line PAf drawn from P through the centre of the lens: for P a' : a' A = PB : Bf, which is also the focal theorem.

The Galilean telescope is susceptible of so little improvement, that we need not employ any time in illustrating its performance.

The simple astronomical telescope is represented in fig. 11. The beam of parallel rays, inclined to the axis, is made to converge to a point G, where it forms an image of the lowest point of a very distant object. These rays decussating from G fall on the eye-glass; the ray from the lowest point B of the object-glass falls on the eye glass at b; and the ray from A falls on a; and the ray from the centre O falls on o. These rays are rendered parallel, or nearly so, by refraction through the eye-glass, and take the direction $b\,i'$, o I, $a\,i$. If the eye be placed so that this pencil of parallel rays may enter it, they converge to a point of the retina, and give distinct vision of the lowest point of the object. It appears inverted, because the rays by which we see the lowest point come in the direction which in simple vision is connected with the upper point of an object. They come from above, and therefore are thought to proceed from above. We see the point as if situated in the direction I o. In like manner the eye placed at I, sees the upper point of the object in the direction IP, and its middle in the direction IE. The proper place for the eye is I: if brought much nearer the glass, or removed much farther from it, some, or the whole, of this extreme pencil of rays will not enter the pupil. It is therefore of importance to determine this point. Because the eye requires parallel rays for distinct vision, it is plain that F must be the principal focus of the eye-glass. Therefore, by the common focal theorem (OPTICS, n° 141. Cor. 5.), OF : OE = OE : OI, or OF : FE = OE : EI.

The magnifying power being measured by the magnitude of the visual angle, compared with the magnitude of the visual angle with the naked eye, we have $\frac{o\,\mathrm{I}\,p}{o\,\mathrm{O}\,p}$, or $\frac{o\,\mathrm{IF}}{o\,\mathrm{OF}}$ for the measure of the magnifying power. This is very nearly $= \frac{\mathrm{OE}}{\mathrm{EI}}$, or $\frac{\mathrm{OF}}{\mathrm{FI}}$.

As the line OE, joining the centres of the lenses, and perpendicular to their surfaces, is called the axis of the telescope, so the ray OG is called the axis of the oblique pencil, being really the axis of the cone of light which has the object-glass for its base. This ray is through its whole course the axis of the oblique pencil; and when its course is determined, the amplification, the field of vision, the apertures of the glasses, are all determined. For this purpose we have only to consider the centre of the object-glass as a radical point, and trace the process of a ray from this point through the other glasses: this will be the axis of some oblique pencil.

It is evident, therefore, that the field of vision depends on the breadth of the eye-glass. Should we increase this, the extreme pencil will pass through I, because O and I are still the conjugate foci of the eye-glass. On the other hand, the angle resolved on for the extent or field of vision gives the breadth of the eye-glass.

We may here observe, by the way, that for all optical instruments there must be two optical figures considered. The first shows the progress of a pencil of rays coming from one point of the object. The various focuses of this pencil show the places of the different images, real or virtual. Such a figure is formed by the three rays AG $a\,i'$, OG o I, BG $b\,i$.

The second shows the progress of the axes of the different pencils proceeding through the centre of the object-glass. The focuses of this pencil of axes show the places where an image of the object glass is formed; and this pencil determines the field of vision, the apertures of the lenses, and the amplification or magnifying power. The three rays OG o I, OFEI, OHPI, form this figure.

See also fig. 17. where the progress of both sets of pencils is more diversified.

The perfection of a telescope is to represent an object in its proper shape, distinctly magnified, with a great field of vision, and sufficiently bright. But there are limits to all these qualities; and an increase of one of them, for the most part, diminishes the rest. The brightness depends on the aperture of the object-glass, and will increase in the same proportion (because $i\,i'$ will always be to AB in the proportion of EF to FO), till the diameter of the emergent pencil is equal to that of the pupil of the eye. Increasing the object-glass any more, can send no more light into the eye. But we cannot make the emergent pencil nearly so large

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ought to give a due share of the honour of it to Dr Barrow and Mr James Gregory. The first of these authors, in his Optical Lectures delivered at Cambridge, has given every proposition which is employed by Huyghens, and has even prosecuted the matter much further. In particular, his theory of oblique slender pencils is of immense consequence to the perfection of telescopes, by showing the methods for making the image of an extended surface as flat as possible. Gregory, too, has given all the fundamental propositions in his *Optica Promota*. But Huyghens, by taking the subject together, and treating it in a system, has greatly simplified it: and his manner of viewing the principal parts of it is incomparably more perspicuous than the performances of Barrow and Gregory.

large as this when the telescope magnifies much; for the great aperture of the object-glass produces an indistinct image at GF, and its indistinctness is magnified by the eye-glass.

A great field of vision is incompatible with the true shape of the object; for it is not strictly true that all rays flowing from O are refracted to I. Those rays which go to the margin of the eye-glass cross the axis between E and I; and therefore they cross it at a greater angle than if they passed through I. Now had they really passed through I, the object would have been represented in its due proportions. Therefore since the angles of the marginal parts are enlarged by the aberration of the eye-glass, the marginal parts themselves will appear enlarged, or the object appear distorted. Thus a chess-board viewed through a reading glass appears drawn out at the corners, and the straight lines are all changed into curves, as is represented in fig. 13.

The circumstance which most peremptorily limits the extent of field is the necessary distinctness. If the vision be indistinct, it is useless, and no other quality can compensate this defect. The distortion is very inconsiderable in much larger angles of vision than we can admit, and is unworthy of the attention paid to it by optical writers. They have been induced to take notice of it, because the means of correcting it in a considerable degree are attainable, and afford an opportunity of exhibiting their knowledge; whereas the indistinctness which accompanies a large field is a subject of most difficult discussion, and has hitherto baffled all their efforts to express by any intelligible or manageable formulæ.

Quæque tractata nitescere posse
Desperat relinquit.

This subject must, however, be considered. The image at GF of a very remote object is not a plain surface perpendicular to the axis of the telescope, but is nearly spherical, having O for its centre. If a number of pencils of parallel rays crossing each other in I fall on the eye-glass, they will form a picture on the opposite side, in the focus F. But this picture will by no means be flat, nor nearly so, but very concave towards E. Its exact form is of most difficult investigation. The elements of it are given by Dr Barrow; and we have given the chief of them in the article Optics, when considering the foci of infinitely slender pencils of oblique rays. Therefore it is impossible that the picture formed by the object-glass can be seen distinctly in all its parts by the eye-glass. Even if it were flat, the points G and H (fig. 11.) are too far from the eye-glass when the middle F is at the proper distance for distinct vision. When, therefore, the telescope is so adjusted that we have distinct vision of the middle of the field, in order to see the margin distinctly we must push in the eye-glass: and having so done, the middle of the field becomes indistinct. When the field of vision exceeds 12 or 15 degrees, it is not possible by any contrivance to make it tolerably distinct all over; and we must turn the telescope successively to the different parts of the field that we may see them agreeably.

The cause of this indistinctness is, as we have already said, the shortness of the lateral foci of lateral and oblique pencils refracted by the eye-glass. We have shown (in Optics, n° 252) how to determine these in all the cases which occur. But the determination is not complete, and relates only to those rays which are in a plane passing through the axis of the lens. But the oblique pencil *I* G *a*, by which an eye placed at I sees the point G of the image, is a cone of light, having a circular base on the eye-glass; of which circle *a b* is one of the diameters. There is a diameter perpendicular to this, which, in this figure, is represented by the point *o*. Fig. 12. represents the base of the cone as seen by an eye placed in the axis of the telescope, with the object-glass as appearing behind it. The point *b* is formed by a ray which comes from the lowest point B of the object-glass, and the point *a* is illuminated by a ray from A. The point at the right-hand of the circular base of this cone of light came from the point C on the left side of the object-glass; and the light comes to *d* from D. Now the laws of optics demonstrate, that the rays which come through the points *c* and *d* are more convergent after refraction than the rays which come through *a* and *b*. The analogies, therefore, which ascertain the foci of rays lying in planes passing thro' the axis do not determine the foci of the others. Of this we may be sensible by looking through a lens to a figure on which are drawn concentric circles crossed by radii. When the telescope is so adjusted that we see distinctly the extremity of one of the radii, we shall not see distinctly the circumference which crosses the extremity with equal distinctness, and *vice versa*. This difference, however, between the foci of the rays which come through *a* and *b*, and those which come through *c* and *d*, is not considerable in the fields of vision, which are otherwise admissible. But the same difference of foci obtains also with respect to the dispersion of light, and is more remarkable. Both d'Alembert and Euler have attempted to introduce it into their formulæ; but they have made them useless for any practical purpose by their inextricable complication.

This must serve as a general indication of the difficulties which occur in the construction of telescopes, even although the object-glass were perfect, forming an image without the smallest confusion or distortion.

There is yet another difficulty or imperfection. The rays of the pencil *a* G *b*, when refracted through the eye-glass, are also separated into their component colours. The edge of the lens must evidently perform the office of a prism, and the white ray G *b* will be so dispersed that if *b i'* be the path of its red ray, the violet ray, which makes another part of it, will take such a course *b n* that the angle *i' b n* will be nearly $\frac{1}{17}$th of G *b i'*. The ray G *a* passing through a part of the lens whose surfaces are less inclined to each other, will be less refracted, and will be less dispersed in the same proportion very nearly. Therefore the two violet rays will be very nearly parallel when the two red rays are rendered parallel.

Hence it must happen, that the object will appear bordered with coloured fringes. A black line seen near the margin on a white ground, will have a ruddy and orange border on the outside and a blue border within: and this confusion is altogether independent on the object-glass, and is so much the greater as the visual angle *b* IE is greater.

Such are the difficulties: They would be unsurmountable were it not that some of them are so connected that, to a certain extent, the diminution of one is accompanied by a diminution of the other. Our readers will recollect, that in the article Optics we gave some account of what are called the *Caustic curves* (Optics n° 252), and showed that these curves are the geometrical loci of the foci of infinitely slender pencils. Consequently the point G is very nearly in the caustic formed by a beam of light consisting of rays parallel to I *a*, and occupying the whole surface of the eye-glass, because the pencil of rays which are collected at G is very small. Any thing therefore that diminishes the mutual inclination of the adjoining rays, puts their concourse farther off. Now this is precisely what we want: for the point G of the image formed by the object glass is already beyond the focus of the oblique slender pencil of parallel rays *i a* and *i b*; and, therefore, if we could make this focus go a little farther from *a* and *b*, we shall bring it nearer to G, and obtain more distinct vision of this point of the object. Now let

Telescope let it be recollected, that in moderate refractions through prisms, two rays which are inclined to each other in a small angle are, after refraction, inclined to each other in the same angle. Therefore, if we can diminish the aberration of the ray $a\,i$, or c I, or $b\,i'$, we diminish their mutual inclination; and consequently the mutual inclination of the rays G a, G c, G b, and therefore lengthen the focus, and get more distinct vision of the point G. Therefore we at once correct the distortion and the indistinctness: and this is the aim of Mr Huyghens's great principle of dividing the refractions. See Optics, nº 120.

The general method is as follows: Let o be the object-glass (fig. 14. A) and E the eye-glass of a telescope, and F their common focus, and FG the image formed by the object-glass. The proportion of their focal distances is supposed to be such as gives as great a magnifying power as the perfection of the object-glass will admit. Let BI be the axis of the emergent pencil. It is known by the focal theorem that GE is parallel to BI: therefore BGE is the whole refraction or deflection of the ray OHB from its former direction. Let it be proposed to diminish the aberrations by dividing this into two parts by means of two glasses D and e, so as to make the ultimate angle of vision $b\,i\,e$ equal to BIE, and thus retain the same magnifying power and visible field. Let it be proposed to divide it into the parts BGC and CGE.

From G draw any line GD to the axis towards O; and draw the perpendicular DH, cutting OG in H; draw H c parallel to GC, cutting GD in g; draw $g\,f$ perpendicular to the axis, and $g\,e$ parallel to GE; draw $e\,b$ perpendicular to the axis; draw D δ parallel to GC, and $\delta\,d$ perpendicular to the axis.

Then if there be placed at D a lens whose focal distance is D d, and another at e whose focal distance is $e\,f$, the thing is done. The ray OH will be refracted into H b, and this into $b\,i$ parallel to BI.

The demonstration of this construction is so evident by means of the common focal theorem, that we need not repeat it, nor the reasons for its advantages (see Optics 120). We have the same magnifying power, and the same field of vision; we have less aberration, and therefore less distortion and indistinctness; and this is brought about by a lens HD of a smaller aperture and a greater focal distance than BE. Consequently, if we are contented with the distinctness of the margin of the field with a single eye-glass, we may greatly increase the field of vision: for if we increase DH to the size of EB we shall have a greater field, and much greater distinctness in the margin; because HD is of a longer focal distance, and will bear a greater aperture, preserving the same distinctness at the edge. On this account the glass HD is commonly called the *Field-glass*.

It must be observed here, however, that although the distortion of the object is lessened, there is a real distortion produced in the the image $f\,g$. But this, when magnified by the glass e, is smaller than the distortion produced by the glass E, of greater aperture and shorter focus, on the undistorted image GF. But because there is a distortion in the second image $f\,g$, this construction cannot be used for the telescopes of astronomical quadrants, and other graduated instruments; because then equal divisions of the micrometer would not correspond to equal angles.

But the same construction will answer in this case, by taking the point D on that side of F which is remote from O (fig. 14. B). This is the form now employed in the telescopes of all graduated instruments.

The exact proportion in which the distortion and the indistinctness at the edges of the field are diminished by this construction, depends on the proportion in which the angle BGE is divided by GC; and is of pretty difficult investigation. But it never deviates far (never $\frac{1}{8}$th in optical instruments) from the proportion of the squares of the angles. We may, without any sensible error, suppose it in this proportion. This gives us a practical rule of easy recollection, and of most extensive use. When we would diminish an aberration by dividing the whole refraction into two parts, we shall do it most effectually by making them equal. In like manner, if we divide it into three parts by means of two additional glasses, we must make each $= \frac{1}{3}$d of the whole; and so on for a greater number.

This useful problem, even when limited, as we have done, to equal refractions, is as yet indeterminate; that is, susceptible of an infinity of solutions: for the point D, where the field-glass is placed, was taken at pleasure: yet there must be situations more proper than others. The aberrations which produce distortion, and those which produce indistinctness, do not follow the same proportions. To correct the indistinctness, we should not select such positions of the lens HD as will give a small focal distance to $b\,e$; that is, we should not remove it very far from F. Huygens recommends the proportion of 3 to 1 for that of the focal distances of the lens HD and $e\,b$, and says that the distance De should be $= 2$ Fe. This will make $e\,i = \frac{1}{2}\,e$F, and will divide the whole refraction into two equal parts, as any one will readily see by constructing the common optical figure. Mr Short, the celebrated improver of reflecting telescopes, generally employed this proportion; and we shall presently see that it is a very good one.

It has been already observed that the great refractions which take place on the eye-glasses occasion very considerable dispersions, and disturb the vision by fringing every thing with colours. To remedy this, achromatic eye-glasses may be employed, constructed by the rules already delivered. This construction, however, is incomparably more intricate than that of object-glasses: for the equations must involve the distance of the radiant point, and be more complicated: and this complication is immensely increased on account of the great obliquity of the pencils.

Most fortunately the Huyghenian construction of an eye-piece enables us to correct this dispersion to a great degree of exactness. A heterogeneous ray is dispersed at H, and the red ray belonging to it falls on the lens $b\,e$ at a greater distance from the centre than the violet ray coming from H. It will therefore be less refracted (cæteris paribus) by the lens $b\,e$; and it is possible that the difference may be such that the red and violet rays dispersed at H may be rendered parallel at b, or even a little divergent, so as to unite accurately with the red ray at the bottom of the eye. How this may be affected, by a proper selection of the places and figures of the lenses, will appear by the following proposition, which we imagine is new, and not inelegant.

Let the compound ray OP (fig. 15. A) be dispersed by the lens PC; and let PV, PR be its violet and red rays, cutting the axis in G and g. It is required to place another lens RD in their way, so that the emergent rays R r, V v, shall be parallel.

Produce the incident ray OP to Z. The angles ZPR, ZPV, are given, (and RPV is nearly $= \frac{\text{ZPR}}{27}$) and the intersections G and g with the axis. Let F be the focus of parallel red light coming through the lens RD in the opposite direction. Then (by the common optical theorem), the perpendicular F ρ will cut PR in such a point ρ, that ρ F will be parallel to the emergent ray R r (see Optics, nº 252 – 256), and to V v. Therefore if ρD cut PV in u, and $u\,f$ be drawn perpendicular to the axis, we shall have (also by the common theorem) the point f for the focus of violet

violet rays, and DF : Df = Dρ : Du = 28 : 27 nearly, or in a given ratio.

The problem is therefore reduced to this, "To draw from a point D in the line CG a line Dρ, which ſhall be cut by the lines PR and PV in the given ratio.

The following conſtruction naturally offers itſelf: Make GM : gM in the given ratio, and draw MK parallel to Pg. Through *any* point D of CG draw the ſtraight line PDK, cutting MK in K. Join GK, and draw Dρ parallel to KG. This will ſolve the problem; and, drawing ρF perpendicular to the axis, we ſhall have F for the focus of the lens RD for parallel red rays.

The demonſtration is evident: for MK being parallel to Pg, we have GM : gM = GK : HK, = ρD : uD, = FD fD, in the ratio required.

This problem admits of an infinity of ſolutions; becauſe the point D may be taken anywhere in the line CG. It may therefore be ſubjected to ſuch conditions as may produce other advantages.

1. It may be reſtricted by the magnifying power, or by the diviſion which we chooſe to make of the whole refraction which produces this magnifying power. Thus, if we have reſolved to diminiſh the aberrations by making the two refractions equal, we have determined the angle RrD. Therefore draw GK, making the angle MGK equal to that which the emergent pencil muſt make with the axis, in order to produce this magnifying power. Then draw MK parallel to Pg, meeting GK in K. Then draw PK, cutting the axis in D, and Dρ parallel to GK, and ρF perpendicular to the axis. D is the place, and DF the focal diſtance of the eye-glaſs

2. Particular circumſtances may cauſe us to fix on a particular place D, and we only want the focal diſtance. In this caſe the firſt conſtruction ſuffices.

3. We may have determined on a certain focal diſtance DF, and the place muſt be determined. In this caſe let

$$\mathrm{GF} : \mathrm{F}\rho = 1 : \tan. \mathrm{G}$$
$$\mathrm{F}\rho : fu = 1 : m,\ m \text{ being } = \tfrac{27}{28}$$
$$fu : fg = \tan. g : 1$$
then $$\mathrm{GF} : fg = \tan. g : m \tan. \mathrm{G}$$
then $$\mathrm{GF}-fg : \mathrm{GF} = \tan. g - m \tan. \mathrm{G} : \tan. g$$
or $$\mathrm{G}g + \mathrm{F}f : \mathrm{GF} = \tan. g - m \tan. \mathrm{G} : \tan. g;$$
and $$\mathrm{GF} = \mathrm{G}g + \mathrm{F}f \frac{\tan. g}{\tan. g - m. \tan. \mathrm{G}},$$ and is therefore given, and the place of F is determined; and ſince FD is given by ſuppoſition, D is determined.

The application of this problem to our purpoſe is difficult, if we take it in the moſt general terms; but the nature of the thing makes ſuch limitations that it becomes very eaſy. In the caſe of the diſperſion of light, the angle GPg is ſo ſmall that MK may be drawn parallel to PG without any ſenſible error. If the ray OP were parallel to CG, then G would be the focus of the lens PC, and the point M would fall on C; becauſe the focal diſtance of red rays is to that of violet rays in the ſame proportion for every lens, and therefore CG : Cg = DF : Df. Now, in a teleſcope which magnifies conſiderably, the angle at the object-glaſs is very ſmall, and CG hardly exceeds the focal diſtance; and CG is to Cg very nearly in the ſame proportion of 28 to 27. We may therefore draw through C (fig. 15. B) a line CK parallel to PG: then draw GK′ perpendicular to the axis of the lenſes, and join PK′; draw K′BE parallel to CG, cutting PK in B; draw BHI parallel to GK, cutting GK′ in H: Join HD and PK. It is evident that CG is biſected in F, and that KB = 2 F′D: alſo K′H : HG = KB : BE, = CD : DG. Therefore DH is parallel to CK′, or to PG. But becauſe PF = FK, PD is = DB, and IH = HB. Therefore ρD = HB, and FD = KB, = 2 F′D; and FD is biſected in F′. Therefore CD = $\frac{\mathrm{CG}+\mathrm{FD}}{2}$.

That is, in order that the eye-glaſs RD may correct the diſperſion of the field-glaſs PC, *the diſtance between them muſt be equal to the half ſum of their focal diſtances* very nearly. More exactly, *the diſtance between them muſt be equal to the half ſum of the focal diſtance of the eye-glaſs, and the diſtance at which the field-glaſs would form an image of the object-glaſs.* For the point G is the focus to which a ray coming from the centre of the object-glaſs is refracted by the field-glaſs.

This is a very ſimple ſolution of this important problem. Huyghens's eye-piece correſponds with it exactly. If indeed the diſperſion at P is not entirely produced by the refraction, but perhaps combined with ſome previous diſperſion, the point M (fig. 15. A) will not coincide with C, (fig. 15. B), and we ſhall have GC to GM, as the natural diſperſion at P to the diſperſion which really obtains there. This may deſtroy the equation CD = $\frac{\mathrm{CG}+\mathrm{FD}}{2}$.

Thus, in a manner rather unexpected, have we freed the eye-glaſſes from the greateſt part of the effect of diſperſion. We may do it entirely by puſhing the eye-glaſs a little nearer to the field-glaſs. This will render the violet rays a little divergent from the red, ſo as to produce a perfect picture at the bottom of the eye. But by doing ſo we have hurt the diſtinctneſs of the whole picture, becauſe F is not in the focus of RD. We remedy this by drawing both glaſſes out a little, and the teleſcope is made perfect.

This improvement cannot be applied to the conſtruction of quadrant teleſcopes, ſuch as fig. 14. B. Mr Ramſden has attempted it, however, in a very ingenious way, which merits a place here, and is alſo inſtructive in another way. The field-glaſs HD (fig. 14. B) is a plano-convex, with its plane ſide next the image GF. It is placed very near this image. The conſequence of this diſpoſition is, that the image GF produces a vertical image $g\,f$, which is much leſs convex towards the glaſs. He then places a lens on the point C, where the red ray would croſs the axis. The violet ray will paſs on the other ſide of it. If the focal diſtance of this glaſs be $f\,c$, the viſion will be diſtinct and free from colour. It has, however, the inconveniency of obliging the eye to be cloſe to the glaſs, which is very troubleſome.

This would be a good conſtruction for a magic-lanthorn, or for the object-glaſs of a ſolar microſcope, or indeed of any compound microſcope.

We may preſume that the reader is now pretty familiar with the different circumſtances which muſt be conſidered in the conſtruction of an eye-piece, and proceed to conſider thoſe which muſt be employed to erect the object.

This may be done by placing the lens which receives the light from the object-glaſs in ſuch a manner, that a ſecond image (inverted with reſpect to the firſt) may be formed beyond it, and this may be viewed by an eye-glaſs. Such a conſtruction is repreſented in fig. 16. But, beſides many other defects, it tinges the object prodigiouſly with colour The ray $o\,d$ is diſperſed at d into the red ray $d\,r$, and the violet $d\,v$, v being farther from the centre than r, the refracted ray $v\,v$ croſſes $r\,r$ both by reaſon of ſpherical aberration and its greater refrangibility. Plate DLV.

But the common day teleſcope, invented by F. Rheita, has, in this reſpect, greatly the advantage of the one now deſcribed. See Optics, n° 260. The rays of compound light are diſperſed at e and f. (Plate CCCLXIV. fig. 13). The violet ray proceeding from f, falls without the red ray at g, but is accurately collected with it at the focus E, as we ſhall demonſtrate by and by. Since they croſs each

other in F, the violet ray must fall within the red ray at i, and if it was refracted there it would have taken one common point with the red ray. But as it falls there it would have separated from it; but by a proper disposition of its refraction, it will keep parallel to it, or nearly so. And this is one excellence of this telescope: when constructed with three eye-glasses perfectly equal, the colour is sensibly diminished, and by taking an eye-glass somewhat smaller, it may be removed entirely. We say no more of it at present, because we shall find its construction included in another, which is still more perfect.

It is evident at first sight that this telescope may be improved, by substituting for the eye-glass $r k$ (fig. 13.) the Huyghenian double eye-glass, or field-glass and eye-glass represented in fig. 14. A, and fig. 14. B; and that the first of these may be improved and rendered achromatic. This will require the two glasses $e f$ and $g h$ to be increased from their present dimensions to the size of a field-glass, suited to the magnifying power of the telescope, supposing it an astronomical telescope. Thus we shall have a telescope of four eye-glasses. The three first will be of a considerable focal distance, and two of them will have a common focus at b. But this is considerably different from the eye-piece of four glasses which are now used, and are far better. We are indebted for them to Mr Dollond, who was a mathematician as well as an artist, and in the course of his research discovered resources which had not been thought of. He had not then discovered the achromatic object-glass, and was busy in improving the eye-glasses by diminishing their spherical aberration. His first thought was to make the Huyghenian addition at both the images of the day telescope. This suggested to him the following eye-piece of five glasses.

Plate D... Fig. 17. represents this eye-piece, but there is not room for the object-glass at its proper distance. A pencil of rays coming from the upper point of the object is made to converge (by the object-glass) to G, where it would form a picture of that part of the object. But it is intercepted by the lens A a, and its axis is bent towards the axis of the telescope in the direction $a b$. At the same time, the rays which converged to G converge to g, and there is formed an inverted picture of the object at $g f$. The axis of the pencil is again refracted at b, crosses the axis of the telescope in H, is refracted again at c, at d, and at e, and at last crosses the axis in I. The rays of this pencil, diverging from g, are made less diverging, and proceed as if they came from g', in the line B $g g'$. The lens c C causes them to converge to g', in the line G″ C g'. The lens d D makes them converge still more to G″, and there they form an erect picture G″ F″; diverging from G″, they are rendered parallel by the refraction at e.

At H the rays are nearly parallel. Had the glass B b been a little farther from A, they would have been accurately so, and the object-glass, with the glasses A and B, would have formed an astronomical telescope with the Huyghenian eye-piece. The glasses C, D, and E, are intended merely for bending the rays back again till they again cross the axis in I. The glass C tends chiefly to diminish the greatest angle [illegible] H I; and then the two glasses D and E are another Huyghenian eye-piece.

The art in this construction lies in the proper adjustment of the glasses, so as to divide the whole bending of the pencil pretty equally among them, and to form the last image in the focus of the eye-glass, and at a proper distance from the other glass. Bringing B nearer to A would bend the pencil more to the axis. Placing C farther from B would do the same thing; but this would be accompanied with more aberration, because the rays would fall at a greater distance from the centres of the lenses. The greatest bending is made at the field-glass D; and we imagine that the telescope would be improved, and made more distinct at the edges of the field, by employing another glass of great focal distance between C and D.

There is an image formed at H of the object-glasses, and the whole light passes through a small circle in this place. It is usual to put a plate here pierced with a hole which has the diameter of this image. A second image of the object-glass is formed at I, and indeed wherever the pencils cross the axis. A lens placed at H makes no change in any of the angles, nor in the magnifying power, and affects only the place where the images are formed. And, on the other hand, a lens placed at f, or F″, where a real image is formed, makes no change in the places of the images, but affects the mutual inclination of the pencils. This affords a resource to the artist, by which he may combine properties which seem incompatible.

The aperture of A determines the visible field and all the other apertures.

We must avoid forming a real image, such as $f g$, or F G″, on or very near any glass. For we cannot see this image without seeing along with it every particle of dust and every scratch on the glass. We see them as making part of the object when the image is exactly on the glass, and we see them confusedly, and so as to confuse the object, when the image is near it. For when the image is on or very near any glass, the pencil of light occupies a very small part of its surface, and a particle of dust intercepts a great proportion of it.

It is plain that this construction will not do for the telescope of graduated instruments, because the micrometer cannot be applied to the second image $f g$, on account of its being a little distorted, as has been observed of the Huyghenian eye-piece.

Also the interposition of the glass C makes it difficult to correct the dispersion.

By proper reasoning from the correction in the Huyghenian eye-piece, we are led to the best construction of one with three glasses; which we shall now consider, taking it in a particular form, which shall make the discussion easy, and make us fully masters of the principles which lead to a better form. Therefore let PA (fig. 18.) be the glass which first receives the light proceeding from the image formed by the object-glass, and let OP be the axis of the extreme pencil. This is refracted into PR, which is again refracted into R r by the next lens B r. Let b be the focus of parallel rays of the second lens. Draw PB r. We know that A b : b B = PB : B r, and that rays of one kind diverging from P will be collected at r. But if PR, PV be a red and a violet ray, the violet ray will be more refracted at V, and will cross the red ray in some intermediate point g of the line R r. If therefore the first image had been formed precisely on the lens PA, we should have a second image at $f g$ free from all coloured fringes.

If the refractions at P and R are equal (as in the common day telescope), the dispersion at V must be equal to that at P, or the angle v V r = VPR. But we have ultimately RPV : R r V = BC : AB, (= B b : A b by the focal theorem). Therefore g V r : $g r$ V (or $g r$: g V, or C f : f B) = B b : A b, and AB : A b = R r : R g.

This shows by the way the advantage of the common day telescope. In this AB = 2 A b, and therefore f is the place of the last image which is free from coloured fringes. But this image will not be seen free from coloured fringes through the eye-glass C r, if f be its focus: For had $g r$, $g v$ been both red rays, they would have been parallel after refraction; but $g v$ being a violet ray, will be more refracted. It will

will not indeed be ſo much deflected from parallеliſm as the violet ray, which naturally accompanies the red ray to r, becauſe it falls nearer the centre. By computation its diſperſion is diminiſhed about $\frac{1}{7}$th.

In order that $g\,v$ may be made parallel to $g\,r$ after refraction, the refraction at r muſt be ſuch that the diſperſion correſponding to it may be of a proper magnitude. How to determine this is the queſtion. Let the diſperſion at g be to the diſperſion produced by the refraction at r (which is required for producing the intended magnifying power) as 1 to 9. Make $9:1 = ff : f\,C, = f\,C : CD$, and draw the perpendicular $D\,r$ meeting the refracted ray $r\,r$ in r'. Then we know by the common focal theorem, that if f be the focus of the lens $C\,r$, red rays diverging from g will be united in r'. But the violet ray $g\,v$ will be refracted into $v\,v'$ parallel to $r\,r'$. For the angle $v\,r'\,r : v\,g\,r =$ (ultimately) $f\,C : CD, = 9:1$. Therefore the angle $v\,r'\,r$ is equal to the diſperſion produced at r, and therefore equal to $r'\,v\,v'$, and $v\,v'$ is parallel to $r\,r'$.

But by this we have deſtroyed the diſtinct viſion of the image formed at $f\,g$, becauſe it is no longer at the focus of the eye-glaſs. But diſtinct viſion will be reſtored by puſhing the glaſſes nearer to the object-glaſs. This makes the rays of each particular pencil more divergent after refraction through A, but ſcarcely makes any change in the directions of the pencils themſelves. Thus the image comes to the focus f, and makes no ſenſible change in the diſperſions.

In the common day teleſcope, the firſt image is formed in the anterior focus of the firſt eye-glaſs, and the ſecond image is at the anterior focus of the laſt eye-glaſs. If we change this laſt for one of half the focal diſtance, and puſh in the eye-piece till the image formed by the object-glaſs is half way between the firſt eye-glaſs and its focus, the laſt image will be formed at the focus of the new eye-glaſs, and the eye-piece will be achromatic. This is eaſily ſeen by making the uſual computations by the focal theorem. But the viſible field is diminiſhed, becauſe we cannot give the ſame aperture as before to the new eye-glaſs; but we can ſubſtitute for it two eye-glaſſes like the former, placed cloſe together. This will have the ſame focal diſtance with the new one, and will allow the ſame aperture that we had before.

On theſe principles may be demonſtrated the correction of colour in eye-pieces with three glaſſes of the following conſtruction.

Let the glaſſes A and B be placed ſo that the poſterior focus of the firſt nearly coincides with the anterior focus of the ſecond, or rather ſo that the anterior focus of B may be at the place where the image of the object-glaſs is formed, by which ſituation the aperture neceſſary for tranſmitting the whole light will be the ſmalleſt poſſible. Place the third C at a diſtance from the ſecond, which exceeds the ſum of their focal diſtances by a ſpace which is a third proportional to the diſtance of the firſt and ſecond, and the focal diſtance of the ſecond. The diſtance of the firſt eye-glaſs from the object-glaſs muſt be equal to the product of the focal diſtance of the firſt and ſecond divided by their ſum.

Let $O\,o$, $A\,a$, $B\,b$, $C\,c$, the focal diſtances of the glaſſes, be O, a, b, c. Then make $AB = a + b$ nearly; $BC = b + c + \frac{b^2}{b+c}$; $OA = \frac{b\,c}{b+c}$. The amplification or magnifying power will be $= \frac{o\,b}{a\,c}$; the equivalent eye-glaſs $= \frac{a\,c}{b}$; and the field of viſion $= 3438' \times \frac{\text{Aperture of A}}{\text{foc. diſt. ob. gl.}}$

Theſe eye-pieces will admit the uſe of a micrometer at the place of the firſt image, becauſe it has no diſtortion.

Mr Dollond was anxious to combine this achromatiſm of the eye-pieces with the advantages which he had found in the eye-pieces with five glaſſes. This eye-piece of three glaſſes neceſſarily has a very great refraction at the glaſs B, where the pencil which has come from the other ſide of the axis muſt be rendered again convergent, or at leaſt parallel to it. This occaſions conſiderable aberrations. This may be avoided by giving part of this refraction to a glaſs put between the firſt and ſecond, in the ſame way as he has done by the glaſs B put between A and C in his five glaſs eye-piece. But this deranges the whole proceſs. His ingenuity, however, ſurmounted this difficulty, and he made eye-pieces of four glaſſes, which ſeem as perfect as can be deſired. He has not publiſhed his ingenious inveſtigation; and we obſerve the London artiſts work very much at random, probably copying the proportions of ſome of his beſt glaſſes, without underſtanding the principle, and therefore frequently miſtaking. We ſee many eye-pieces which are far from being achromatic. We imagine therefore that it will be an acceptable thing to the artiſts to have preciſe inſtructions how to proceed, nothing of this kind having appeared in our language, and the inveſtigations of Euler, D'Alembert, and even Boſcovich, being ſo abſtruſe as to be inacceſſible to all but experienced analyſts. We hope to render it extremely ſimple.

It is evident, that if we make the rays of different colours unite on the ſurface of the laſt eye-glaſs but one, commonly called the *field-glaſs*, the thing will be done, becauſe the diſperſion from this point of union will then unite with the diſperſion produced by this glaſs alone; and this increaſed diſperſion may be corrected by the laſt eye-glaſs in the way already ſhown.

Therefore let A, B (fig. 19.) be the ſtations which we have fixed on for the firſt and ſecond eye-glaſſes, in order to give a proper portion of the whole refraction to the ſecond glaſs. Let b be the anterior focus of B. Draw $PB\,r$ through the centre of B. Make $A\,b : b\,B = AB : BK$. Draw the perpendicular $K\,r$, meeting the refracted ray in r. We know by the focal theorem, that red rays diverging from P will converge to r; but the violet ray PV, being more refracted, will croſs $R\,r$ in ſome point g. Drawing the perpendicular $f\,g$, we get f for the proper place of the field-glaſs. Let the refracted ray $R\,r$, produced backwards, meet the ray OP coming from the centre of the object-glaſs in O. Let the angle of diſperſion RPV be called p, and the angle of diſperſion at V, that is, $r\,V\,v$, be v, and the angle $V\,r\,R$ be r.

It is evident that $OR : OP = p : v$, becauſe the diſperſions are proportional to the ſines of the refractions, which, in this caſe, are very nearly as the refractions themſelves.

Let $\frac{OP}{OR}\left(\text{or } \frac{o\,p}{p\,B} \text{ or } \frac{p\,B}{b\,B}\right)$ be made $= m$. Then $v = m\,p$; alſo $p : r = BK : AB, = b\,B : A\,b$, and $r = p \cdot \frac{A\,b}{b\,B}$, or, making $\frac{A\,b}{B\,b} = n$, $r = n\,p$; therefore $v : r = m : n, = \frac{p\,B}{b\,B} : \frac{A\,b}{b\,B}, = p\,B : A\,b$.

The angle $R\,g\,V = g\,V\,r + g\,r\,V = p \cdot \overline{m+n}$; and $R\,g\,V : R\,r\,v = R\,r : R\,g$, or $m + n : n = R\,r : R\,g$, and $R\,g = R\,r\,\frac{n}{m+n}$. But $R\,r$ is ultimately $= BK = \frac{AB}{b\,B}$

$\frac{b\,B}{A\,b} = \frac{AB}{n}$. Therefore $R\,g = \frac{AB}{n} \times \frac{n}{m+n} = \frac{AB}{m+n}$, and $B\,f = \frac{AB}{m+n}$.

This value of $B\,f$ is evidently $= b\,B \times \frac{AB}{p\,B + A\,b}$. Now b B being a conſtant quantity while the glaſs B is the ſame, the place of union varies with $\frac{AB}{p\,B + A\,b}$. If we remove B a little farther from A, we increaſe AB, and p B, and A b, each by the ſame quantity. This evidently diminiſhes B f. On the other hand, bringing B nearer to A increaſes B f. If we keep the diſtance between the glaſſes the ſame, but increaſe the focal diſtance b B, we augment B f, becauſe this change augments the numerator and diminiſhes the denominator of the fraction $\frac{b\,B \times AB}{p\,B + A\,b}$.

In this manner we can unite the colours at what diſtance we pleaſe, and conſequently can unite them in the place of the intended field-glaſs, from which they will diverge with an increaſed diſperſion, viz. with the diſperſion competent to the refraction produced there, and the diſperſion $p \times \overline{m+n}$ conjoined.

It only remains to determine the proper focal diſtances of the field-glaſs and eye-glaſs, and the place of the eye-glaſs, ſo that this diſperſion may be finally corrected.

This is an indeterminate problem, admitting of an infinity of ſolutions. We ſhall limit it by an equal diviſion of the two remaining refractions, which are neceſſary in order to produce the intended magnifying power. This conſtruction has the advantage of diminiſhing the aberration. Thus we know the two refractions, and the diſperſion competent to each; it being nearly $\frac{1}{17}$th of the refraction. Call this q. The whole diſperſion at the field-glaſs conſiſts of q, and of the angle K g V of fig. 19. which we alſo know to be $= p \times \overline{m+n}$. Call their ſum s.

Let fig. 20. n° 1. repreſent this addition to the eye-piece. C g is the field-glaſs coming in the place of $f\,g$ of fig. 19. and R g w is the red ray coming from the glaſs BR. Draw $g\,s$ parallel to the intended emergent pencil from the eye-glaſs; that is, making the angle C s g with the axis correſpond to the intended magnifying power. Biſect this angle by the line g K. Make $s\,g : g\,q = s : q$, and draw q K, cutting C g in t. Draw t T D, cutting $g\,k$ in t, and the axis in D. Draw $t\,d$ and D r perpendicular to the axis. Then a lens placed in D, having the focal diſtance D d, will deſtroy the diſperſion at the lens $g\,c$, which refracts the ray $g\,w$ into $g\,r$.

Let $g\,v$ be the violet ray, making the angle $v\,g\,r = s$. It is plain, by the common optical theorem, that $g\,r$ will be refracted into $r\,r'$ parallel to t D. Draw g D r' meeting $r\,r'$, and join $v\,r'$. By the focal theorem two red rays $g\,r$, $g\,v$, will be united in r'. But the violet ray $g\,v$ will be more refracted, and will take the path $v\,v'$, making the angle of diſperſion $r'\,v\,v' = q$, very nearly, becauſe the diſperſion at v does not ſenſibly differ from that at r. Now, in the ſmall angles of refraction which obtain in optical inſtruments, the angles $r\,r'\,v$, $r\,g\,v$ are very nearly as $g\,r$ and $r\,r'$, or as gD and Dr', or as CD and DT; which, by the focal theorem, are as C d and d D; that is, D $d : d\,c = r\,g\,v : r\,r'\,v$. But D $d : d$ C $=$ D $t : t\,t$, $= s\,g : g\,q$, $= s : q$. But $r\,g\,v = s$; therefore $r\,r'\,v = q$, $= r'\,v\,v'$, and $v\,v'$ is parallel to $r\,r'$, and the whole diſperſion at g is corrected by the lens D r. The focal diſtance C c of C g is had by drawing C x parallel to K g, meeting R g in x, and drawing $x\,c$ perpendicular to the axis.

It is eaſy to ſee that this (not inelegant) conſtruction is not limited to the equality of the refractions $w\,g\,r$, K $r\,r'$. In whatever proportion the whole refraction $w\,g\,s$ is divided, we always can tell the proportion of the diſperſions which the two refractions occaſion at g and r, and can therefore find the values of s and q. Indeed this ſolution includes the problem in p. 365. col. 1. par. 2.; but it had not occurred to us till the preſent occaſion. Our readers will not be diſpleaſed with this variety of reſource.

The intelligent reader will ſee, that in this ſolution ſome quantities and ratios are aſſumed as equal which are not ſtrictly ſo, in the ſame manner as in all the elementary optical theorems. The paralleliſm, however, of $v\,v'$ and $r\,r'$ may be made accurate, by puſhing the lens D r nearer to C g, or retiring it from it. We may alſo, by puſhing it ſtill nearer, induce a ſmall divergency of the violet ray, ſo as to produce accurate viſion in the eye, and may thus make the viſion through a teleſcope more perfect than with the naked eye, where diſperſion is by no means avoided. It would therefore be an improvement to have the eye-glaſs in a ſliding tube for adjuſtment. Bring the teleſcope to diſtinct viſion; and if any colour be viſible about the edges of the field, ſhift the eye-glaſs till this colour is removed. The viſion may now become indiſtinct: but this is corrected by ſhifting the place of the whole eye-piece.

We have examined trigonometrically the progreſs of a red and a violet ray through many eye-pieces of Dollond's and Ramſden's beſt teleſcopes; and we have found in all of them that the colours are united on or very near the field-glaſs; ſo that we preſume that a theory ſomewhat analogous to ours has directed the ingenious inventors. We meet with many made by other artiſts, and even ſome of theirs, where a conſiderable degree of colour remains, ſometimes in the natural order and often in the contrary order. This muſt happen in the hands of mere imitators, ignorant of principle. We preſume that we have now made this principle ſufficiently plain.

Fig. 20. N° 2. repreſents the eye-piece of a very fine ſpy-glaſs by Mr Ramſden; the focal length of its object-glaſs is $8\frac{1}{4}$ inches, with $1\frac{1}{10}$th of aperture, $2°\,05'$ of viſible field, and 15,4 magnifying power. The diſtances and focal lengths are of their proper dimenſions, but the apertures are $\frac{1}{4}$ larger, that the progreſs of a lateral pencil might be more diſtinctly drawn. The dimenſions are as follow:

Foc. lengths Aa=0,775 Bb=1,025 Cc=1,01 Dd=0,79
Diſtances AB=1,18 BC=1,83 CD=1,105.

It is perfectly achromatic, and the colours are united, not preciſely, at the lens C g, but about $\frac{1}{10}$th of an inch nearer the eye-glaſs.

It is obvious that this combination of glaſſes may be uſed as a microſcope; for if, inſtead of the image formed by the object-glaſs at FG, we ſubſtitute a ſmall object, illuminated from behind, as in compound microſcopes; and if we draw the eye-piece a very ſmall way from this object, the pencils of parallel rays emergent from the eye-glaſs D will become convergent to very diſtant points, and will there form an inverted and enlarged picture of the object, which may be viewed by a Huyghenian eye-piece; and we may thus get high magnifying powers without uſing very deep glaſſes. We tried the eye-piece of which we have given the dimenſions in this way, and found that it might be made to magnify 180 times with very great diſtinctneſs. When uſed as the magnifier of a ſolar microſcope, it infinitely ſurpaſſes every thing we have ever ſeen. The picture formed by a ſolar microſcope is generally ſo indiſtinct, that it is fit only for amuſing ladies; but with this magnifier it ſeemed perfectly ſharp. We therefore recommend this to the artiſts as a valuable article of their trade.

The only thing which remains to be conſidered in the

 theory

theory of refracting teleſcopes is the forms of the different lenſes. Hitherto we have had no occaſion to conſider any thing but their focal diſtances; but their aberrations depend greatly on the adjuſtment of their forms to their ſituations. When the conjugate foculeſ of a lens are determined by the ſervice which it is to perform, there is a certain form or proportion between the curvatures of their anterior and poſterior ſurfaces, which will make their aberrations the ſmalleſt poſſible.

It is evident that this proportion is to be obtained by making the fluxion of the quantity within the parentheſis in the formula of par. 2. col. 2. p. 348. equal to nothing. When this is done, we obtain this formula for a, the radius of curvature for the anterior ſurface of a lens. $\frac{1}{a}=\frac{2m^2+m}{2m+4}+\frac{4m+4}{2(m+4)r}$, where m is the ratio of the ſine of incidence to the ſine of refraction, and r is the diſtance of the focus of incident rays, poſitive or negative, according as they converge or diverge, all meaſured on a ſcale of which the unit is n, = half of the radius of the equivalent iſoſceles lens.

It will be ſufficiently exact for our purpoſe to ſuppoſe $m=\frac{3}{2}$, though it is more nearly $\frac{31}{20}$. In this caſe $\frac{1}{a}=\frac{b}{7}+\frac{10}{7r},=\frac{42r+70}{49r}$. Therefore $a=\frac{49r}{42r+70}$. And $\frac{1}{b}=\frac{1}{a}-1,=\frac{1-a}{a}$.

As an example, let it be required to give the radii of curvature in inches for the eye-glaſs *be* of page 362. col. 1. par. 2. which we ſhall ſuppoſe of $1\frac{1}{2}$ inches focal diſtance, and that ec $(=r)$ is $3\frac{3}{4}$th inches.

The radius of curvature for the equivalent iſoſceles lens is 1,5, and its half is 0,75. Therefore $r=\frac{3\frac{3}{4}}{0{,}75},=5$; and our formula is $a=\frac{49\times5}{42\times5+70},=\frac{245}{280},=0{,}875$; and $\frac{1}{b}=\frac{1-a}{a},=\frac{0{,}125}{0{,}875}$, and $b=\frac{0{,}875}{0{,}125},=7$.

Theſe values are parts of a ſcale, of which the unit is 0,75 inches. Therefore

a, in inches, $=0{,}875\times0{,}75,=0{,}65525$
b, in inches, $=7\times0{,}75,\quad=5{,}25$.

And here we muſt obſerve that the poſterior ſurface is concave: for b is a poſitive quantity, becauſe $1-a$ is a poſitive quantity as well as a; therefore the centre of ſphericity of both ſurfaces lies beyond the lens.

And this determination is not very different from the uſual practice, which commonly makes this lens a plane convex with its flat ſide next the eye: and there will not be much difference in the performance of theſe two lenſes; for in all caſes of maxima and minima, even a pretty conſiderable change of the beſt dimenſions does not make a ſenſible change in the reſult.

The ſame conſideration leads to a rule which is very ſimple, and ſufficiently exact for ordinary ſituations. This is to make the curvatures ſuch, that the incident and emergent pencils may be nearly equally inclined to the ſurfaces of the lens. Thus in the eye-piece with five glaſſes, A and B ſhould be moſt convex on their anterior ſides; C ſhould be moſt convex on the poſterior ſide; D ſhould be nearly iſoſceles; and E nearly plano-convex.

But this is not ſo eaſy a matter as appears at firſt ſight. The lenſes of an eye-piece have not only to bend the ſeveral pencils of light to and from the axis of the teleſcope; they have alſo to form images on the axes of theſe pencils. Theſe offices frequently require oppoſite forms, as mentioned in par. 3. col. 2 p. 360. Thus the glaſs A of fig. 20. n° 2. ſhould be moſt convex on the ſide next the object, that it may produce little diſtortion of the pencils. But it ſhould be moſt convex next the eye, that it may produce diſtinct viſion of the image FG, which is very near it. This image ſhould have its concavity turned towards A, whereas it is towards the object-glaſs. We muſt therefore endeavour to make the vertical image fg flatter, or even convex. This requires a glaſs very flat before and convex behind. For ſimilar reaſons the object-glaſs of a microſcope and the ſimple eye-glaſs of an aſtronomical teleſcope ſhould be formed the ſame way.

This is a ſubject of moſt difficult diſcuſſion, and requires a theory which few of our readers would reliſh; nor does our limits afford room for it. The artiſts are obliged to grope their way. The proper method of experiment would be, to make eye-pieces of large dimenſions, with extravagant apertures to increaſe the aberrations, and to provide for each ſtation A, B, C, and D, a number of lenſes of the ſame focal diſtance, but of different forms: and we would adviſe making the trial in the way of a ſolar microſcope, and to have two eye pieces on trial at once. Their pictures can be formed on the ſame ſcreen, and accurately compared; whereas it is difficult to keep in remembrance the performance of one eye-piece, and compare it with another.

We have now treated the theory of refracting teleſcopes with conſiderable minuteneſs, and have perhaps exceeded the limits which ſome readers may think reaſonable. But we have long regretted that there is not any theory on this ſubject from which a curious perſon can learn the improvements which have been made ſince the time of Dr Smith, or an artiſt learn how to proceed with intelligence in his profeſſion. If we have accompliſhed either of theſe ends, we truſt that the public will receive our labours with ſatisfaction.

We cannot add any thing to what Dr Smith has delivered on the theory of reflecting teleſcopes. There appears to be the ſame poſſibility of correcting the aberration of the great ſpeculum by the contrary aberration of a convex ſmall ſpeculum, that we have practiſed in the compound object-glaſs of an achromatic refracting teleſcope. But this cannot be, unleſs we make the radius of the convex ſpeculum exceedingly large, which deſtroys the magnifying power and the brightneſs. This therefore muſt be given up. Indeed their performance, when well executed, does already ſurpaſs all imagination. Dr Herſchel has found great advantages in what he calls the *front view*, not uſing a plane mirror to throw the pencils to one ſide. But this cannot be practiſed in any but teleſcopes ſo large, that the loſs of light, occaſioned by the interpoſition of the obſerver's head, may be diſregarded.

Nothing remains but to deſcribe the mechaniſm of ſome of the moſt convenient forms.

To deſcribe all the varieties of ſhape and accommodation which may be given to a teleſcope, would be a taſk as trifling as prolix. The artiſts of London and of Paris have racked their inventions to pleaſe every fancy, and to ſuit every purpoſe. We ſhall content ourſelves with a few general maxims, deduced from the ſcientific conſideration of a teleſcope, as an inſtrument by which the viſual angle ſubtended by a diſtinct object is greatly magnified.

The chief conſideration is to have a ſteady view of the diſtant object. This is unattainable, unleſs the axis of the inſtrument be kept conſtantly directed to the ſame point of it: for when the teleſcope is gently ſhifted from its poſition, the object *ſeems to move* in the ſame or in the oppoſite direction, according as the teleſcope inverts the object or ſhows

ſhows it erect. This is owing to the magnifying power, becauſe the apparent angular motion is greater than what we naturally connect with the motion of the teleſcope. This does not happen when we look through a tube without glaſſes.

All ſhaking of the inſtrument therefore makes the object dance before the eye; and this is diſagreeable, and hinders us from ſeeing it diſtinctly. But a tremulous motion, however ſmall, is infinitely more prejudicial to the performance of a teleſcope, by making the object quiver before us. A perſon walking in the room prevents us from ſeeing diſtinctly; nay, the very pulſation in the body of the obſerver, agitates the floor enough to produce this effect, when the teleſcope has a great magnifying power; For the viſible motion of the object is then an imperceptible tremor, like that of an harpſichord wire, which produces an effect preciſely ſimilar to optical indiſtinctneſs; and every point of the object is diffuſed over the whole ſpace of the angular tremor, and appears coexiſtent in every part of this ſpace, juſt as a harpſichord wire does while it is ſounding. The more rapid this motion is, the indiſtinctneſs is the more complete. Therefore the more firm and elaſtic and well bound together the frame-work and apertures of our teleſcope is, the more hurtful will this conſequence be. A mounting of lead, were it practicable, would be preferable to wood, iron, or braſs. This is one great cauſe of the indiſtinctneſs of the very fineſt reflecting teleſcopes of the uſual conſtructions, and can never be totally removed. In the Gregorian form, it is hardly poſſible to damp the elaſtic tremor of the ſmall ſpeculum, carried by an arm ſupported at one end only, even though the tube were motionleſs. We were witneſſes of a great improvement made on a four-feet reflecting teleſcope, by ſupporting the ſmall ſpeculum by a ſtrong plate of lead placed acroſs the tube, and led by an adjuſting ſcrew at each end. But even the great mirror may vibrate enough to produce indiſtinctneſs. Refracting teleſcopes are free from this inconveniency, becauſe a ſmall angular motion of the object-glaſs round one of its own diameters has no ſenſible effect on the image in its focus. They are affected only by an angular motion of the axis of the teleſcope or of the eye-glaſſes.

This ſingle conſideration gives us great help towards judging of the merits of any particular apparatus. We ſhould ſtudy it in this particular, and ſee whether its form makes the tube readily ſuſceptible of ſuch tremulous motions. If it does, the firmer it is and the more elaſtic it is, the worſe. All forms therefore where the tube is ſupported only near the middle, or where the whole immediately or remotely depend on one narrow joint, are defective.

Reaſoning in this way, we ſay with confidence, that of all the forms of a teleſcope apparatus, the old faſhioned ſimple ſtand repreſented in fig. 21. is by far the beſt, and that others are ſuperior according as the diſpoſition of the points of ſupport of the tube approaches to this. Let the pivots A, B, be fixed in the lintel and ſole of a window. Let the four braces terminate very near to theſe pivots. Let the teleſcope lie on the pin F*f*, reſting on the ſhoulder round the eye piece, while the far end of it reſts on one of the pins 1, 2, 3, &c.; and let the diſtance of theſe pins from F very little exceed the length of the teleſcope. The trembling of the axis, even when conſiderable, cannot affect the points of the tube, becauſe the braces terminate almoſt at the pivots. The tremor of the brace CD does as little harm, becauſe it is nearly perpendicular to the tube. And if the object glaſs were cloſe at the upper ſupporting pin, and the focus at the lower pin F, even the bending and trembling of the tube will have no effect on its optical axis. The inſtrument is only ſubject to horizontal tremors. Theſe may be almoſt annihilated by having a ſlender rod coming from a hook's joint in the ſide of the window, and paſſing through ſuch another joint cloſe by the pin F. We have ſeen an inſtrument of this form, having AB parallel to the earth's axis. The whole apparatus did not coſt 50 ſhillings, and we find it not in the leaſt ſenſible manner affected by a ſtorm of wind. It was by obſervations with this inſtrument that the tables of the motions of the Georgium Sidus, publiſhed in the Edinburgh Tranſactions, were conſtructed, and they are as accurate as any that have yet appeared. This is an excellent equatorial.

But this apparatus is not portable, and it is ſadly deficient in elegance. The following is the beſt method we have ſeen of combining theſe circumſtances with the indiſpenſable requiſites of a good teleſcope.

The pillar VX (fig. 22.) riſes from a firm ſtand, and has a horizontal motion round a cone which completely fills it. This motion is regulated by a rack-work in the box at V. The ſcrew of this rack-work is turned by means of the handle P, of a convenient length, and the ſcrew may be diſengaged by the click or detent V, when we would turn the inſtrument a great way at once. The teleſcope has a vertical motion round the joint Q placed near the middle of the tube. The lower end of the tube is ſupported by the ſtay OT. This conſiſts of a tube RT, faſtened to the pillar by a joint T, which allows the ſtay to move in a vertical plane. Within this tube ſlides another, with a ſtiff motion. This tube is connected with the teleſcope by another joint O, alſo admitting motion in a vertical plane. The ſide M of this inner tube is formed into a rack, in which works a pinion fixed to the top of the tube RT, and turned by the flat finger-piece R. The reader will readily ſee the advantages and the remaining defects of this apparatus. It is very portable, becauſe the teleſcope is eaſily diſengaged from it, and the legs and ſtay fold up. If the joint Q were immediately under A, it would be much freer from all tremor in the vertical plane. But nothing can hinder other tremors ariſing from the long pillar and the three ſpringy legs. Theſe communicate all external agitations with great vigour. The inſtrument ſhould be ſet on a ſtone pedeſtal, or, what is better, a caſk filled with wet ſand. This pedeſtal, which neceſſity perhaps ſuggeſted to our ſcientific navigators, is the beſt that can be imagined.

Fig. 23 is the ſtand uſually given to reflecting teleſcopes. The vertical tube FBG is faſtened to the tube by finger ſcrews, which paſs through the ſlits at F and G. This arch turns round a joint in the head of the divided pillar, and has its edge cut into an oblique rack, which is acted on by the horizontal ſcrew, furniſhed with the finger-piece A. This ſcrew turns in a horizontal ſquare frame. This frame turns round a horizontal joint in the off ſide, which cannot be ſeen in this view. In the ſide of this frame next the eye there is a finger-ſcrew *a*, which paſſes through the frame, and preſſes on the round horizontal plate D. By ſcrewing down this finger-ſcrew, the frame is brought up, and preſſes the horizontal ſcrew to the rack. Thus the elevation of the teleſcope is fixed, and may be nicely changed by the finger applied to A and turning this ſcrew. The horizontal round plate D moves ſtiffly round on another plate of nearly equal diameter. This under plate has a deep conical hollow ſocket, which is nicely fitted by grinding to a ſolid cone formed on the top of the great upright pillar, and they may be firmly fixed in any poſition by the finger-ſcrew E. To the under plate is faſtened a box *c*, containing a horizontal ſcrew C, which always works in a rack cut in the edge of the upper plate, and cannot be diſengaged from it. When a great vertical or horizontal motion is wanted, the ſcrews *a* and E are ſlacked, and by tightening them the teleſcope may be fixed

Fig. 1.

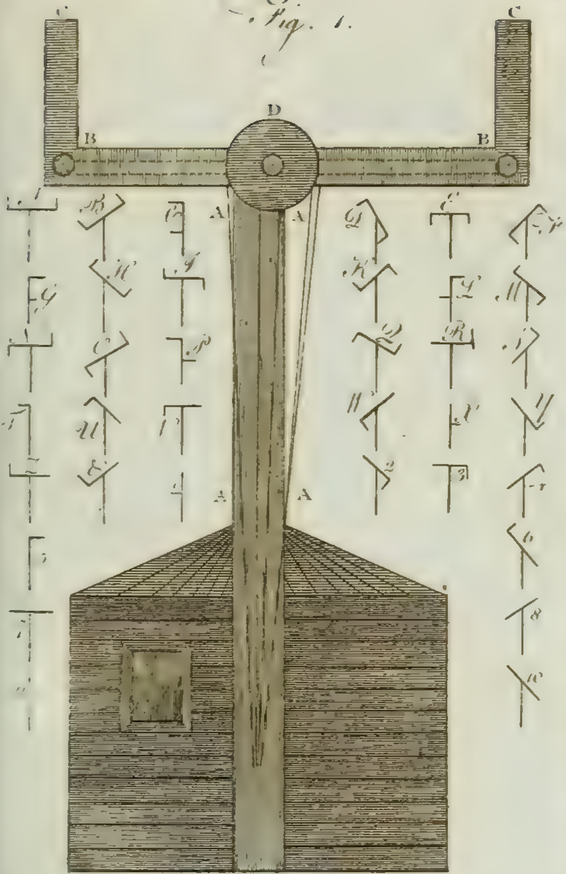


Fig. 2.

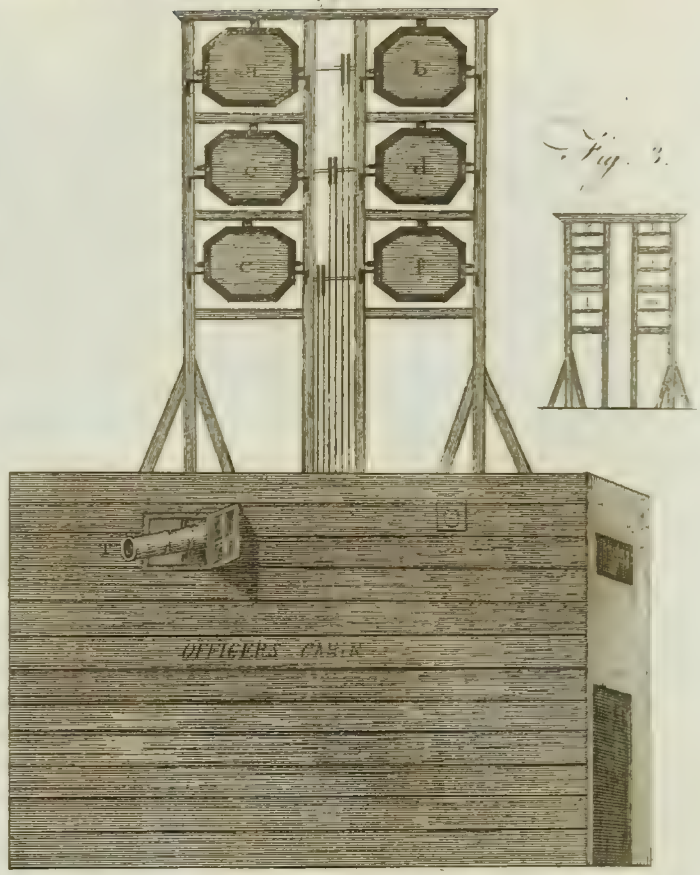
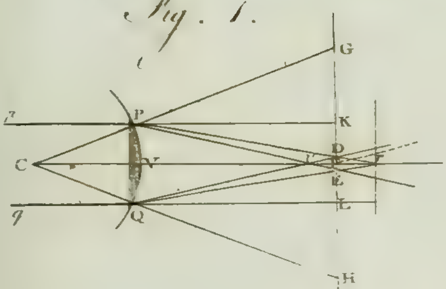


Fig. 3.

TELESCOPE.

Fig. 1.



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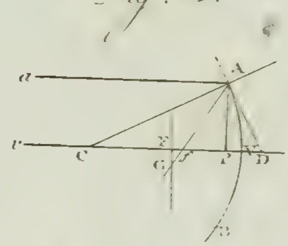


Fig. 2.

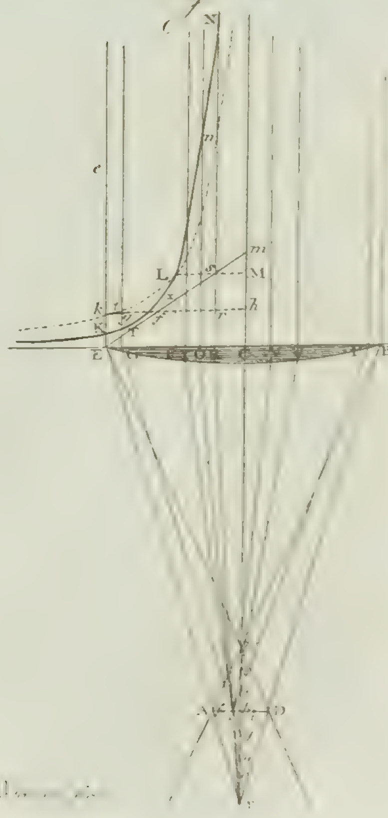


Fig. 4. A

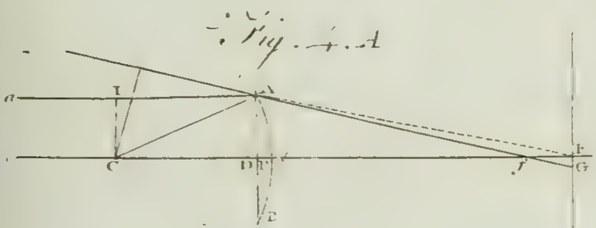


Fig. 4. B

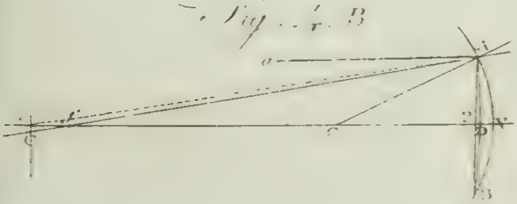


Fig. 5.B

Fig. 5.

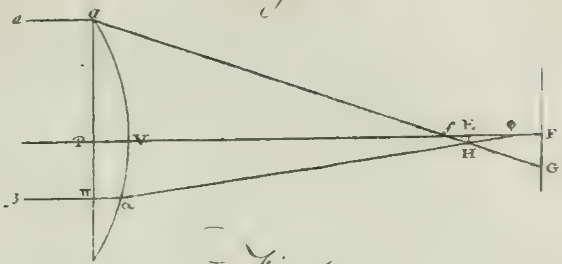


Fig. 5.C

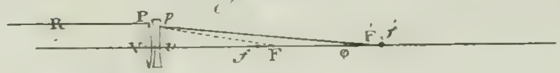


Fig. 7.

Fig. 6.

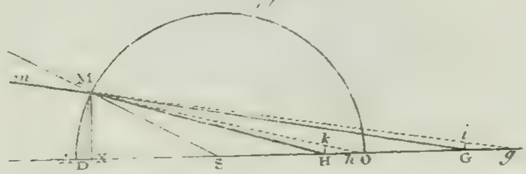


Fig. 8.

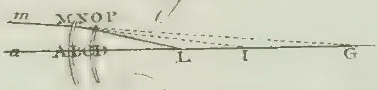


Fig. 9. A

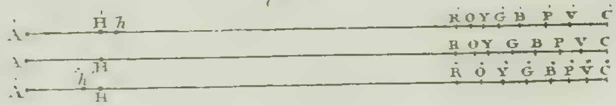


Fig. 10.B

Fig. 10.

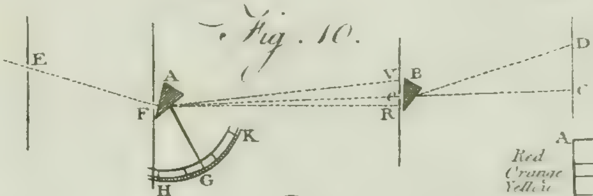


Fig. 9. B

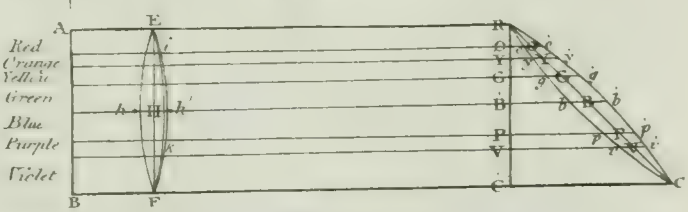


Fig. 13.

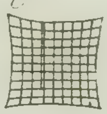


Fig. 12.

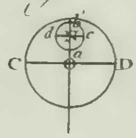


Fig. 11.

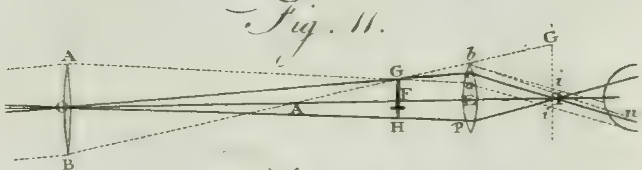


Fig. 15. A

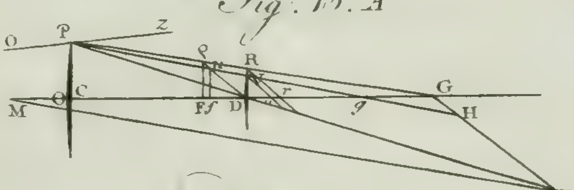


Fig. 14. A

Fig. 15. B

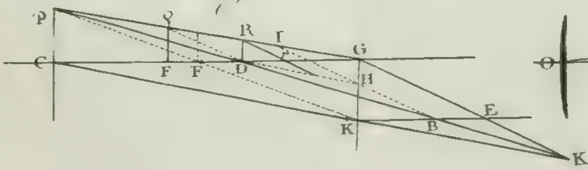
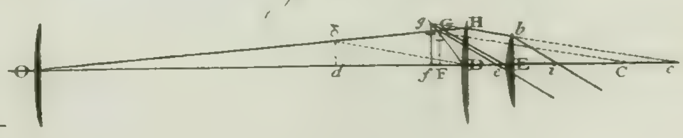


Fig. 14. B



J. Bell Prin. Mal. Sculptor fecit.

Telescope.

fixed in any position, and then any small movements may be given it by the finger plates A and C.

This stand is very subject to brisk tremor, either from external agitation of the pedestal, or from the immediate action of the wind; and we have seldom seen distinctly through telescopes mounted in this manner, till one end of the tube was pressed against something that was very steady and unelastic. It is quite astonishing what a change this produces. We took a very fine telescope made by James Short, and laid the tube on a great lump of soft clay, pressing it firmly down into it. Several persons, ignorant of our purpose, looked through it, and read a table of logarithms at the distance of 310 yards. We then put the telescope on its stand, and pointed it to the same object; none of the company could read at a greater distance than 235 yards, although they could perceive no tremor. They thought the vision as sharp as before; but the incontrovertible proof of the contrary was, that they could not read at such a distance.

If the round plates were of much greater dimensions; and if the lower one, instead of being fixed to the pillar, were supported on four stout pillars standing on another plate; and if the vertical arch had a horizontal axis turning on two upright frames firmly fixed to the upper plate—the instrument would be much freer from tremor. Such stands were made formerly; but being much more bulky and inconvenient for package, they have gone into disuse.

The high magnifying powers of Dr Herschel's telescopes made all the usual apparatus for their support extremely imperfect. But his judgment, and his ingenuity and fertility in resource, are as eminent as his philosophical ardour. He has contrived for his reflecting telescopes stands which have every property that can be desired. The tubes are all supported at the two ends. The motions, both vertical and horizontal, are contrived with the utmost simplicity and firmness. We cannot more properly conclude this article than with a description of his 40 feet telescope, the noblest monument of philosophical zeal and of princely munificence that the world can boast of.

Plat DV. represents a view of this instrument in a meridional situation, as it appears when seen from a convenient distance by a person placed to the south-west of it. The foundation in the ground consists of two concentric circular brick walls, the outermost of which is 42 feet in diameter, and the inside one 21 feet. They are two feet six inches deep under ground; two feet three inches broad at the bottom, and one foot two inches at the top; and are capped with paving stones about three inches thick, and twelve and three quarters broad. The bottom frame of the whole apparatus rests upon these two walls by twenty concentric rollers III, and is moveable upon a pivot, which gives a horizontal motion to the whole apparatus, as well as to the telescope.

The tube of the telescope A, though very simple in its form, which is cylindrical, was attended with great difficulties in the construction. This is not to be wondered at, when its size, and the materials of which it is made, are considered. Its length is 39 feet four inches; it measures four feet ten inches in diameter; and every part of it is of iron. Upon a moderate computation, the weight of a wooden tube must have exceeded an iron one at least 3000 pounds; and its durability would have been far inferior to that of iron. It is made of rolled or sheet iron, which has been joined together without rivets, by a kind of seaming well known to those who make iron-funnels for stoves.

Very great mechanical skill is used in the contrivance of the apparatus by which the telescope is supported and directed. In order to command every altitude, the point of support is moveable; and its motion is effected by mechanism, so that the telescope may be moved from its most backward point of support to the most forward, and, by means of the pulleys GG suspended from the great beam H, be set to any altitude, up to the very zenith. The tube is also made to rest with the point of support in a pivot, which permits it to be turned sidewise.

Telescope.

The concave face of the great mirror is 48 inches of polished surface in diameter. The thickness, which is equal in every part of it, remains now about three inches and a half; and its weight, when it came from the cast was 2118 pounds, of which it must have lost a small quantity in polishing. To put this speculum into the tube, it is suspended vertically by a crane in the laboratory, and placed on a small narrow carriage, which is drawn out, rolling upon planks, till it comes near the back of the tube; here it is again suspended and placed in the tube by a peculiar apparatus.

The method of observing by this telescope is by what Dr Herschel calls the *front view*; the observer being placed in a seat C, suspended at the end of it, with his back towards the object he views. There is no small speculum, but the magnifiers are applied immediately to the first focal image.

From the opening of the telescope, near the place of the eye-glass, a speaking pipe runs down to the bottom of the tube, where it goes into a turning joint; and after several other inflections, it at length divides into two branches, one going into the observatory D, and the other into the workroom E. By means of the speaking pipe the communications of the observer are conveyed to the assistant in the observatory, and the workman is directed to perform the required motions.

In the observatory is placed a valuable sidereal time-piece, made by Mr Shelton. Close to it, and of the same height, is a polar distance-piece, which has a dial-plate of the same dimensions with the time-piece: this piece may be made to show polar distance, zenith distance, declination or altitude, by setting it differently. The time and polar distance pieces are placed so that the assistant sits before them at a table, with the speaking-pipe rising between them; and in this manner observations may be written down very conveniently.

This noble instrument, with proper eye-glasses, magnifies above 6000 times, and is the largest that has ever been made. Such of our readers as wish for a fuller account of the machinery attached to it, viz. the stairs, ladders, and platform B, may have recourse to the second part of the Transactions of the Royal Society for 1795; in which, by means of 18 plates and 63 pages of letter-press, an ample detail is given of every circumstance relating to joiner's work, carpenter's work, and smith's work, which attended the formation and erection of this telescope. It was completed on August the 28th 1789, and on the same day was the sixth satellite of Saturn discovered.

TELL (William), an illustrious Swiss patriot, chief instrument of the revolution which delivered the Swiss cantons from the German yoke in 1307. Grisler, the governor of these provinces for the emperor Albert, having ordered him, under pain of death, to shoot at an apple placed on the head of one of his children; he had the dexterity, though the distance was very considerable, to strike it off without hitting the child. The tyrant, perceiving he had another arrow concealed under his cloak, asked him for what purpose? To which he boldly replied, "To have shot you thro' the heart, if I had had the misfortune to kill my son." The enraged governor now ordered him to be hanged; but his fellow-citizens, animated by his fortitude and pa-

patriotism flew to arms; attacked and vanquished Grisler, who was shot to death by Tell; and the association for the independency took place that instant.

Tell-Tale, a name sometimes given to the *Perpetual-Log*. See that article.

TELLER, an officer of the exchequer, in ancient records called *tallier*. There are four of these officers, whose duty is to receive all monies due to the king, and to give the clerk of the pells a bill to charge him therewith. They likewise pay all money due from the king, by warrant from the auditor of the receipt; and make weekly and yearly books both of their receipts and payments, which they deliver to the lord treasurer.

TELLINA, in natural history, a genus of animals belonging to the class of *vermes*, and order of *testaceæ*. The animal is a tethys; the shell is bivalve, generally sloping to one side, with three teeth at the hinge. Gmelin reckons about [illegible] species.

The tellinæ bury themselves in the mud or sand at the bottom of the sea, keeping a communication with the water above by means of short tubes or pipes.

TEMISSA, a large town in Africa, about 120 miles north east of Mourzouk, the capital of Fezzan. Here the caravan of pilgrims from Bornou and Nigritia, which takes its departure from Mourzouk, and travels by the way of Cairo to Mecca, usually provides the stores of corn and dates, and dried meat, that are requisite for its dreary passage.

TEMPE (anc. geog.), a most pleasant place or valley of Thessaly. That it was there, appears from the epithets *Thessalica* (Livy), *Thessala* (Ovid); but in what particular district is the question. From the Phthiotica of Catullus, it should seem to be of Phthiotis: but the Peneus, which ran through Tempe, was at too great a distance, being separated from it by Mount Othrys and others. First, however, we shall define Tempe, previous to the determining the particular district in which it lay. The Peneus, according to Pliny, running down between Ossa to the south and Olympus to the north for 500 stadia, is for half that space navigable: in the direction of this course lies what is called *Tempe*, extending in length for five miles, in breadth for almost an acre and an half, with gentle convexities rising on the right and left beyond ken of human sight. Within glides the Peneus in its verdant light, green in its pebbles, charming in the grass on its banks, harmoniously vocal with the music of birds. In this description Strabo and Ælian agree; the last adding, that it has an agreeable variety of places of retreat; and that it is not the work of man's hand, but the spontaneous production of nature; and Strabo says, that formerly the Peneus formed a lake in this spot, being checked in its course by the higher grounds about the sea; but that an opening being made by an earthquake, and Mount Ossa torn from Olympus, the Peneus gained a free course between them. But Livy, who calls Tempe a grove, remarks a degree of horror rather than amenity, with which the Roman army was struck on marching over the narrow pass; for, besides the defile, difficult to go over, which runs on for five miles, there are steep rocks on each hand, down which the prospect is apt to cause a dizziness, heightened by the noise and depth of the interfluent Peneus. Hence it appears that Tempe was in the Pelasgiotis, whose extremity was formerly the Peneus, but afterwards, as is probable, allotted to Magnesia; and thus Pliny places the mouth of the Peneus not in Thessaly itself, but in the Magnesia of Thessaly.

TEMPER, in a mechanical sense. See TEMPERING.

TEMPER, in a moral sense, the disposition of mind whether natural or acquired. The word is seldom used by good writers without an epithet, as a *good* or *bad* temper; though one of the most beautiful poems in the language is entitled *The Triumphs of Temper.*

It is well observed by an elegant essayist, that more constant uneasiness arises from ill temper than from ill fortune; as a bad temper embitters every sweet, and converts a paradise into a place of torment. For subduing the heart to softness, and preserving a due balance of the passions, a proper culture of the understanding and of the taste is the best method. He who employs his time in the studies of elegant literature, or the fine arts, has almost always a good temper; whilst the man who is absorbed in the pursuits of profound science is apt to acquire a severity of disposition, little less disagreeable, though generally much less pernicious, than the capriciousness of the idler. Music, painting, and poetry, teach the mind to select the agreeable parts of those objects which surround us, and by habituating it to a pure and permanent delight, gradually superinduce an habitual good humour. It is of infinite importance to happiness to accustom the mind, from infancy, to turn from deformed and painful scenes, and to contemplate whatever can be found of moral and natural beauty.

So much of the happiness of private life depends on the government of the temper, that the temper ought to be a principal object of regard in a well conducted education. The suffering of children to tyrannize without controul over servants and inferiors, is the ruin of many an amiable disposition. The virtues of humanity, benevolence, humility, cannot be too early enforced; at the same time, care should be taken that an infant of two or three years old should never be beaten or spoken to harshly for any offence which it can possibly commit.

TEMPERAMENT, among physicians, the same with constitution, or a certain disposition of the solids and fluids of the human body, by which it may be properly denominated strong, weak, lax, &c.

In every person there are appearances of a temperament peculiar to himself, though the ancients only took notice of four, and some have imagined these were deduced from the theories of the four humours or four cardinal qualities; but it is more probable that they were first founded on observation, and afterwards adapted to those theories, since we find that they have a real existence, and are capable of receiving an explanation. The two that are most distinctly marked are the sanguineous and melancholic, viz. the temperaments of youth and age.

1. *Sanguineous.* Here there is laxity of solids, discoverable by the softness of hair and succulency; large system of arteries, redundancy of fluids, florid complexion; sensibility of the nervous power, especially to pleasing objects; irritability from the plethora; mobility and levity from lax solids. These characters are distinctly marked, and are proved by the diseases incident to this age, as hæmorrhagies, fevers, &c. but these, as they proceed from a lax system, are more easily cured.

2. *Melancholic Habit.* Here greater rigidity of solids occurs, discoverable by the hardness and crispature of the hair; small proportion of the fluids, hence dryness and leanness; small arteries, hence pale colour; venous plethora, hence turgescency of these, and lividity; sensibility, frequently exquisite; moderate irritability, with remarkable tenacity of impressions; steadiness in action and slowness of motion, with great strength; for excess of this constitution in maniacs gives the most extraordinary instance of human strength we know. This temperament is most distinctly marked in old age, and in males. The sanguineous temperament

Temperament. Temperance. ment of youth makes us not diſtinguiſh the melancholic till the decline of life, when it is very evident, from diſeaſes of the veins, hemorrhoids, apoplexy, cachexy, obſtructions of the viſcera, particularly of the liver, dropſies, affections of the alimentary canal, chiefly from weaker influence of the nervous power. So much for the ſanguineous and melancholic temperaments; the other two are not ſo eaſily explained. The choleric temperament takes place between youth and manhood. In the

3. *Choleric*, the diſtribution of the fluids is more exactly balanced; there is leſs ſenſibility, and leſs obeſity, with more irritability, proceeding from greater tenſion, leſs mobility and levity, and more ſteadineſs in the ſtrength of the nervous power. As to the

4. *Phlegmatic*. This temperament cannot be diſtinguiſhed by any characters of age or ſex. It agrees with the ſanguineous in laxity and ſucculency. It differs from that temperament, and the melancholic, by the more exact diſtribution of the fluids. Again, it differs from the ſanguineous, by having leſs ſenſibility, irritability, mobility, and perhaps ſtrength, though ſometimes indeed this laſt is found to be great.

Theſe are the ancient temperaments. The temperaments, indeed, are much more various; and very far from being eaſily marked and reduced to their genera and ſpecies, from the great variety which is obſervable in the conſtitutions of different men.

TEMPERAMENT, in muſic, is defined by Rouſſeau to be an operation which, by means of a ſlight alteration in the intervals, cauſes the difference between two contiguous ſounds to diſappear, makes each of theſe ſounds ſeem identical with the other, which, without offending the ear, may ſtill preſerve their reſpective intervals or diſtances one from the other. By this operation the ſcale is rendered more ſimple, and the number of ſounds which would otherwiſe be neceſſary retrenched. Had not the ſcale been thus modified, inſtead of twelve ſounds alone, which are contained in the octave, more than ſixty would be indiſpenſably required to form what we properly call *modulation* in every tone.

It is proved by computation, that upon the organ, the harpſichord, and every other inſtrument with keys, there is not, and there ſcarcely can be, any chords properly in tune, ſave the octave alone. The cauſe is this, that though three thirds major, or four thirds minor, ought to form a juſt octave, thoſe are found to ſurpaſs, and theſe not to reach it.

TEMPERANCE, that virtue which a man is ſaid to poſſeſs who moderates and reſtrains his ſenſual appetites. It is often, however, uſed in a much more general ſenſe, as ſynonymous with moderation, and is then applied indiſcriminately to all the paſſions.

Temperance (ſays Mr Nelſon) is the virtue that bridles our irregular deſires; it is nearly allied to prudence, and has a cloſe connection with juſtice; it calms revenge, and quenches the fire of unjuſt reſentment: it checks the Epicure, and ſtops the riotous hand of the Bacchanalian; it extinguiſhes or abates the flames of luſt, and baniſhes every lawleſs action; it ſilences the flippant detracting tongue, and gives in its ſtead a pleaſing moderation of ſpeech; it ſhuts the door againſt avarice, and proves experimentally, that happineſs does not conſiſt in the eager purſuit or acquiſition of riches, but in a contented mind; it curbs the ſtrongeſt of all other paſſions, gaming, and diſtinguiſhes juſtly the abſurdity and folly of making that a dangerous trade, which was only deſigned as a relaxation and an amuſement: temperance, in a word, is the parent of many virtues; the parent of peace, proſperity, health, and joy.

Nothing can be more ſtrange to all obſervation than the practice of forſaking temperance; ſince every day's experience proves to us, that intemperance produces the oppoſite to what we ſeek. Suppoſe, when a child is born, we aſk the parents what it is they wiſh in that child; they will anſwer, life. But as life alone, that is, mere exiſtence, may, by infirmity or other accidents, be very wretched, they will naturally wiſh for health and happineſs. Well then, life, health, and happineſs, are the general wiſhes of parents for their children. Now let us ſee how their wiſhes are likely to ſucceed. Their firſt ſtep is uſually a ſhameful neglect of the food of nature, the breaſt; the next, a blind gratification of their will; the third, an almoſt total neglect of their manners; and a fourth, the cheriſhing them in every irregular affection. Where then is the wonder that parents are diſappointed? Life and health depend on proper food and other judicious management on one part; and if ſick, an obedience to remedies on the other part; and happineſs eſſentially depends in the firſt place on health; in the next, on the due government of our ſenſes, affections, and paſſions. See here how much mankind deviate from themſelves; how far they depart from their own principles. But what is the remedy? Nothing more obvious. Let parents exerciſe their reaſon in all the ſteps they take for their children's welfare; let them examine right and wrong; let them not only avoid paſſion, but labour to correct their own errors of judgment, that they may be the better enabled to prevent them in their children; but, particularly, let them fix in them the knowledge, love, and habit, of temperance. Temperance. Templars.

TEMPERING, in the mechanic arts, the preparing of ſteel and iron, ſo as to render them more compact, hard, and firm; or even more ſoft and pliant, according to their reſpective occaſions. See IRON and STEEL.

TEMPESTA. See MOLYN.

TEMPLARS, TEMPLERS, or *Knights of the Temple*, a religious order inſtituted at Jeruſalem in the beginning of the 12th century, for the defence of the holy ſepulchre and the protection of Chriſtian pilgrims. They were firſt called *The poor of the Holy City*, and afterwards aſſumed the appellation of *Templers*, becauſe their houſe was near the temple. The order was founded by Baldwin II. then king of Jeruſalem, with the concurrence of the pope; and the principal articles of their rule were: That they ſhould hear the holy office throughout every day; or that, when their military duties ſhould prevent this, they ſhould ſupply it by a certain number of pater noſters: that they ſhould abſtain from fleſh four days in the week, and on Fridays from eggs and milk-meats: that each knight might have three horſes, and one eſquire: and that they ſhould neither hunt nor fowl. After the ruin of the kingdom of Jeruſalem about 1186, they ſpread themſelves through Germany and other countries of Europe, to which they were invited by the liberality of the Chriſtians. In the year 1228, this order acquired ſtability, by being confirmed in the council of Troyes, and ſubjected to a rule of diſcipline drawn up by St Bernard. In every nation they had a particular governor, called *maſter of the Temple*, or of the *militia of the Temple*. Their grand-maſter had his reſidence at Paris.

The order of Templars flouriſhed for ſome time, and acquired, by the valour of its knights, immenſe riches and an eminent degree of military renown: but as their proſperity increaſed, their vices were multiplied, and their arrogance, luxury, and cruelty roſe at laſt to ſuch a monſtrous height, that their privileges were revoked, and their order ſuppreſſed with the moſt terrible circumſtances of infamy and ſeverity. Their accuſers were two of their own body, and their chief proſecutor Philip the Fair of France, who addreſſed his complaints

Templars. ... Clement V. The pope, though at first unwilling to proceed against them, was under a necessity of complying with the king's desire; so that, in the year 1307, upon an appointed day, and for some time afterwards, all the knights, who were dispersed throughout Europe, were seized and imprisoned, and many of them, after trials for alleged crimes, were convicted and put to death. In 1312 the whole order was suppressed by the council of Vienne. A part of their rich revenues they possessed was bestowed upon other orders, especially on the knights of St John, now of Malta, and the rest confiscated to the respective treasuries of the sovereign princes in whose dominions their possessions lay.—The knights Templars, in order to justify the severity with which they were treated, were charged with apostasy to the Saracens, and holding correspondence with them, with insulting the majesty of God, turning into derision the gospel of Christ, and trampling upon the obligation of all laws human and divine. Candidates, it is said, upon admission to this order, were commanded to spit, in token of contempt, upon an image of Christ, and after admission to worship either a cat or a wooden head crowned with gold. It is farther affirmed, that, among them, the odious and unnatural act of sodomy was a matter of obligation; and they are charged with other crimes too horrible to be mentioned, or even imagined. However, though there be reason to believe, that in this order, as well as others of the same period, there were shocking examples of impiety and profligacy; yet that the whole order was thus enormously corrupt, there is no reason to believe. The pope indeed, though he acted with severity, acted with justice. He sent two cardinals to Paris, who, publishing his bull against the order, condemned those Templars who had made the voluntary confession to be burnt by a slow fire. The criminals recanted their former confessions, but acknowleged themselves worthy of death, because they had unjustly accused the order of crimes of which they were innocent. Several authors of those times wrote in defence of the order; and Boccace alleges, that its extirpation was owing to the avarice of the king of France, who coveted the rich possessions the Templars then enjoyed in France.

The king of Arragon was much pressed to treat the Templars in his kingdom as they had been treated in France; but his constant answer was, "We must be first convinced of their guilt, and it will be then time enough to talk of their punishment." The people, however, were in general so provoked against them, that they were compelled to shut themselves up in the fortresses belonging to their order, to prevent their being torn in pieces; which precaution was represented to the king of Arragon as an act of rebellion. He marched, therefore, with a corps of troops against one of these fortresses. The knight who commanded surrendered immediately, and told the king the truth, assuring him that they desired nothing but a fair trial; with which declaration the king was extremely moved, took the whole order into his protection, and forbade any to abuse or insult them under the heaviest penalties. At the same time he declared, he was ready to receive any informations against them that were supported by proofs; but if the informers failed therein, he would punish them as they deserved.

These facts plead strongly for the innocence of the Templars, or at least they prove that their guilt must have been exaggerated: and if we add, that many of the accusations advanced against them flatly contradict each other, and that many members of this unfortunate order solemnly avowed their innocence while languishing under the severest tortures, and even with their dying breath—it would seem probable, that king Philip set on foot this bloody tragedy, with a view to gratify his avarice, and glut his resentment against the Templars, and especially against their grand master, who had highly offended him. The principal cause of his implacable hatred against them was, that in his quarrel with Boniface VIII. the knights espoused the cause of the pope, and furnished him with money to carry on the war. They originally wore a white habit, with red crosses sewed upon their cloaks as a mark of distinction.

Temple. TEMPLE (Sir William), was born in London in the year 1628. The family from which he sprung was ancient, and is said to have assumed the surname of Temple from the manor of Temple, in the hundred of Sparken Hill, in Leicestershire. He was first sent to school at Penshurst, in Kent, under the care of his uncle, the celebrated Dr Hammond, then minister of that parish; but at the age of ten he was removed thence to a school at Bishop-Stortford, in Hertfordshire. When he had acquired a sufficient knowledge of the Greek and Latin, he returned home at the age of fifteen; and, two years after, he went to Cambridge, where he was placed under the tuition of the learned Dr Cudworth, then fellow of Emanuel College. His father, Sir John Temple, being a statesman, seems to have destined him for the same way of life; and on this account, after residing at Cambridge two years, which were principally spent in acquiring a competency of French and Spanish, both languages exceedingly useful for his intended pursuits, he was sent abroad to finish his education.

Mr Temple began his travels by visiting France in 1648. As he chose to pass through the Isle of Wight, where his majesty was detained a prisoner, he there accidentally met with the second daughter of Sir Peter Osborn of Chicksand, in Bedfordshire, then governor of Guernsey for the king; and this lady being on a journey with her brother to St Maloes, where their father then was, our young traveller joined their party. This gave rise to an honourable amour, which, at the end of seven years, concluded in a happy marriage. Having resided two years in France, and learned the French language perfectly, Mr Temple made a tour through Holland, Flanders, and Germany, during which he became completely master of the Spanish. In 1654 he returned from the continent, and, marrying Miss Osborn, passed his time in retirement with his father, his two brothers, and a sister, then in Ireland, happy in that perfect harmony which has been so often remarked in their family.

As he rejected all offers made him of employment under Cromwell, the five years which he lived in Ireland were spent chiefly in improving himself in history and philosophy; but at the Restoration, in 1660, being chosen a member of the convention there, while others were trying to make their court to the king, Mr Temple opposed the poll-bill with so much spirit, that his conduct soon attracted the attention of the public, and brought him into notice. In the succeeding parliament, in 1661, he was elected with his father for the county of Carlow; and, in the year following, he was chosen one of the commissioners to be sent from that parliament to the king, which gave him an opportunity of waiting on the duke of Ormond, the new lord-lieutenant, then at London. Soon after he went back to Ireland, but with a resolution of quitting that kingdom, and of removing with his family to England.

On his return he met with a very favourable reception from the duke of Ormond; and soon acquired such a considerable share in his esteem, that the duke complained of him as the only man in Ireland that had never asked any thing from him. When he mentioned his design of carrying his family to England, his grace said, that he hoped he would

would at least give him leave to write in his favour to the two great ministers, Clarendon then lord chancellor, and the earl of Arlington, who was secretary of state. This the father did in such strong terms, as procured him the friendship of these two noblemen, as well as the good opinion of the king. Mr Temple, however, made no other use of this advantage than to tell lord Arlington, that if his majesty had any employment abroad, which he was fit for, he should be happy to undertake it; but, at the same time, he requested that he might not be sent into any of the northern climates, to which he had a very great aversion. Lord Arlington replied, he was very sorry he had made such an objection, as there was no other employment then undisposed of except that of joint envoy to Sweden. However, in 1665, about the beginning of the first Dutch war, lord Arlington sent a messenger to acquaint him that he must immediately come to his house; which he did, and found that his lordship's business was to tell him, that the king had occasion to send some person abroad upon an affair of the utmost importance, and that he had resolved to make him the first offer; but that he must know, without delay, and without telling him what it was, whether he would accept of it, and that he must be ready to set out in two or three days, without mentioning it to any of his friends. After a little consideration, Mr Temple told his lordship, that, as he took him to be his friend, and as he had advised him not to refuse, as it would be an entrance into his majesty's service, he should consult no farther. This business was to carry a secret commission to the bishop of Munster; which he set out with on the second of August, and executed so much to the satisfaction of Charles II. that, on his return to Brussels, his majesty appointed him resident there, and created him a baronet. As Brussels was a place which he had long wished to reside at, in April 1666 he sent for his family; but, before their arrival, he had been again obliged to depart upon business to the prelate's court: for the bishop having listened to terms of accommodation with France, Sir William wrote two letters to dissuade him from that alliance, and these not having the desired effect, he went in disguise to Munster, where, though he arrived too late to secure the prince in his first engagement, yet he prevailed on him to permit five or six thousand of his best troops to enter into the Spanish service. In this journey he passed for a Spanish envoy, having twenty Spanish guards to attend him. In this manner he first went to Dusseldorp, where the duke of Newburgh, though in the French interest, gave him a guard to Dortmund; but when he reached that place, finding the gates shut, he was forced to proceed to a village, at the distance of a league, which, being full of Brandenburg troops, he was under the necessity of lodging in a barn, upon a straw bed, with his page for a pillow. Next day he was entertained at a castle belonging to the bishop of Munster, by one Gorges a Scotch lieutenant general in that prelate's service, with what he calls a very episcopal way of drinking. The general coming to the large hall, in which stood a great many flaggons ready charged, he called for wine to drink the king's health. A silver bell, that might hold about two quarts, was upon this brought him; and, as soon as he received it, he pulled out the clapper, and giving it to Sir William, to whom he intended to drink, ordered the bell to be filled. When this was done, he drank off the contents to his majesty's health; and asking Sir William for the clapper, put it on, and turning down the bell, rang it, to shew that he had drank fair, and left nothing in it. He then took out the clapper, desired Sir William to give it to whomsoever he pleased; and, ordering the bell to be filled again, presented it to Sir William: but as the latter seldom used to drink, he had generally some gentleman with him to supply his place in this respect whenever it might be necessary. Having finished his business at Munster, he returned to Brussels, where he passed a year with great pleasure and satisfaction.

Two months after the conclusion of the peace with the Dutch at Breda, Sir William's sister, who resided with him at Brussels, being very desirous of seeing Holland, he went thither incognito to gratify her desire: but while he was at the Hague, he paid a private visit to Mr De Witt, in which he laid the foundation of that close intimacy which afterwards subsisted between them.

In the spring of 1667, a new war breaking out between France and Spain, which exposed Brussels to the danger of falling into the hands of the former, Sir William sent his lady and family to England; but he himself remained there with his sister till the Christmas following, when he was ordered by the king to come over privately to London. Taking the Hague in his way, he paid another visit to De Witt, and, pursuant to his instructions, proposed those overtures to him which produced the triple alliance. Soon after his arrival at the British court, he returned, on the 16th of January 1668, with the character of envoy extraordinary and plenipotentiary to Holland; where a conference being opened, he brought that treaty to a perfect conclusion in the short space of five days. The ratifications of this alliance being exchanged on the 15th of February, he repaired to Brussels; and a treaty being set on foot between France and Spain at Aix-la-Chapelle, he set out for that place on the 24th of April in quality of his majesty's ambassador extraordinary and mediator. Here he arrived on the 27th: and it was chiefly owing to his assistance that the Spaniards were brought to sign the articles of that peace on the second of May. This service being completed, he returned to Brussels, with a view of remaining there in his former station of resident; but he received letters from the earl of Arlington, with the king's order to continue as ambassador, and to serve his country in that quality in Holland, as, on account of the late alliances, his majesty was resolved to renew a character which the crown of England had discontinued there since the time of king James. Sir William being now left at liberty to return to England, embraced the opportunity; and, upon his arrival at London, he was received with every possible demonstration of favour both by the king and the court.

Setting out again for Holland, with his new character of the king's ambassador, he arrived at the Hague in the end of August 1668. Here he enjoyed the confidence of that great minister De Witt, and lived in great intimacy with the prince of Orange, who was then only eighteen years of age; but, in September 1669, he was hurried back to England by lord Arlington, who ordered him to put his foot in the stirrup as soon as he should receive his letter. When Sir William waited on the earl, he found that he had not one word to say to him; for, after making him attend a long time, he only asked him a few indifferent questions respecting his journey. Next day he was received as coolly by the king; but the secret soon came out, and he was pressed to return to the Hague, and pave the way for a war with Holland. This, however, he excused himself from having any hand in; which so much provoked the lord treasurer Clifford, that he refused to pay him an arrear of two thousand pounds due from his embassy. Disgusted with Arlington's behaviour, which was so unlike the friendship he had formerly professed, Sir William now retired to his house at Sheen near Richmond, in Surry; and in this retreat, when free from the hurry of business, he wrote his Observations on the United Provinces, and one part of his Miscellanies, in the time

Temple. close of the second Dutch war. About the end of summer, however, 1673, the king wishing to put an end to the war, sent for Sir William, and desired him to go to Holland to negotiate a peace; but proposals having been sent from Spain at the same time to the marquis de Fresno, the Spanish ambassador at London, Sir William was ordered to treat with him; and a treaty was accordingly concluded in three days, and the peace restored, respecting the foundations of the Triple alliance, which had been so long wrecked. In June 1674 he was sent out ambassador to Holland to offer the king's mediation between France and the confederates, then at war, which was accepted not long after; Lord Berkeley, Sir William Temple, and Sir Leoline Jenkins, being declared ambassadors and mediators; and Nimeguen, which Sir William had proposed, was at length agreed upon by all parties to be the place of treaty. During his stay at the Hague, the prince of Orange, who was fond of the English language, and of the plain English way of eating, constantly dined and supped once or twice a week at his house; and by this familiarity he so much gained the prince's confidence and esteem, that he had a considerable hand in his marriage with the Princess Mary, daughter of James II.

In July 1676 he removed his family to Nimeguen, where he spent the remainder of that year without making any progress in the treaty; and the year following his son was sent over with letters from the lord treasurer, ordering him to return, and succeed Mr Coventry as secretary of state. In consequence of this order, Sir William came over to England in the spring of 1677; and though the affair of the secretary's place was dropped at his desire, he did not return to Nimeguen that year. About this time, the prince having the king's leave to come over, he soon after married the Princess Mary; and this gave occasion for a new coolness between lord Arlington and Sir William, as he and the lord treasurer Osborn, who was related to Sir William's lady, were only privy to that affair. After the prince and princess were gone to Holland, as the court always seemed inclined to favour France, the king wished to engage Sir William in some negotiations with that crown: but he was so ill satisfied with this proposal, that he offered to give up all pretensions to the office of secretary; and desiring the lord treasurer to acquaint his majesty with his intentions, retired to Sheen, in hopes of being taken at his word. Upon a discovery, however, of the French designs not to evacuate the Spanish towns agreed by the treaty to be delivered up, the king commanded him to go upon a third embassy to the states; with whom he concluded a treaty: by which England engaged, in case France refused to evacuate the towns in forty days, to declare war immediately against that nation: but before half that time was elapsed, one Du Cross was sent from the English court to Holland upon a business which damped all the good humour excited by the treaty there, and which produced such sudden and astonishing changes in this country, as gave Sir William a distaste for all public employments.

In 1679 he went back to Nimeguen, where the French delayed to sign the treaty till the last hour; but having concluded it, he returned to the Hague, whence he was soon after sent for to enter upon the secretary's office, which Mr Coventry at length resolved to resign. He accordingly came over, and went to court, as all his friends hoped, with a full intention of assuming his office; but he started some difficulty, because he had not a seat in the house of commons, thinking that, by his not being a member, the public business would suffer at such a critical time, when the contests between the two parties ran so high that the king thought fit to send the duke of York into Flanders, and the parliament to put the lord treasurer Danby into the Tower. After this his majesty still pressed Sir William to be secretary of state; using as an argument for his compliance, that he had nobody to consult with at a time when he had the greatest need of the best advice. Notwithstanding all this, Sir William declined the king's offer, advising him to choose a council in whom he could confide, and upon whose abilities he could depend. This advice the king followed; and the choice of the persons being concerted between his majesty and Sir William, the old council was dissolved four days after, and the new one established, of which the latter was a member.

In 1680 the councils began again to be changed, on the king's illness, at the end of summer, and the duke of York's return privately to court. In this juncture Sir William, endeavouring to bring to the king's favour and business some persons to whom his majesty had taken a dislike, if not an aversion, he met with such treatment from them as gave him a fresh distaste to the court, at which he seldom made his appearance; so that he resided principally at Sheen. Soon after this the king sent for him again; and having proposed that he should go as ambassador into Spain, Sir William consented: but when his equipage was almost ready, and part of the money paid down for it, the king changed his mind, and told him that he would have him defer his journey till the end of the session of parliament, in which he was chosen a member for the university of Cambridge. In this session the spirit of party ran so high that it was impossible to bring the house to any kind of temper. The duke was sent into Scotland; but this would not satisfy them, nor any thing but a bill of exclusion; which Sir William strenuously opposed, saying, that "His endeavour ever should be to unite the royal family, and that he would never enter into any councils to divide them." Not long after this period, the parliament being dissolved by his majesty, without the advice of his privy council, and contrary to what he had promised, Sir William made a bold speech against it; for which he was very ill used by some of those friends who had been most earnest in promoting the last change in the ministry. Upon this he grew quite tired of public business, declined the offer he had of again serving for the university in the next parliament, that was soon after called, and met at Oxford; and seeing his majesty resolved to govern without his parliament, and to supply his treasury through another channel, he retired to Sheen a few days after, whence he sent word by his son, that "he would pass the rest of his days like a good subject, but would never more meddle with public affairs." From that time Sir William lived at this place till the end of that reign and for some time in the next; when having purchased a small seat, called *Moor Park*, near Farnham in Surry, which he conceived a great fondness for on account of its solitude and retirement, and its healthy and pleasant situation, and being much afflicted with the gout, and broken with age and infirmities—he resolved to spend the remainder of his life in this agreeable retreat. In his way thither, therefore, he waited on king James, who was then at Windsor, and begged his favour and protection to one "that would always live as a good subject, but, whatever might happen, never again enter upon any public employment;" desiring his majesty to give no credit to any thing he might hear to the contrary. The king, who used to say that Sir William Temple's character was always to be believed, promised him whatever he desired, gently reproached him for not entering into his service, which, he said, was his own fault; and kept his word as faithfully to Sir William as Sir William did to his majesty, during the surprising turn of affairs that soon after followed by the arrival of the prince of Orange. At the time of this happy revolution, in 1688, Moor-Park becoming unsafe,

Temple. ſafe, as it lay in the way of both armies, he went back to the houſe at Sheen, which he had given up to his ſon; to whom he refuſed leave, though importunately begged, to go and meet the prince of Orange at his landing: but after king James's abdication, when the Prince reached Windſor, he went thither to wait upon his highneſs, and carried his ſon along with him. The prince preſſed him to enter into his ſervice, and to be ſecretary of ſtate; but his age and infirmities confirming him in the reſolution he had made not to meddle any more with public affairs, he was ſatisfied that his ſon alone ſhould enjoy his majeſty's favour. Mr John Temple was upon this appointed ſecretary at war; but he had hardly been a week in that office, when he reſolved to put an end to his own exiſtence; which he did on the 14th of April 1689, by throwing himſelf out of a boat, hired for that purpoſe, in ſhooting London-bridge; having firſt put ſtones into his pocket to make him ſink ſpeedily.

In 1694 Sir William had the misfortune to loſe his lady, who was a very extraordinary woman, as well as an affectionate wife. He was then conſiderably turned of ſixty; at which age he practiſed what he had ſo often declared to be his opinion, that "an old man ought then to conſider himſelf of no farther uſe in the world except to himſelf and his friends." After this he lived four years, very much affected with the gout; and his ſtrength and ſpirits being worn out by the infirmities of age, he expired in the month of January 1698. He died at Moor-Park, where his heart was buried in a ſilver box under the ſun dial in his garden, oppoſite to a window from which he uſed to contemplate and admire the works of nature, with his ſiſter, the ingenious lady Gifford. This was according to his will; in purſuance of which his body was privately interred in Weſtminſter Abbey, and a marble monument erected in 1722, after the death of lady Gifford, who reſembled him in genius as well as in perſon, and left behind her the character of one of the beſt and moſt conſtant friends in the world.

Sir William Temple's principal works are, 1. Memoirs from 1672 to 1692: They are very uſeful for thoſe who wiſh to be acquainted with the affairs of that period. 2. Remarks upon the State of the United Provinces. 3. An Introduction to the Hiſtory of England: This is a Sketch of a General Hiſtory. 4. Letters written during his laſt embaſſies. And. 5. Miſcellanies, which contain a great many curious pieces that diſplay conſiderable depth of thought. He was an accompliſhed gentleman, a ſound politician, a patriot, and a great ſcholar. And if this great idea ſhould perchance be ſhaded by ſome touches of *vanity* and *ſpleen*, the reader will be ſo candid as to conſider, that the greateſt, wiſeſt, and the beſt of men, have ſtill ſome failings and imperfections which are inſeparable from human nature.

Temple, *templum*, a public building, erected in honour of ſome deity, either true or falſe; and wherein the people meet to pay religious worſhip to the ſame. The word is formed from the Latin *templum*, which ſome derive from the Greek τεμενος, ſignifying the ſame thing; and others from τεμνω, *abſcindo*, "I cut off, I ſeparate," in regard a temple is a place ſeparated from common uſes; others with more probability derive it from the old Latin word *templare*, "to contemplate." It is certain the ancient augurs gave the name *templa* to thoſe parts of the heavens which were marked out for the obſervation of the flight of birds. Their formula was this: *Templa teſqua ſunto*. Temples were originally all open, and hence received their name. See Phil. Tranſ. n° 471. ſect. 5. where we have an account of an ancient temple in Ireland of the ſame ſort as our famous Stonehenge. The word *templum*, in its primary ſenſe among the old Romans, ſignified nothing more than a place ſet apart and conſecrated by the augurs, whether incloſed or open, in the city or in the fields. Temple.

Clemens Alexandrinus and Euſebius refer the origin of temples to the ſepulchres built for the dead. This notion has been lately illuſtrated and confirmed by a variety of teſtimonies by Mr Farmer in his Treatiſe on the Worſhip of Human Spirits, p. 373, &c. Herodotus and Strabo will have the Egyptians to have been the firſt who built temples to the gods. The firſt erected in Greece is aſcribed to Deucalion, by Apollonius, Argonaut. lib. iii. In antiquity we meet with many people who would not build any temples to their gods for fear of confining them to too narrow bounds. They performed their ſacrifices in all places indifferently, from a perſuaſion that the whole world is the temple of God, and that he required no other. This was the doctrine of the magi, followed by the Perſians, the Scythians, the Numidians, and many other nations mentioned by Herodotus. lib. i. Strabo, lib. xv. and Cicero in his ſecond oration againſt Verres.

The Perſians, who worſhipped the ſun, believed it would wrong his power to incloſe him in the walls of a temple, who had the whole world for his habitation; and hence, when Xerxes ravaged Greece, the magi exhorted him to deſtroy all the temples he met with.

The Sicyonians would build no temple to their godeſs Coronis; nor the Athenians, for the like reaſon, erect any ſtatue to Clemency, who, they ſaid, was to live in the hearts of men, not within ſtone walls.

The Bithynians had no temples but the mountains to worſhip on; nor had the ancient Germans any other but the woods.

Even ſome philoſophers have blamed the uſe and building of temples, particularly Diogenes, Zeno, and his followers the Stoics. But it may be ſaid, that if God hath no need of temples, men have need of places to meet in for the public offices of religion: accordingly temples may be traced back even into the remoteſt antiquity. See *Hoſpinian de Origine Templorum*.

The Romans had ſeveral kinds of temples; whereof thoſe built by the kings, &c. conſecrated by the augurs, and wherein the exerciſe of religion was regularly performed, were called, by way of eminence, *templa*, "temples." Thoſe that were not conſecrated, were called *ædes*. The little temples, that were covered or roofed, they called *ædiculæ*. Thoſe open, *ſacella*. Some other edifices, conſecrated to particular myſteries of religion, they called *fana* and *delubra*.

All theſe kinds of temples, Vitruvius tells us, had other particular denominations, according to the form and manner of their conſtruction, as will be hereafter ſpecified.

Indeed the Romans outdid all nations with regard to temples: they not only built temples to their gods, to their virtues, to their diſeaſes, &c. but alſo to their emperors, and that in their life time; inſtances whereof we meet with in medals, inſcriptions, and other monuments. Horace compliments Auguſtus hereupon, and ſets him above Hercules and all the heroes of fable; becauſe thoſe were admitted into temples only after their death, whereas Auguſtus had his temples and altars while living.

Præſenti tibi maturos largimur honores;
Jurandaſque tuum per nomen ponimus aras.

Epiſt. ad Aug.

Suetonius, on this occaſion, gives an inſtance of the modeſty of that emperor, who would allow of no *temples* being erected to him in the city; and even in the provinces, where he knew it was uſual to raiſe temples to the very proconſuls, refuſed

Temple. of gods; but those erected in the name of Rome as well as known.

The most celebrated temples among the Romans were the Capitol and Pantheon. They had also the temple of Saturn, which served for the public treasury; and the temple of Janus.

The temple at Jerusalem was similar in its plan to the TABERNACLE. The first temple was begun by Solomon about the year of the world 2992, and before Christ 1012 according to some chronologers, and finished in eight years. Great mistakes have been committed respecting the dimensions of this temple, by confounding the emblematical description of Ezekiel with the plain account of it in the books of Kings and Chronicles. It consisted of the holy of holies, the sanctuary, and a portico. The holy of holies was a square room of 20 cubits; the sanctuary, or holy place, was 40 cubits long and 20 broad, consequently the length of both these together was 60 cubits. The portico, which stood before the sanctuary, was 20 cubits long and 10 cubits broad. Whether the portico was separated by a wall from the rest of the temple or not, is not mentioned in scripture. If it was, the whole length of the temple, computing the cubit at 22 inches, did not exceed 110 feet in length and 36 feet 8 inches in breadth. In the portico stood the two brazen pillars called *Jachin* and *Boaz*, which, upon comparing and reconciling the seemingly different account in different places, appear to have been 40 cubits high and about 4 cubits diameter. The court probably at first extended all round the temple. Now we are told, that the court about the tabernacle was 100 cubits long and 50 broad: and as Solomon made every part of the temple about twice as large as the corresponding part in the tabernacle, we have reason to conclude, that the court around the temple was 200 cubits long and 100 broad. According to this description, which is taken from the scripture history, the temple of Solomon was by no means so large as it is commonly represented. Still, however, it was very magnificent in size and splendid in ornament. It was plundered of its treasures in the reign of Rehoboam, and repaired by Joash; it was again spoiled in the time of Ahaz and of Hezekiah; and after being restored by Josiah, was demolished by Nebuchadnezzar in the year of the world 3416, after it had stood 476 years according to Josephus, and according to Usher 428 years.

The second temple was built by the Jews, after their return from the Babylonish captivity, under the direction and influence of Zerubbabel their governor, and of Joshua the high-priest, with the leave and encouragement of Cyrus the Persian emperor, to whom Judea was now become a tributary kingdom. According to the Jews, this temple was destitute of five remarkable appendages, which were the chief glory of the first temple; viz. the ark and mercy-seat, the Shechinah, the holy fire on the altar, which had been first kindled from heaven, the urim and thummim, and the spirit of prophecy. This temple was plundered and profaned by Antiochus Epiphanes, who also caused the public worship in it to cease; and afterwards purified by Judas Maccabæus, who restored the divine worship; and after having stood five hundred years, rebuilt by Herod, with a magnificence approaching to that of Solomon's. Tacitus calls it *immensæ opulentiæ templum;* and Josephus says, it was the most astonishing structure he had ever seen, as well on account of its architecture as its magnitude, and likewise the richness and magnificence of its various parts and the preparation of its sacred appurtenances. This temple, which Herod began to build about sixteen years before the birth of Christ, and so far completed in nine years and a half as to be fit for divine service, was at length destroyed by the Romans on the same month and day of the month on which Solomon's temple was destroyed by the Babylonians.

The Indian temples, or pagodas, are sometimes of a prodigious size. They are commonly erected near the banks of the Ganges, Kistna, or other sacred rivers, for the benefit of ablution in the purifying stream. Where no river flows near the foot of the pagoda, there is invariably in the front of it a large tank or reservoir of water. These are, for the most part, of a quadrangular form, are lined with freestone or marble, have steps regularly descending from the margin to the bottom, and Mr Crauford observed many between three and four hundred feet in breadth. At the entrance of all the more considerable pagodas there is a portico, supported by rows of lofty columns, and ascended by a handsome flight of stone steps; sometimes, as in the instance of Tripetti*, to the number of more than a hundred. Under this portico, and in the courts that generally inclose the whole building, an innumerable multitude assemble at the rising of the sun; and, having bathed in the stream below, and, in conformity to an immemorial custom over all the East, having left their sandals on the border of the tank, impatiently await the unfolding of the gates by the ministring brahmin. The gate of the pagoda universally fronts the east, to admit the ray of the solar orb; and, opening, presents to the view an edifice partitioned out, according to M. Thevenot in his account of Chitanagar, in the manner of the ancient cave-temples of Elora, having a central nave or body; a gallery ranging on each side; and, at the farther end, a sanctuary, or chapel of the deity adored, surrounded by a stone balustrade to keep off the populace. Those who wish to peruse a more particular account of the Indian temples may consult Maurice's Indian Antiquities. See also PAGODA and SERINGHAM.

Maurice's Indian Antiquities, vol. iii p. 352.

Crauford's Sketches, vol. i. p. 106.

* Voyage des Indes, tom. ii.

TEMPLE, in architecture. The ancient temples were distinguished, with regard to their construction, into various kinds; as, *Temple in antis*, *Ædes in antis*. These, according to Vitruvius, were the most simple of all temples, having only angular pilasters, called *antæ* or *parastatæ*, at the corners, and two Tuscan columns on each side of the doors. *Temple, tetrastyle*, or simple *tetrastyle*, was a temple that had four columns in front and as many behind. Such was the temple of Fortuna Virilis at Rome. *Temple, prostyle*, that which had only columns in its front or fore side; as that of Ceres at Eleusis in Greece. *Temple, amphiprostyle*, or *double prostyle*, that which had columns both before and behind, and which was also tetrastyle. *Temple, periptere*, that which had four rows of insulated columns around, and was exastyle, *i. e.* had six columns in front; as the temple of Honour at Rome. *Temple, diptere*, that which had two wings and two rows of columns around, and was also octostyle, or had eight columns in front; as that of Diana at Ephesus.

TEMPLES, among us, denote two inns of court in London, thus called, because anciently the dwelling-house of the knights-templars. At the suppression of that order, they were purchased by the professors of the common law, and converted into *hospitia* or inns. They are called the *inner* and *middle temple*, in relation to Essex-house; which was also a part of the house of the templars, and called the *outer temple*, because situated without Temple-Bar. In the middle temple, during the time of the templars, the king's treasure was kept; as was also that of the kings of France in the house templars at Paris. The chief officer was the master of the temple, who was summoned to parliament in 47 Hen. III. and from him the chief minister of the temple church is still called *master of the temple*.

TEMPLES, in anatomy, a double part of the head, reaching from the forehead and eyes to the two ears. The temples are chiefly formed of two bones called *offa temporis*. These

These parts, according to physicians, were called *tempora*, from their showing the age or time of a man by the colour of the hair, which turns white in this part before any other; which Homer seems to have been aware of, by his calling men *poliocrotaphi*, *q. d.* "grey-templed."

TEMPORAL, a term generally used for secular, as a distinction from ecclesiastical. Thus we say temporal lords, and spiritual or ecclesiastical lords.

TEMPORALTIES *of Bishops*, are the revenues, lands, tenements, and lay-fees, belonging to bishops, as they are barons and lords of parliament.

The custody of the temporalties of bishops forms a branch of the king's ordinary revenues (see REVENUE.).—These, upon the vacancy of the bishopric, are immediately the right of the king, as a consequence of his prerogative in church matters; whereby he is considered as the founder of all archbishoprics and bishoprics, to whom, during the vacancy, they revert. And for the same reason, before the dissolution of abbeys, the king had the custody of the temporalties of all such abbeys and priories as were of royal foundation (but not of those founded by subjects), on the death of the abbot or prior. Another reason may also be given why the policy of the law hath vested this custody in the king; because, as the successor is not known, the lands and possessions of the see would be liable to spoil and devastation if no one had a property therein. Therefore the law has given the king, not the temporalties themselves, but the custody of the temporalties, till such time as a successor is appointed; with power of taking to himself all the intermediate profits, without giving any account to the successor; and with the right of presenting (which the crown very frequently exercises) to such benefices and other preferments as fall within the time of vacation. This revenue is of so high a nature, that it could not be granted out to a subject, before or even after it accrued: but now, by the statute 15 Edw. III. st. 4. c. 4 & 5. the king may, after the vacancy, lease the temporalties to the dean and chapter; saving to himself all advowsons, escheats, and the like. Our ancient kings, and particularly William Rufus, were not only remarkable for keeping the bishoprics a long time vacant, for the sake of enjoying the temporalties, but also committed horrible wastes on the woods and other parts of the estate; and to crown all, would never, when the see was filled up, restore to the bishop his temporalties again, unless he purchased them at an exorbitant price. To remedy which, king Hen. I. granted a charter at the beginning of his reign, promising neither to sell, nor let to farm, or take any thing from, the domains of the church, till the successor was installed. And it was made one of the articles of the great charter, that no waste should be committed in the temporalties of bishoprics, neither should the custody of them be sold. The same is ordained by the statute of Westminster the first; and the statute 14 Edw. III. stat. 4. c. 4. (which permits a lease to the dean and chapter) is still more explicit in prohibiting the other exactions. It was also a frequent abuse, that the king would, for trifling or no causes, seize the temporalties of bishops, even during their lives, into his own hands: but this is guarded against by statute 1 Edw. III. st. 2. c. 2

Black. Comment. ... i.

This revenue of the king, which was formerly very considerable, is now by a customary indulgence almost reduced to nothing: for, at present, as soon as the new bishop is consecrated and confirmed, he usually receives the restitution of his temporalties quite entire and untouched from the king; and then, and not sooner, he has a fee-simple in his bishopric, and may maintain an action for the profits.

TENACITY, in natural philosophy, that quality of bodies by which they sustain a considerable pressure or force of any kind without breaking. It is the quality opposite to fragility or brittleness. See *Strength of Materials*.

TENACULUM, in surgery, an instrument used in amputation, for pulling out bleeding vessels that are to be tied by ligatures. See SURGERY.

TENAILLES and TENAILLIONS. } See FORTIFICATION, Sect. I. § 3 and 5.

TENANT, one that holds lands or tenements of some lord or landlord, by rent, fealty, &c. See TENURE.

TENAWWIT. See LOXIA, species 13.

TENCH, in ichthyology. See CYPRINUS, species 3.

TENDER, a small ship in the service of men of war, for carrying men, provisions, or any thing else that is necessary.

TENDONS, in anatomy, are white, firm, and tenacious parts, contiguous to the muscles, and usually forming their extremities. See ANATOMY, n° 85.

TENEBRIO, in natural history, a genus of insects belonging to the order of *Coleoptera*. The antennæ are moniliform, the last joint being roundish; the thorax is plano-convex and marginated; the head projecting, and the elytra are somewhat stiff. Gmelin enumerates about 63 species. The larvæ of some live in damp places under ground among rubbish; of others in flour and different kinds of food, where they undergo their metamorphosis. The perfect insects are very troublesome in houses; eating bread, meat, &c. They precipitately avoid the light; resorting in troops to dark damp cellars, where putrefaction allures and nourishes them. They are all of a very dark gloomy appearance, from which circumstance they take their name.

TENEDOS (anc. geog.), an island on the coast of Troas, at the distance of 40 stadia from the continent, and 80 in compass; with a cognominal Æolian town, and a temple of Apollo Smintheus. Its origin is derived from Tennes or Tenes, who being exposed in a coffer or bog by his father Cygnus the Thracian, at the instigation of the mother-in-law, was by fate carried to this island, made king of it, and at length worshipped as a god on account of his virtues. The island was famous for its earthen ware, for which purpose it had an excellent red clay; and hence Bochart would derive the appellation from *tinedom*, a "red clay." *Tenedia securis*, is a proverbial saying to denote severity; from a law there passed, that persons found in the act of adultery should be put to death; a severity executed on the king's son; and therefore, in the coins of Tenedos, on one are two heads in memorial of the king and his son, and on the reverse an axe, (Aristotle). This island still retains its ancient name: and is one of the smallest islands of the Archipelago, situated near the coast of Lesser Asia, west of the ruins of Troy. It is chiefly rocky, but fertile, being remarkable for producing the best Muscodine wine in the Levant: and its position, thus near the mouth of the Hellespont, has given it importance in all ages; vessels bound toward Constantinople finding shelter in its port, or safe anchorage in the road, during the Etesian or contrary winds, and in foul weather. The emperor Justinian erected a magazine to receive the cargoes of the corn-ships from Alexandria, when detained there. This was a lofty building, two hundred and eighty feet long and ninety broad. The voyage from Egypt was rendered less precarious, and the grain preserved until it could be transported to the capital. Afterwards, during the troubles of the Greek empire, Tenedos experienced a variety of fortune. The pirates, who infested these seas, made it for many years their place of rendezvous: and Othman seized it in 1302, procured vessels, and thence subdued the other islands of the Archipelago. It has continued in the possession of the Turks ever since:

and on the eastern side is a pretty large town, seated at the foot of a mountain, with a fine harbour commanded by a castle. E. Long. 27. 0. N. Lat. 29. 30.

TENERIFF, an island of Africa, and one of the Canaries, being the most considerable for riches, trade, and extent. It lies to the south of the island of Salvages, to the west of the Grand Canary, to the north of the island of Gomera, and to the east of that of Palma. It is of a triangular form, being about 45 miles in length and 20 in breadth; and in the centre is the famous *peak*, called by the natives *El Pico de Teyde*, which in clear weather may be seen at the distance of 120 miles, like a thin blue vapour very little darker than the sky.

The most frequented harbour is called *Santa Cruz*, which is on the south side of the island, and where ships with good anchors and cables may be safe in all weathers. At this port is the principal commercial town in the island, called also *Santa Cruz*, in the middle of which is a mole, built at a vast expence for the convenience of landing; between the mole and the town is a fort called *St Philips*, and near it is a steep rocky den or valley, beginning at the sea shore, and running far in land, which would render the attack of an enemy very difficult; there are also other forts for its defence, all joined together by a thick stone wall, and mounted with cannon.

Glas's History of the Canary Islands. Santa Cruz is a large town, containing several churches and convents, an hospital, and the best constructed private buildings of any in the Canary islands. It contains about 7000 inhabitants; it is not fortified on the land side, and all the country near it is dry, stony, and barren.

About four leagues to the south of Santa Cruz, close to the sea, there is a cave, with a chapel called the *chapel of our Lady of Candelaria*, in which is an image of the Virgin Mary, that is held in as much reverence here as that of Diana was at Ephesus. This chapel is endowed with so many ornaments that it is the richest place in all the seven islands. At a certain season of the year almost all the inhabitants go thither on pilgrimage, and innumerable and incredible stories are related and universally believed concerning this image.

About four miles in land from Santa Cruz stands the city of St Chrystobal de la Laguna, which is the metropolis of the island, and contains two parish churches and five convents, but has no trade, being inhabited principally by the gentry of the island; the inhabitants are numerous, yet nobody is seen in the streets, which are solitary and desolate, so that grass grows in those that are most frequented. There are many other towns in the island which contain a great number of people, but none are more than three leagues from the sea.

All the fertile ground within a league of the sea is covered with vines; that of the next league is sown with corn, the third is adorned with woods, and above the woods are the clouds, for the island gradually ascends fom the sea, rising on all sides till it terminates in the peak, which is the centre.

On the south-east of the island inland from *Candelaria* is a town called *Guimar*, where there are some families which know themselves to be the genuine unmixed offspring of the original natives; but they know nothing of the manners of their ancestors, nor have they preserved any remains of their language. They are fairer than the Spaniards of Andalusia.

Teneriff contains about 96,000 persons, supposed to be equal to the number of inhabitants of all the rest of the seven islands put together. The peasants in general are wretchedly clothed; when they do appear better, they are habited in the Spanish fashion. The men, in a genteeler line, dress very gayly, and are seldom seen without long swords. It is remarked, that few of them walk with dignity and ease; which may be attributed to the long cloaks they usually wear. The women wear veils: those worn by the lower ranks are of black stuff, those of the higher of black silk; and such among the latter as have any claim to beauty are far from being over careful in concealing their faces by them. The young ladies wear their fine long black hair plaited, and fastened with a comb or a riband on the top of the head. White's Voyage to New South Wales, 1788.

The common people, and in this they resemble the inhabitants of most of the islands in the Pacific Ocean lately discovered, have in them a strong tendency to thieving; they are besides lazy, and the most importunate beggars in the world. "I observed likewise (says Mr White) that the itch was so common among them, and had attained such a degree of virulence, that one would almost be led to believe it was epidemic there. Some of the women are so abandoned and shameless, that it would be doing an injustice to the prostitutes met with in the streets of London to say they are like them. The females of every degree are said to be of an amorous constitution, and addicted to intrigue; for which no houses could be better adapted than those in Teneriff.

"The manufactures carried on here are very few, and the product of them little more than sufficient for their own consumption. They consist of taffeties, gauze, coarse linens, blankets, a little silk, and curious garters. The principal dependence of the inhabitants is on their wine (their staple commodity), oil, corn, and every kind of stock for shipping. With these the island abounds: and, in their season, produces not only the tropical fruits, but the vegetable productions of the European gardens, in the greatest plenty. Teneriff enjoys an agreeable and healthful mediocrity of climate. Indeed none seems better adapted for the restoration of a valetudinarian; as, by going into the mountains, he may graduate the air, and choose that state of it which best suits his complaint. But although the inhabitants are thus healthy, and have so little occasion for medical aid, they loudly complain of the want of knowledge in the professional gentlemen of the island."

The height of the peak of Teneriff has been so variously estimated and calculated by different travellers and geographers, that we can only take the mean between the two extremes of their decisions. Dr Halley allows but two miles and a quarter from the level of the sea to the summit of the sugar-loaf, whilst the Spanish account of the Canary islands, translated by Mr Glas in 1763, makes it no less than five miles; and others have assigned a height different from both these. That it is an extinguished volcano is universally known; and we are persuaded that the following account of the crater, and of some experiments made on its brink by M. Mongez on the 24th of August 1785, will prove not unacceptable to our chemical readers. Rye's excursion to the Peak of Teneriff.

"The crater of the peak of Teneriff (says he) is a true sulphur-pit, similar to those of Italy. It is about 50 fathoms long and 40 broad, rising abruptly from east to west. At the edges of the crater, particularly on the under side, are many spiracles, or natural chimneys, from which there exhale aqueous vapours and sulphureous acids, which are so hot as to make the thermometer rise from 9° to 34° of Reaumur. The inside of the crater is covered with yellow, red, or white, argillaceous earth, and blocks of lava partly decomposed. Under these blocks are found superb crystals of sulphur; these are eight-sided rhomboidal crystals, sometimes an inch in length, and, I suppose, they are the finest crystals of volcanic sulphur that have ever been found. The water that exhales from the spiracles is perfectly pure, and not in the least acid, as I was convinced by several experiments. Journ. de Physique.

"The

Teneriff. "The elevation of the peak above the level of the sea is near 1900 toifes; which induced me to make feveral chemical experiments in order to compare the phenomena with thofe that occur in our laboratories. I fhall here confine myfelf merely to the refults.

"The volatilization and cooling of liquors were here very confiderable. Half a minute was fufficient for the diffipation of a pretty ftrong dofe of æther. The action of acids on metals, earths, and alkalis, was flow; and the bubbles which efcaped during the effervefcence were much larger than ordinary. The production of vitriols was attended with very fingular phenomena. That of iron affumed all at once a very beautiful violet colour, and that of copper was fuddenly precipitated of a very bright blue colour. I examined the moifture of the air by means of the hygrometer, of pure alkali, and of vitriolic acid; and I thence concluded, as well as from the direction of the aqueous vapours, that the air was very dry; for at the end of three hours the vitriolic acid had fuffered hardly any change either in colour or weight; the fixed alkali remained dry, except near the edges of the veffel that contained it, where it was a little moift; and Sauffure's hygrometer pointed to 64°, as nearly as the impetuous wind which then blew would permit us to judge.

"Liquors appeared to us to have loft nothing of their fmell or ftrength at this height; a circumftance which contradicts all the tales that have hitherto been related on this head: volatile alkali, ether, fpirit of wine, retained all their ftrength; the fmoking fpirit of Boyle was the only one that feemed to have loft any fenfible portion of its energy. Its evaporation, however, was not the lefs quick; in 30 feconds, a quantity which I had poured into a cup was entirely volatilized; and nothing remained but the fulphur which tinged the rims and the bottom. When I poured the vitriolic acid on this liquor, there happened a violent detonation, and the vapours that arofe had a very fenfible degree of heat. I tried to form volatile alkali by decompofing fal ammoniac with the fixed alkali; but the production was flow and hardly fenfible, while at the level of the fea this procefs, made with the fame fubftances, in the fame proportions, fucceeded very readily and in abundance.

"As I was curious to inveftigate the nature of the vapours that exhale from the crater, and to know whether they contained inflammable air, fixed air, and marine acid, I made the following experiments: I expofed on the edge of one of the fpiracles a nitrous folution of filver in a cup; it remained more than an hour in the midft of the vapours which were continually exhaling, but without any fenfible alteration; which fufficiently fhews that no vapours of marine acid exhale from the crater. I then poured into it fome drops of marine acid, when a precipitation of luna cornea immediately enfued: but inftead of being white, as that precipitate generally is, it was of a fine dark violet colour, which quickly became grey, and it affumed the form of fmall fcaly cryftals. Thefe were very diftinct when looked at with a glafs, and they were even vifible to the naked eye. I think myfelf juftifiable in attributing this alteration of colour to the vapours of inflammable air, according to fome experiments that I have made on the precipitation of luna cornea in fuch air. Lime-water, expofed for three hours on the margin of the crater, and in the neighbourhood of a fpiracle, was not covered with any calcareous pellicle, nor even hardly with any filmy appearance; which proves, in my opinion, not only that no vapours of fixed air exhale from the crater, but that the atmofpheric air, which refts upon it, contains very little of that air, and that the inflammable vapours and fulphureous acids alone are fenfible and confiderable. The electricity of the atmofphere was pretty confiderable, for Sauffure's electrometer, when held in the hand at the height of about five feet, indicated three degrees, while on the ground it pointed only to one and a half. The electricity was pofitive." W. Long. 16. 18. N. Lat. 28. 29.

Tenefmus || Tenifon.

TENESMUS, in medicine, a name given by medical writers to a complaint which is a continual defire of going to ftool, but without any ftool being ready to be voided. This is properly no primary difeafe, but merely a fymptomatic one, and differs in degree according to the difeafe on which it is an attendant. See MEDICINE, n° 111.

TENIERS (David), the Elder, a Flemifh painter, born at Antwerp in 1582. He received the firft rudiments of his art from the famous Rubens, who highly efteemed him for his promifing genius, and with great fatisfaction examined and commended his defigns. From the fchool of that celebrated painter Teniers went to finifh his ftudies at Rome. He attached himfelf to Adam Elfheimer for fix years; and from the inftructions of two fuch incomparable mafters, he formed to himfelf a peculiar ftyle, which his fon cultivated fo happily afterward as to bring it to the utmoft perfection. His pictures were fmall; and his fubjects ufually fhops elaboratories, humorous converfations, and rural feftivities. The demand for his pieces was univerfal; and even his mafter Rubens thought them an ornament to his cabinet. He died at Antwerp in 1649.

TENIERS (David) the Younger, alfo an admirable painter, was the fon of the former, and was born at Antwerp in 1610. He obtained the name of *Ape of Painting*, from his imitating the manner of different painters with fuch exactnefs as to deceive even the niceft judges. He improved greatly under his father, and obtained fuch reputation as introduced him to the favour of the great. The archduke Leopold William made him gentleman of his bed-chamber; and all the pictures of his gallery were copied by Teniers, and engraved by his direction. The king of Spain and Don Juan of Auftria fet fo high a value on his pictures, that they built a gallery on purpofe for them. William prince of Orange honoured him with his friendfhip; and Rubens not only efteemed his works, but affifted him with his advice. His principal talent lay in landfcapes adorned with fmall figures. He alfo painted men drinking and fmoking, chemifts elaboratories, country fairs, and the like. His fmall figures are fuperior to his large ones. He died in 1694.

The works of the father and fon are thus diftinguifhed: The latter difcover a finer touch and frefher pencil, greater variety of attitudes, and a better difpofition of the figures. The father retained fomething of the tone of Italy in his colouring, which was ftronger than the fon's; befides, the fon ufed to put at the bottom of his pictures, David Teniers, junior.

Abraham, another fon of David the Elder, was equal, if not fuperior, to his father and brother in the expreffion of his characters, and his underftanding the *claro obfcuro*; though he was inferior in the fprightlinefs of his touch, and the lightnefs of his pencil.

TENISON (Dr Thomas), archbifhop of Canterbury, was born at Cottenham in Cambridgefhire in 1636: and ftudied at Corpus Chrifti college in Cambridge. In his youth, while the fanatical government lafted, he applied himfelf to phyfic; but afterward went into orders, and was fome time minifter of St Andrew's church, Cambridge; where he attended the fick during the plague in 1665, which his parifhioners acknowledged by the prefent of a piece of plate. He fhowed himfelf very active againft the growth of Popery by his writings both in king Charles and king James's reigns: in 1680 he was prefented to the vicarage of St Martin's in the Fields, London, to which parifh he made feveral donations: and among others, endowed

Tennis. a free school, and built a handsome library, which he furnished with useful books. King William and queen Mary, in 1689, presented him to the archdeaconry of London; in 1691, he was nominated to the see of Lincoln, and in 1694 he succeeded Dr Tillotson as archbishop of Canterbury. He performed all the duties of a good primate for 20 years, and died in 1715.

TENNIS, a play at which a ball is driven by a racket.

As many persons would become players at tennis, provided they could easily understand the rudiments of the game, so as to form a just judgment of the players, or at least to know who wins and who loses, we have here attempted to give so plain a description of it, that no one can be at a loss, if ever he should bet or play. As to the executive part, it requires great practice to make a good player, so that nothing can be done without it; all we presume to do is to give an insight into the game, whereby a person may not seem a total stranger to it when he happens to be in a tennis court.

The game of tennis is played in most capital cities in Europe, particularly in France, from whence we may venture to derive its origin. It is esteemed with many to be one of the most ancient games in Christendom, and long before king Charles I.'s time it was played in England.

This game is as intricate as any game whatever; a person who is totally ignorant of it may look on for a month together, without being able to make out how the game is decided. Therefore we shall begin by describing the court in which it is played.

The size of a tennis court is generally about 96 or 97 feet by 33 or 34, there being no exact dimension ascribed to its proportion, a foot more or less in length or width being of no consequence. A line or net hangs exactly across the middle, over which the ball must be struck, either with a racket or board to make the stroke good. Upon the entrance of a tennis court, there is a long gallery which goes to the dedans, that is, a kind of front gallery, where spectators usually stand, into which, whenever a ball is struck, it tells for a certain stroke. This long gallery is divided into different compartiments or galleries, each of which has its particular name, as follows; from the line towards the dedans are the *first gallery*, *door*, *second gallery*, and the *last gallery*, which is called the *service side*. From the dedans to the last gallery are the figures 1, 2, 3, 4, 5, 6, at a yard distance each, by which the chaces are marked, and is one of the most essential parts of the game, as will appear in the following description.

On the other side of the line are also the *first gallery*, *door*, *second gallery*, and *last gallery*; which is called the *hazard-side*. Every ball struck into the last gallery on this side reckons for a certain stroke the same as the dedans. Between the second and this last gallery are the figures 1, 2, to mark the chaces on the hazard-side. Over this long gallery, or these compartiments, is a covering, called the penthouse, on which they play the ball from the service-side, in order to begin a set of tennis, from which it is called a *service*. When they miss putting the ball (so as to rebound from the pent-house) over a certain line on the service-side, it is deemed a fault, two of which are reckoned for a stroke. If the ball rolls round the pent house, on the opposite side of the court, so as to fall beyond a certain line described for that purpose, it is called *passe*, reckons for nothing on either side, and the player must serve again.

On the right hand side of the court from the dedans is what they call the *tambour*, a part of the wall which projects, and is so contrived in order to make a variety in the stroke, and render it more difficult to be returned by the adversary; for when a ball strikes the *tambour*, it varies its direction, and requires some extraordinary judgment to return it over the line. The last thing on the right hand side is called the *grill*, wherein if the ball is struck, it is also 15, or a certain stroke.

The game of tennis is played by what they call *sets*; a set of tennis consists of six games: but if they play what is called an advantage-set, two above five games must be won on one side or the other successively, in order to decide; or, if it comes to six games all, two games must still be won on one side to conclude the set; so that an advantage-set may last a considerable time; for which kind of sets the court is paid more than for any other.

We must now describe the use of the chaces, and by what means these chaces decide or interfere so much in the game. When the player gives his service at the beginning of a set, his adversary is supposed to return the ball; and wherever it falls after the first rebound untouched, the chace is called accordingly; for example, if the ball falls at the figure 1, the chace is called at a yard, that is to say, at a yard from the dedans: this chace remains till a second service is given; and if the player on the service side lets the ball go after his adversary returns it, and if the ball falls on or between any of these figures or chaces, they must change sides, there being two chaces; and he who then will be on the hazard side, must play to win the first chace; which if he wins by striking the ball so as to fall, after its first rebound, nearer to the dedans than the figure 1, without his adversary's being able to return it from its first hop, he wins a stroke, and then proceeds in like manner to win the second chace, wherever it should happen to be. If a ball falls on the line with the first gallery door, second gallery, or last gallery, the chace is likewise called at such or such a place, naming the gallery, door, &c. When it is just put over the line, it is called a chace at the line. If the player on the service-side returns a ball with such force as to strike the wall on the hazard-side so as to rebound, after the first hop over the line, it is also called a chace at the line.

The chaces on the hazard-side proceed from the ball being returned either too hard or not quite hard enough; so that the ball after its first rebound falls on this side of the blue line, or line which describes the hazard-side chaces; in which case it is a chace at 1, 2, &c. provided there is no chace depending. When they change sides, the player, in order to win this chace, must put the ball over the line anywhere, so that his adversary does not return it. When there is no chace on the hazard-side, all balls put over the line from the service side, without being returned, reckon for a stroke.

As the game depends chiefly upon the marking, it will be necessary to explain it, and to recommend those who play at tennis to have a good and unbiassed marker, for on him the whole set may depend: he can mark in favour of the one and against the other in such a manner, as will render it two to one at starting, though even players. Instead of which the marker should be very attentive to the chaces, and not be anyway partial to either of the players.

This game is marked in a very singular manner, which makes it at first somewhat difficult to understand. The first stroke is called 15, the second 30, the third 40, and the fourth game, unless the players get four strokes each: in that case, instead of calling it 40 all, it is called *deuce*; after which, as soon as any stroke is got, it is called *advantage*; and in case the strokes become equal again, *deuce* again, till one or the other gets two strokes following, which win the game; and as the games are won, so they are marked and called; as one game love, two games to one, &c. towards the set, of which so many of these games it consists.

Although but one ball at a time is played with, a number of balls are made use of at this game to avoid trouble, and are handed to the players in baskets for that purpose: by

nnis. which means they can play as long as they pleaſe, without ever having occaſion to ſtoop for a ball.

As to the odds at tennis, they are by no means fixed, but are generally laid as follow:

Upon the firſt ſtroke being won between even players, that is, fifteen love, the odds are of the ſingle

game	7 to	4
Thirty love	4	1
Forty love	8	1
Thirty fifteen	2	1
Forty fifteen	5	1
Forty thirty	3	1
The odds of a four game ſet when the first game is won, are	7	4
When two games love	4	1
Three games love	8 to	1
When two games to one	2	1
Three games to one	5	1
The odds of a ſix game ſet when the firſt game is won, are	3	2
When two games love	2	1
Three games love	4	1
Four games love	10	1
Five games love	21	1
When two games to one	8	5
Three games to one	5	2
Four games to one	5	1
Five games to one	15	1
When three games to two	7	4
Four games to two	4	1
Five games to two	10	1
When four games to three	2	1
Five games to three	5	1
The odds of an advantage ſet when the firſt game is won, are	5	4
When two games love	7	4
Three games love	3	1
Four games love	5	1
Five games love	15	1
When two games to one	4	3
Three games to one	2	1
Four games to one	7	2
Five games to one	10	1
When three games to two	3	2
Four games to two	3	1
Five games to two	8	1
When four games to three	8	5
Five games to three	3	1
When five games to four	2	1
When ſix games to five	5	2

The foregoing odds, as beforeſaid, are generally laid, but the chaces interfering makes the odds very precarious; for example, when there is a chace at half a yard, and a ſet is five games all, and in every other reſpect equal, the odds are a good five to four; and if it were ſix games to five, and forty thirty with the ſame chace, the odds then would be a guinea to a ſhilling; ſo that it is plain that the odds at this game differ from thoſe of any other: for one ſtroke will reduce a ſet, ſuppoſing the players to be five games all, from an even wager to three to two, and ſo on in proportion to the ſtage of the ſet.

There are various methods of giving odds at tennis, in order to make a match equal; and that they may be underſtood, we ſhall give the following liſt of them, with their meanings, ſo that any perſon may form a judgment of the advantage received or given.

The loweſt odds that can be given, excepting the choice of the ſides, is what they call a *biſque*, that is, a ſtroke to be taken or ſcored whenever the player, who receives the advantage, thinks proper: for inſtance, ſuppoſe a critical game of the ſet to be forty thirty, by taking the *biſque*, he who is forty becomes game, and ſo in reſpect of two *biſques*, &c. Tennis, Tent.

The next greater odds are *fifteen*, that is, a certain ſtroke given at the beginning of each game.

After theſe, *half thirty*, that is, fifteen one game, and thirty the next. Then follow the whole *thirty*, *forty*, &c,

There are alſo the following kind of odds which are given, viz.

Round ſervices; theſe are ſervices given round the penthouſe, ſo as to render it eaſy for the *ſtriker out* (the player who is on the hazard ſide) to return the ball.

Half court, that is, being obliged or confined to play into the adverſary's half-court; ſometimes it is played ſtraightwiſe, and at other times acroſs; both which are great advantages given by him ſo confined, but the ſtrait half-court is the greateſt.

Touch-no-wall, that is, being obliged to play within the compaſs of the walls, or ſides of the court. This is a conſiderable advantage to him who receives it; as all the balls muſt be played gently, and conſequently they are much eaſier to take than thoſe which are played hard, or according to the uſual method of play.

Barring the hazards, that is, barring the dedans, tambour, grill, or the laſt gallery on the hazard-ſide, or any particular one or more of them.

Theſe are the common kind of odds or advantages given; but there are many others, which are according to what is agreed by the players: ſuch as playing with *board* againſt *racket*, *cricket-bat* againſt *racket*, &c.

The game of tennis is alſo played by four perſons, two partners on each ſide. In this caſe, they are generally confined to their particular quarters, and one of each ſide appointed to ſerve and ſtrike out; in every other reſpect, the game is played in the ſame manner as when two only play.

Any thing more to be ſaid upon this ſubject would be needleſs, as nothing can be recommended, after reading this ſhort account of tennis, but practice and attention, without which no one can become a proficient at the game.

TENOR, or TENOUR, the purport or content of a writing or inſtrument in law, &c.

TENOR, in muſic, the firſt mean, or middle part, or that which is the ordinary pitch of the voice, when neither raiſed to a treble nor lowered to a baſs.

TENSE, in grammar, an inflection of verbs, whereby they are made to ſignify or diſtinguiſh the circumſtance of time in what they affirm. See GRAMMAR.

TENT, in war, a pavilion or portable houſe. Tents are made of canvaſs, for officers and ſoldiers to lie under when in the field. The ſize of the officers tents is not fixed; ſome regiments have them of one ſize and ſome of another: a captain's tent and marquee is generally $10\frac{1}{2}$ feet broad, 14 deep, and 8 high: the ſubalterns are a foot leſs; the major's and lieutenant colonel's a foot larger; and the colonel's two feet larger. The ſubalterns of foot lie two in a tent, and thoſe of horſe but one. The tents of private men are $6\frac{1}{2}$ feet ſquare, and 5 feet high, and hold five ſoldiers each. The tents for horſe are 7 feet broad and 9 feet deep: they hold likwiſe five men and their horſe accoutrements. — The word is formed from the Latin *tentorium*, of *tendo* "I ſtretch," becauſe tents are uſually made of canvaſs ſtretched out, and ſuſtained by poles, with cords and pegs.

TENT, in ſurgery, a roll of lint made into the ſhape of a nail with a broad flat head, chiefly uſed in deep wounds and ulcers. They are of ſervice, not only in conveying medicines to the moſt intimate receſſes and ſinuſes of the wound, but to prevent the lips of the wound from uniting before it

is

is healed from the bottom; and by their assistance grumous blood, matter, &c. are readily evacuated.

TENTER, Teize, or Tenter, a machine used in the cloth manufactory, to stretch out the pieces of cloth, stuff, &c. or only to make them even and set them square.

It is usually about 4½ feet high, and for length exceeds that of the longest piece of cloth. It consists of several long square pieces of wood, placed like those which form the barriers of a manege; so, however, as that the lower cross pieces of wood may be raised or lowered as is found requisite, to be fixed at any height by means of pins. Along the cross pieces, both the upper and under one, are hooked nails, called *tenter hooks*, driven in from space to space.

To put a piece of Cloth on the TENTER. While the piece is yet quite wet, one end is fastened to one of the ends of the tenter; then it is pulled by force of arms towards the other end, to bring it to the length required: that other end being fastened, the upper list is hooked on to the upper cross-piece, and the lower list to the lowest cross-piece, which is afterwards lowered by force, till the piece have its desired breadth. Being thus well stretched, both as to length and breadth, they brush it with a stiff hair brush, and then let it dry. Then they take it off; and, till they wet it again, it will retain the length and breadth the tenter gave it.

TENTHREDO, the SAW-FLY; a genus of insects belonging to the order of *hymenoptera*. The mouth is furnished with jaws, which are horny, arched, dentated within; the right jaw being obtuse at the apex: the lip cylindrical, trifid: there are four feelers, unequal and filiform: the wings are plain and turned: the sting consists of two serrated laminæ, and the scutellum of two grains placed at a distance. Gmelin mentions 143 species. These insects are not very shy. Some, by means of their saw, deposit in the buds of flowers, others on the twigs of trees or shrubs, eggs from which are produced caterpillars. The implement with which they are armed is nowise formidable; as it appears only destined to the purpose of depositing their eggs.

TENTHS, and FIRST FRUITS *of Spiritual Preferments*, a branch of the king's revenue. See REVENUE.

These were originally a part of the Papal usurpations over the clergy of this kingdom; first introduced by Pandulph the pope's legate, during the reigns of king John and Henry III. in the see of Norwich; and afterwards attempted to be made universal by the popes Clement V. and John XXII. about the beginning of the 14th century. The first fruits, *primitiæ* or *annates*, were the first year's whole profits of the spiritual preferment, according to a rate or *valor* made under the direction of pope Innocent IV. by Walter bishop of Norwich in 38 Hen. III. and afterwards advanced in value by commission from pope Nicholas III. A. D. 1292, 20 Edw. I.; which valuation of pope Nicholas is still preserved in the exchequer. The tenths, or *decimæ*, were the tenth part of the annual profit of each living by the same valuation; which was also claimed by the holy see, under no better pretence than a strange misapplication of that precept of the Levitical law, which directs, that the Levites "should offer the tenth part of their tithes as a heave-offering to the Lord, and give it to Aaron the high-priest." But this claim of the pope met with vigorous resistance from the English parliament; and a variety of acts were passed to prevent and restrain it, particularly the statute 6 Hen. IV. c. 1. which calls it a *horrible mischief and damnable custom*. But the Popish clergy, blindly devoted to the will of a foreign master, still kept it on foot; sometimes more secretly, sometimes more openly and avowedly: so that in the reign of Henry VIII. it was computed, that in the compass of 50 years 800,000 ducats had been sent to Rome for first fruits only. And as the clergy expressed this willingness to contribute so much of their income to the head of the church, it was thought proper (when in the same reign the papal power was abolished, and the king was declared the head of the church of England) to annex this revenue to the crown; which was done by statute 26 Hen. VIII. c. 3. (confirmed by statute 1 Eliz. c. 4.); and a new *valor beneficiorum* was then made, by which the clergy are at present rated.

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By these last mentioned statutes all vicarages under ten pounds a year, and all rectories under ten marks, are discharged from the payment of first fruits: and if, in such livings as continue chargeable with this payment, the incumbent lives but half a year, he shall pay only one quarter of his first fruits; if but one whole year, then half of them; if a year and a half, three quarters; and if two years, then the whole, and not otherwise. Likewise by the statute 27 Hen. VIII. c. 8. no tenths are to be paid for the first year, for then the first fruits are due: and by other statutes of queen Anne, in the fifth and sixth years of her reign, if a benefice be under L. 50 *per annum* clear yearly value, it shall be discharged of the payment of first-fruits and tenths.

Thus the richer clergy being, by the criminal bigotry of their Popish predecessors, subjected at first to a foreign exaction, were afterwards, when that yoke was shaken off, liable to a like misapplication of their revenues through the rapacious disposition of the then reigning monarch: till at length the piety of queen Anne restored to the church what had been thus indirectly taken from it. This she did, not by remitting the tenths and first fruits entirely; but, in a spirit of the truest equity, by applying these superfluities of the larger benefices to make up the deficiencies of the smaller. And to this end she granted her royal charter, which was confirmed by the statute 2 Ann. c. 11. whereby all the revenue of first fruits and tenths is vested in trustees for ever, to form a perpetual fund for the augmentation of poor livings. This is usually called *Queen Anne's bounty*; which has been still farther regulated by subsequent statutes.

TENURE, in law, signifies the manner whereby lands or tenements are held, or the service that the tenant owes to his lord.

Of this kingdom almost all the real property is by the policy of our laws supposed to be granted by, dependent upon, and holden of, some superior lord, by and in consideration of certain services to be rendered to the lord by the tenant or possessor of this property. The thing holden is therefore styled a *tenement*, the possessors thereof *tenants*, and the manner of their possession a *tenure*. Thus all the lands in the kingdom is supposed to be holden, mediately or immediately, of the king; who is styled the *lord paramount*, or above all. Such tenants as held under the king immediately, when they granted out portions of the lands to inferior persons, became also lords with respect to those inferior persons, as they were still tenants with respect to the king; and, thus partaking of a middle nature, were called *mesne* or *middle lords*. So that if the king granted a manor to A, and he granted a portion of the land to B, now B was said to hold of A, and A of the king; or, in other words, B held his lands immediately of A, but mediately of the king. The king therefore was styled *lord paramount*: A was both tenant and lord, or was a mesne lord; and B was called *tenant paravail*, or the *lowest tenant*, being he who was supposed to make avail, or profit of the land. In this manner are all the lands of the kingdom holden which are in the hands of subjects: for, according to Sir Edward Coke, in the law of England we have not properly *allodium*, which is the name by which the feudists abroad distinguish

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such

ſuch eſtates of the ſubject as are not holden of any ſuperior. So that at the firſt glance we may obſerve, that our lands are either plainly feuds, or partake very ſtrongly of the feodal nature.

All tenures being thus derived, or ſuppoſed to be derived, from the king, thoſe that held immediately under him, in right of his crown and dignity, were called his *tenants in capite*, or *in chief*; which was the moſt honourable ſpecies of tenure, but at the ſame time ſubjected the tenants to greater and more burdenſome ſervices than inferior tenures did. And this diſtinction ran through all the different ſorts of tenure.

There ſeem to have ſubſiſted among our anceſtors four principal ſpecies of lay-tenures, to which all other may be reduced: the grand criteria of which were the natures of the ſeveral ſervices or renders that were due to the lords from their tenants. The ſervices, in reſpect of their quality, were either *free* or *baſe* ſervices: in reſpect of their quantity and the time of exacting them were either *certain* or *uncertain*. Free ſervices were ſuch as were not unbecoming the character of a ſoldier or a freeman to perform; as to ſerve under his lord in the wars, to pay a ſum of money, and the like. Baſe ſervices were ſuch as were fit only for peaſants or perſons of a ſervile rank; as to plough the lord's land, to make his hedges, to carry out his dung, or other mean employments. The certain ſervices, whether free or baſe, were ſuch as were ſtinted in quantity, and could not be exceeded on any pretence; as, to pay a ſtated annual-rent, or to plough ſuch a field for three days. The uncertain depended upon unknown contingencies; as, to do military ſervice in perſon, or pay an aſſeſſment in lieu of it when called upon; or to wind a horn upon the appearance of invaders; which are free ſervices; or to do whatever the lord ſhould command; which is a baſe or villein ſervice.

From the various combinations of theſe ſervices have ariſen the four kinds of lay-tenure which ſubſiſted in England till the middle of the laſt century; and three of which ſubſiſt to this day. Of theſe Bracton (who wrote under Henry the Third) ſeems to give the cleareſt and moſt compendious account of any author ancient or modern; of which the following is the outline or abſtract: "Tenements are of two kinds, *frank-tenement*, and *villenage*. And of frank-tenements, ſome are held freely in conſideration of homage and knight-ſervice; others in free-ſocage, with the ſervice of fealty only. And again, of villenages, ſome are *pure*, and others *privileged*. He that holds in pure villenage ſhall do whatſoever is commanded him, and always be bound to an uncertain ſervice. The other kind of villenage is called *villein-ſocage*; and theſe villein-ſocmen do villein ſervices, but ſuch as are certain and determined." Of which the ſenſe ſeems to be as follows; firſt, where the ſervice was free, but uncertain, as military ſervice with homage, that tenure was called the *tenure in chivalry*, *per ſervitium militare*, or by knight-ſervice. Secondly, where the ſervice was not only free, but alſo certain, as by fealty only, by rent and fealty, &c. that tenure was called *liberum ſocagium*, or *free ſocage*. Theſe were the only free holdings or tenements; the others were villenous or ſervile: as, thirdly, where the ſervice was baſe in its nature, and uncertain as to time and quantity, the tenure was *purum villenagium*, abſolute or pure villenage. Laſtly, where the ſervice was baſe in its nature, but reduced to a certainty, this was ſtill villenage, but diſtinguiſhed from the other by the name of *privileged villenage*, *villenagium privilegiatum*; or it might be ſtill called *ſocage* (from the certainty of its ſervices), but degraded by their baſeneſs into the inferior title of *villanum ſocagium*, villein-ſocage.

1. The military tenure, or that by knight-ſervice, was done away by ſtat. 12 Car. II. For an account of this ſpecies of tenure ſee *Feodal Syſtem*, and *Knight-Service*; and for its incidents, ſee Relief, Primer-seisin, Wardship, Marriage, Fines, and Escheat.

2. The ſecond ſpecies of tenure or free-ſocage, not only ſubſiſts to this day, but has in a manner abſorbed and ſwallowed up (ſince the ſtatute of Charles the Second) almoſt every other ſpecies of tenure. See Socage.

The other grand diviſion of tenure, mentioned by Bracton, is that of villenage, as contradiſtinguiſhed from *liberum tenementum*, or frank-tenure. And this (we may remember) he ſubdivides into two claſſes, pure and privileged villenage: from whence have ariſen two other ſpecies of our modern tenures.

3. From the tenure of pure villenage have ſprung our preſent copyhold-tenures, or tenure by copy of court-roll at the will of the lord; in order to obtain a clear idea of which, it will be previouſly neceſſary to conſult the articles Manor and Villenage.

As a farther conſequence of what has been there explained, we may collect theſe two main principles, which are held to be the ſupporters of a copyhold-tenure, and without which it cannot exiſt; 1. That the lands be parcel of and ſituate within that manor under which it is held. 2. That they have been demiſed, or demiſable, by copy of court-roll immemorially. For immemorial cuſtom is the life of all tenures by copy; ſo that no new copyhold can, ſtrictly ſpeaking, be granted at this day.

In ſome manors, where the cuſtom hath been to permit the heir to ſucceed the anceſtor in his tenure, the eſtates are ſtyled *copyholds of inheritance*; in others, where the lords have been more vigilant to maintain their rights, they remain copyholds for life only; for the cuſtom of the manor has in both caſes ſo far ſuperſeded the will of the lord, that, provided the ſervices be performed or ſtipulated for by fealty, he cannot in the firſt inſtance refuſe to admit the heir of his tenant upon his death; nor, in the ſecond, can he remove his preſent tenant ſo long as he lives, though he holds nominally by the precarious tenure of his lord's will.

The fruits and appendages of a copyhold-tenure, that it hath in common with free tenures, are fealty, ſervices (as well in rents as otherwiſe), reliefs, and eſcheats. The two latter belong only to copyholds of inheritance; the former to thoſe for life alſo. But, beſides theſe, copyholds have alſo heriots, wardſhip, and fines. Heriots, which are agreed to be a Daniſh cuſtom, are a render of the beſt beaſt or other good (as the cuſtom may be) to the lord on the death of the tenant. This is plainly a relic of villein tenure; there being originally leſs hardſhip in it, when all the goods and chattels belonged to the lord, and he might have ſeized them even in the villein's lifetime. Theſe are incident to both ſpecies of copyhold; but wardſhip and fines to thoſe of inheritance only. Wardſhip, in copyhold eſtates, partakes both of that in chivalry and that in ſocage. Like that in chivalry, the lord is the legal guardian, who uſually aſſigns ſome relation of the infant tenant to act in his ſtead: and he, like guardian in ſocage, is accountable to his ward for the profits. Of fines, ſome are in the nature of primerſeiſins, due on the death of each tenant, others are mere fines for alienations of the lands; in ſome manors, only one of thoſe ſorts can be demanded, in ſome both, and in others neither. They are ſometimes arbitrary and at the will of the lord, ſometimes fixed by cuſtom; but, even when arbitrary, the courts of law, in favour of the liberty of copyholders, have tied them down to be reaſonable in their extent; otherwiſe they might amount to diſheriſon of the eſtate. No fine therefore is allowed to be taken upon deſcents and alienations (unleſs in particular circumſtances) of

more

more than two years improved value of the eſtate. From this inſtance of tenderneſs and regard of the favourable diſpoſition that the law of England (which is a law of liberty) hath always ſhown to this ſpecies of tenants, by removing, as far as poſſible, every real badge of ſlavery from them, however ſome nominal ones may continue. It ſuffered cuſtom very early to get the better of the expreſs terms upon which they held their lands, by declaring, that the will of the lord was to be interpreted by the cuſtom of the manor; and, where no cuſtom has been ſuffered to grow up to the prejudice of the lord, as in this caſe of arbitrary fines, the law itſelf interpoſes in an equitable method, and will not ſuffer the lord to extend his power ſo far as to diſinherit the tenant.

4. There is yet a tenth ſpecies of tenure, deſcribed by Bracton, under the name ſometimes of *privileged villenage*, and ſometimes of *villein-ſocage*. See *Privileged* VILLENAGE.

Having in the preſent article and thoſe referred to, taken a compendious view of the principal and fundamental points of the doctrine of tenures, both ancient and modern, we cannot but remark the mutual connection and dependence that all of them have upon each other. And upon the whole it appears, that, whatever changes and alterations theſe tenures have in proceſs of time undergone, from the Saxon era to the 12 Car. II. all lay-tenures are now in effect reduced to two ſpecies; free tenure in common ſocage, and baſe tenure by copy of court roll. But there is ſtill behind one other ſpecies of tenure, reſerved by the ſtatute of Charles II. which is of a ſpiritual nature, and called the tenure in *FRANK-Almoign*; ſee that article.

A particular account of the ancient tenures would to many perſons be highly amuſing. We can only ſelect a few of the moſt ſingular, referring the curious reader for more information to Anderſon's Origin of Commerce, Henry's Hiſtory of Britain, and Blount's *Fragmenta Antiquitates*.

In the 19th of Henry III. Walter Gately held the manor of Weſtcourt, in Bedington in Surry, yielding yearly to the king one croſs-bow, *baliſtam*, value twelve pence.

Anno tertio Edw. I. Oſbert de Longchamp, knight, held his lands of Ovenhelle in Kent, for perſonally guarding the king forty days into Wales at his own expence, with one horſe of five ſhillings value, one ſack worth ſixpence, and one broch for that ſack. *N. B.* All perſonal ſervices, or attendances on our kings in thoſe times, were limited to forty days, at their own expence.

The like the ſame year of Laurence de Broke, who for his hamlet of Renham in Middleſex, found the king one ſoldier, a horſe worth five ſhillings, a ſack worth fivepence, and a broch worth twopence (this broch was a kind of cup, jug, pot, or baſon), for forty days, at his own expence, wherever his army ſhall be within the four ſeas. This was ſettled (ſays Mr Blount) at the Stone Croſs, which ſtood near the May-pole in the Strand, London, where the judges-itinerant uſed in old times to ſit.

Robert Manſell's tenure of lands in Peverel paid the ſame ſervice, and the horſe, ſack, and broch, of the ſame prices.

12mo Edw. I. Henry de Averning's tenure of the manor of Morton in Eſſex, was to find a man, a horſe worth ten ſhillings, four horſe-ſhoes, a leather ſack, and an iron broch.

The year following, three perſons held thirty acres of land in Carleton in Norfolk, by the ſervice of bringing the king, whenever he ſhall be in England, twenty-four paſties of freſh herrings, at their firſt coming in.

Another held his manor in Norfolk of that king, by annually ſupplying him at his exchequer with two veſſels, called *mues*, of wine made of pearmains. "Here (ſays our author) it is worth obſerving, that in King Edward the Firſt's time pearmain cyder was called *wine*." This therefore ſeems to account for the mention of vineyards in old times in Kent, Suſſex, and other parts of England, which has ſo often puzzled many people to elucidate.

Another perſon, in the 21ſt of the ſaid king, held thirty acres of land, valued at ten ſhillings yearly in the exchequer, or fourpence *per* acre, in Cambridgeſhire, for furniſhing a truſs of hay for the king's neceſſary-houſe or privy, whenever he ſhall come into that county.

Another, in the 34th of that king, held a manor in Kent, for providing a man to lead three greyhounds when the king ſhall go into Gaſcony, ſo long as a pair of ſhoes of fourpence ſhould laſt.

And that we may not again recur to theſe old tenures, we ſhall further add, from the ſame author, that in the firſt year of king Edward II. Peter Spileman made fine to the king for his lands by ſerjeanty, to find one to ſerve as a ſoldier for forty days in England, with a coat of mail; alſo to find ſtraw for the king's bed, and hay for his horſe.

This article of ſtraw for the king's bed we did not ſo much wonder at, when we found it in an article in William the Conqueror's time; but it is ſomewhat more remarkable ſo late as the days of king Edward the Second.

Several others, we find, held their lands of the crown in thoſe times by very different tenures. One, by paying two white capons annually; another, by carrying the king's ſtandard whenever he happens to be in the county of Suſſex; another, by carrying a rod or batoon before the king on certain occaſions; another, by ſerving the office of chamberlain of the exchequer, a very good place at preſent; another, by building and upholding a bridge; another, by being marechal (*meretricum*), *i.e.* as Mr Blount tranſlates it, of the laundreſſes in the king's army; another, by acting as a ſerjeant at arms for the king's army whilſt in England; one ſupplies a ſervant for the king's larder; another, for his wardrobe; others, to find ſervants for this or that foreſt; another, a hawk; one preſents the king a pair of ſcarlet hoſe annually; others are bound to ſupply ſoldiers with armour for certain days, for the keeping this or that caſtle; one, viz. for the manor of Elſton in Nottinghamſhire, pays yearly rent of one pound weight of cummin ſeed, two pair of gloves, and a ſteel needle; another, is to repair the ironwork of the king's ploughs; Ela Counteſs of Warwick, in the 13th year of king Edward I. held the manor of Hokenorton in Oxfordſhire, in the barony of D'Oyly, by the ſerjeanty of carving at the king's table on his birth-day, and ſhe to have the knife the king then uſes at table.

TEOS, one of the twelve Ionian cities, was ſituated on the ſouth ſide of the Ionian peninſula, and diſtinguiſhed by being the place where the poet Anacreon and the hiſtorian Hecatæus were born.

TERAPHIM, or THERAPHIM, a word in the Hebrew language, which has exerciſed much the ingenuity of the critics. It occurs 13 or 14 times in the Old Teſtament, and is commonly interpreted *idols*. We will not trouble our readers with the numerous conjectures which have been formed reſpecting the meaning of this word. The only way to determine it, if it be at all poſſible, would be to examine and compare all the paſſages in which it occurs, and to conſult the ancient tranſlations. Conjectures are uſeleſs; every man may make a new one, which will have juſt as good a title to belief as thoſe which have been already propoſed.

TERCERY, one of the largeſt iſlands of the Azores, or Weſtern Iſlands, lying in the Atlantic Ocean. It is about 40 miles in circumference; and ſurrounded with craggy rocks, which render it almoſt inacceſſible. The ſoil is fertile,

fertile, abounding in corn, wine, and fruits; and they have such plenty of cattle, that they supply the ships therewith that call there. However, their principal trade is wood. The inhabitants are lively and well made; and they pretend to a great deal of religion and gallantry at the same time. They pique themselves upon points of honour, and are extremely revengeful. It is their custom to rove about in the night-time in quest of intrigues, and seldom fail in finding women for their purpose. It is subject to Portugal; and Angra is the capital town. W. Long. 27. 1. N. Lat. 28. 45.

TEREBELLA, the PIERCER, in natural history, a genus of insects belonging to the class of *vermes*, and order of *mollusca*. The body is filiform, the mouth placed before; the preputium puts forth a pedunculated tubulous gland. There are several capillary tentacula about the mouth. There are ten species.

Terebinthine Electuary. See PHARMACY, n° 599.

TEREBINTHUS, in botany. See PISTACIA.

TEREDO, in natural history, a genus of *vermes* belonging to the order of *testacea*. The animal is a terebella; there are two valves, calcareous, hemispherical, and cut off before, and two lanceolated. The shell is tapering, bending, and capable of penetrating wood. There are only three species; the *navalis*, *utriculus*, and *clava*.

The *navalis*, or ship-worm, which has a very slender smooth cylindrical shell, inhabits the Indian seas, whence it was imported into Europe. It penetrates easily into the stoutest oak-planks, and produces dreadful destruction to the ships by the holes it makes in their sides; and it is to avoid the effects of this insect that vessels require sheathing.

The head of this creature is well prepared by nature for the hard offices which it has to undergo, being coated with a strong armour, and furnished with a mouth like that of the leech; by which it pierces wood, as that animal does the skin; a little above this it has two horns which seem a kind of continuation of the shell; the neck is as strongly provided for the service of the creature as the head, being furnished with several strong muscles; the rest of the body is only covered by a very thin and transparent skin, through which the motion of the intestines is plainly seen by the naked eye; and by means of the microscope several other very remarkable particulars become visible there. This creature is wonderfully minute when newly excluded from the egg, but it grows to the length of four or six inches, and sometimes more.

When the bottom of a vessel, or any piece of wood which is constantly under water, is inhabited by these worms, it is full of small holes; but no damage appears till the outer parts are cut away: Then their shelly habitations come into view; in which there is a large space for inclosing the animal, and surrounding it with water. There is an evident care in these creatures never to injure one another's habitations; by this means each case or shell is preserved entire; and in such pieces of wood as have been found eaten by them into a sort of honeycomb, there never is seen a passage or communication between any two of the shells, tho' the woody matter between them often is not thicker than a piece of writing-paper.

They penetrate some kinds of wood much more easily than others. They make their way most quickly into fir and alder, and grow to the greatest size. In the oak they make small progress, and appear small and feeble, and their shells much discoloured.

Since each of these animals is lodged in a solitary cell, and has no access to those of its own species, it has been matter of surprise how they should increase to so vast a multitude. Upon dissecting them, it appears that every individual has the parts of both sexes, and is therefore supposed to propagate by itself.

The sea-worms, which are pernicious to our shipping, appear to have the same office allotted them in the waters which the termites have on the land (see TERMES). They will appear, on a very little consideration, to be most important beings in the great chain of creation, and pleasing demonstrations of that infinitely wise and gracious Power which formed, and still preserves, the whole in such wonderful order and beauty: for if it was not for the rapacity of these and such animals, tropical rivers, and indeed the ocean itself, would be choked with the bodies of trees which are annually carried down by the rapid torrents, as many of them would last for ages, and probably be productive of evils, of which, happily, we cannot in the present harmonious state of things form any idea (A); whereas now being consumed by these animals, they are more easily broken in pieces by the waves; and the fragments which are not devoured become specifically lighter, and are consequently more readily and more effectually thrown on shore, where the sun, wind, insects, and various other instruments, speedily promote their entire dissolution. *Phil. Trans.* for 1781.

TERENCE, or PUBLIUS TERENTIUS AFER, a celebrated comic poet of ancient Rome, was born at Carthage in Africa. He was slave to Terentius Lucanus the senator; who gave him his liberty on account of his wit, his good mien, and great abilities. Terence, on his becoming a freed man, applied himself to the writing of comedies; in the execution of which he imitated Menander and the other celebrated comic poets of Greece. Cicero gives him the most pompous eulogiums, both for the purity of his language and the perspicuity and beauty of his compositions, which he considers as the rule and standard of the Latin tongue; and observes, that they were esteemed so fine and elegant, that they were thought to have been written by Scipio and Lelius, who were then the greatest personages and the most eloquent of the Roman people. Terence died while on a voyage into Greece, about the 15th year before the Christian era. There are six of his comedies extant, of which the best editions are the Elzevir one 1635, 12mo; that *cum integris notis Donati, et selectis variorum*, 1686, 8vo; Westerhovius's, in two vols 4to 1726; and that of Bentley the same year 4to. Madam Dacier has given a beautiful French version of this author; and a very good English translation was published in 4to, 1768, by Mr Colman.

TERM, in law, is generally taken for a limitation of time or estate; as, a lease for term of life or years.

Term, however, is more particularly used for that time wherein our courts of justice are open; in opposition to which, the rest of the year is called *vacation*.

TERM, in grammar, denotes some word or expression in a language.

The word *term*, *terminus*, is borrowed metaphorically, by the grammarians and philosophers, from the measurers or surveyors

(A) That wood will endure in water for many centuries, is apparent from the oak stakes which were driven into the bed of the river Thames on the invasion of this island by Julius Cæsar, one of which is to be seen in Sir Ashton Lever's museum, and likewise from those bodies of trees which are daily found in the bogs and morasses of Great Britain and Ireland, which after a duration, the former of eighteen hundred, the latter of upwards of two thousand years, are found in a perfect state of preservation.

Terms.

bounders of lands: as a field is defined and distinguished by its *termini*, or limits, so is a thing or matter spoken of by the word or term it is denoted by.

Term in the Arts, or *Term of Art*, is a word which, besides the literal and popular meaning which it has or may have in common language, bears a further and peculiar meaning in some art or science.

TERMS, the several times or seasons of the year, wherein the tribunals, or courts of judicature, are open to all who think fit to complain of wrong, or to seek their rights by due course of law, or action; and during which the courts in Westminster-hall sit and give judgment. But the high court of parliament, the chancery, and inferior courts, do not observe the terms; only the courts of king's-bench, common pleas, and exchequer, which are the highest courts at common law. In contradistinction to these, the rest of the year is called *vacation*.

Of these terms there are four in every year, during which time matters of justice are dispatched. *Hilary-term*, which, at London, begins the 23d day of January, or if that be Sunday, the next day after; and ends the 12th of February following. *Easter-term*, which begins the Wednesday fortnight after Easter-day, and ends the Monday next after Ascension day. *Trinity-term*, beginning the Friday next after Trinity-Sunday, and ending the Wednesday fortnight after. *Michaelmas-term*, which begins the sixth day of November, and ends the 28th of November following. Each of these terms have also their returns. These terms are supposed by Mr Selden to have been instituted by William the Conqueror; but Sir H. Spelman hath shewn, that they were gradually formed from the canonical constitutions of the church; being no other than those leisure seasons of the year which were not occupied by the great festivals or fasts, or which were not liable to the general avocations of rural business. Throughout all Christendom, in very early times, the whole year was one continual term for hearing and deciding causes. For the Christian magistrates, in order to distinguish themselves from the heathens, who were very superstitious in the observation of their *dies fasti* and *nefasti*, administered justice upon all days alike; till at length the church interposed, and exempted certain holy seasons from being profaned by the tumult of forensic litigations; as, particularly, the time of Advent and Christmas, which gave rise to the winter vacation; the time of Lent and Easter, which created that in the spring; the time of Pentecost, which produced the third; and the long vacation, between midsummer and Michaelmas, which was allowed for the hay-time and harvest. All Sundays also, and some particular festivals, as the days of the purification, ascension, &c. were included in the same prohibition, which was established by a canon of the church, A. D. 517, and fortified by an imperial constitution of the younger Theodosius, comprized in the Theodosian code. Afterwards, when our own legal constitution was established, the commencement and duration of our law terms were appointed, with a view to these ecclesiastical prohibitions; and it was ordered by the laws of king Edward the Confessor, that from Advent to the octave of the Epiphany, from Septuagesima to the octave of Easter, from the Ascension to the octave of Pentecost, and from three in the afternoon of all Saturdays till Monday morning, the peace of God and holy church shall be kept throughout the whole kingdom.

And so extravagant was afterwards the regard paid to these holy times, that though the author of the Mirror mentions only one vacation of considerable length, containing the months of August and September, yet Britton says, that in the reign of king Edward I. no secular plea could be held, nor any man sworn on the Evangelists, in the time of Advent, Lent, Pentecost, harvest, and vintage, the days of the great litanies, and all solemn festivals. He adds, that the bishops and prelates granted dispensations for taking assizes and juries in some of these holy seasons, upon reasonable occasions; and soon after a general dispensation was established in parliament by stat. Westm. 1. 3 Edw. I. cap. 51. that assizes of novel disseisin, *mort d'ancestor*, and darrein presentment, should be taken in Advent, Septuagesima, and Lent, as well as inquests; at the special request of the king to the bishops. The portions of time that were not included within these prohibited seasons fell naturally into a fourfold division; and from some festival, or saint's day, that immediately preceded their commencement, were denominated the terms of *St Hilary*, of *Easter*, of the *Holy Trinity*, and of *St Michael*: which terms have been since regulated and abbreviated by several acts of parliament; particularly Trinity-term by stat. 32 Hen. VIII. cap. 2. and Michaelmas-term by stat. 16 Car. I. cap. 6. and again by stat. 24 Geo. II. cap. 48.

TERMS, *Oxford*. Hilary or Lent-term begins January 14th, and ends the Saturday before Palm-Sunday. Easter-term begins the tenth day after Easter, and ends the Thursday before Whitsunday. Trinity-term begins the Wednesday after Trinity-Sunday, and ends after the act, or 6th of July, sooner or later, as the vice-chancellor and convocation please. Michaelmas-term begins October the 10th, and ends December the 17th.

TERMS, *Cambridge*. Lent-term begins January the 14th, and ends Friday before Palm-Sunday. Easter-term begins the Wednesday after Easter-week, and ends the week before Whitsunday. Trinity-term begins the Wednesday after Trinity-Sunday, and ends the Friday after the commencement, or 2d of July. Michaelmas-term begins October the 10th, and ends December the 16th.

TERMS, *Scottish*. The court of session has two terms, the winter and summer. The winter begins on 12th November, and ends 11th March, only there is a recess of three weeks at Christmas. The summer term commences 12th May, and ends 11th July. The court of exchequer has four terms: 1. Candlemas term begins 15th January, and ends 3d February; 2. Whitsuntide term begins 12th May, and ends 2d June; 3. Lammas term begins 17th June, and ends 5th July; 4. Martinmas term begins 24th November, and ends 20th December.

TERMS, *Irish*. In Ireland the terms are the same as at London, except Michaelmas-term, which begins October the 13th, and adjourns to November the 3d, and thence to the 6th.

TERMES, in entomology; a genus of insects belonging to the order of *aptera*, according to Linnæus, but by others it is arranged more properly under the *neuroptera*. The mouth has two horny jaws; the lip is horny and quadrifid. the laciniæ being linear and acute: there are four feelers, which are equal and filiform. The antennæ are moniliform in most species, and the eyes two. There are eight species, according to Gmelin; the *fatale*, *destructor*, *arda*, *mordax*, *capense*, *fatidicum*, *pulsatorium*, and *divinatorium*. But as Gmelin has followed the classification of Linnæus in arranging the termes under the order of aptera, it is not improbable that several of these which are mentioned as species of the termes may belong to a different genus. It will be sufficient, in the present article, to describe the fatale, which we are enabled to do from very accurate information.

The *termes fatale*, *bellicosus*, or white ant, is of a yellow colour above; the wings also yellowish; the costa is ferruginous; the stemmata are near the eyes, the central point being somewhat prominent. Of the white ant we have a very curious and interesting description, in the Philo-

2 sophical

Termes. sophical Transactions for 1781, by Mr Henry Smeathman of Clement's Inn. According to this account, the works of these insects surpass those of the bees, wasps, beavers, and other animals, as much at least as those of the most polished European nations excel those of the least cultivated savages. And even with regard to man, his greatest works, the boasted pyramids, fall comparatively far short, even in size alone, of the structures raised by these insects. The labourers among them employed in this service are not a quarter of an inch in length; but the structures which they erect rise to 10 or 12 feet and upwards above the surface of the earth. Supposing the height of a man to be six feet, the author calculates, that the buildings of these insects may be considered, relatively to their size and that of a man, as being raised to near five times the height of the greatest of the Egyptian pyramids; that is, corresponding with considerably more than half a mile. We may add, that, with respect to the interior construction, and the various members and dispositions of the parts of the building, they appear greatly to exceed that or any other work of human construction.

The most striking parts of these structures are, the royal apartments, the nurseries, magazines of provisions, arched chambers and galleries, with their various communications; the ranges of Gothic-shaped arches, projected, and not formed by mere excavation, some of which are two or three feet high, but which diminish rapidly, like the arches of ailes in perspectives; the various roads, sloping staircases, and bridges, consisting of one vast arch, and constructed to shorten the distance between the several parts of the building, which would otherwise communicate only by winding passages. In some parts near Senegal, their number, magnitude, and closeness of situation, make them appear like the villages of the natives. But these and many other curious instances of the great sagacity and powers of these insects cannot be understood, without viewing the plates in which their feeble frames, and comparatively stupendous works, are delineated. See Phil. Transf. above referred to.

The economy of these industrious insects appears to have been very attentively observed by the ingenious author, as well as their buildings. There are three distinct ranks or orders among them, constituting a well-regulated community. These are, first, the *labourers*, or working insects; next the *soldiers*, or fighting order, who do no kind of labour, and are about twice as long as the former, and equal in bulk to about 15 of them; and lastly, the winged or perfect insects, which may be called the *nobility* or *gentry* of the state; for they neither labour nor fight, being scarcely capable even of self-defence. "These only are capable of being elected *kings* or *queens*; and nature has so ordered it, that they emigrate within a few weeks after they are elevated to this state, and either establish new kingdoms, or perish within a day or two."

The first order, the working insects, are most numerous, being in the proportion of 100 to 1 of the soldiers. In this state they are about $\frac{1}{4}$ of an inch long, and 25 of them weigh about a grain, so that they are not so large as some of our ants. See Plate DI. fig. 1. and 2.

The second order, or soldiers, have a very different form from the labourers, and have been by some authors supposed to be the males, and the former neuters; but they are, in fact, the same insects as the foregoing, only they have undergone a change of form, and approached one degree nearer to the perfect state. They are now much larger, being half an inch long, and equal in bulk to fifteen of the labourers, (fig. 3. and 4.)

The third order, or the insect in its perfect state, varies its form still more than ever. The head, thorax, and abdomen, differ almost entirely from the same parts in the labourers and soldiers; and, besides this, the animal is now furnished with four fine large brownish, transparent, wings, with which it is at the time of emigration to wing its way in search of a new settlement. It differs so much from the other two, that they have not hitherto been supposed to belong to the same community. In fact, they are not to be discovered in the nest till just before the commencement of the rainy season; when they undergo the last change, which is preparative to the formation of new colonies. They are equal in bulk to two soldiers and about 30 labourers (see fig. 5), and by means of the wings with which they are furnished they roam about for a few hours; at the end of which time they lose their wings, and become the prey of innumerable birds, reptiles, and insects: while probably not a pair out of many millions of this unhappy race get into a place of safety, fulfil the first law of nature, and lay the foundation of a new community. In this state many fall into the neighbouring waters, and are eaten with avidity by the Africans. The author found them delicate, nourishing, and wholesome, without sauce or other help from cookery than merely roasting them in the manner of coffee.

The few fortunate pairs who happen to survive this annual massacre and destruction, are represented by the author as being casually found by some of the labourers, that are continually running about on the surface of the ground, and are elected kings and queens of new states. Those who are not so elected and preserved certainly perish, and most probably in the course of the following day. By these industrious creatures the king and queen elect are immediately protected from their innumerable enemies, by inclosing them in a chamber of clay; where the business of propagation soon commences. Their "voluntary subjects" then busy themselves in constructing wooden nurseries, or apartments entirely composed of wooden materials, seemingly joined together with gums. Into these they afterwards carry the eggs produced from the queen, lodging them there as fast as they can obtain them from her. The author even furnishes us with plausible reasons to believe, that they here form a kind of garden for the cultivation of a species of microscopical mushroom; which Mr Konig (in an Essay on the East Indian Termites, read before the Society of Naturalists of Berlin) conjectures to be the food of the young insects. But perhaps the most wonderful, and at the same time best authenticated, part of the history of these singular insects, is that which relates to the queen or mother of the community in her pregnant state.

After impregnation, a very extraordinary change begins to take place in her person, or rather in her abdomen only. It gradually increases in bulk, and at length becomes of such an enormous size as to exceed the bulk of the rest of her body 1500 or 2000 times. She becomes 1000 times heavier than her consort, and exceeds 20,000 or 30,000 times the bulk of one of the labourers. In this state, the matrix has a constant peristaltic or undulating motion; the consequence of which is (as the author has counted them) (fig. 8.) the protrusion of 80,000 eggs in 24 hours.

These eggs, says the author, "are instantly taken from her body by her attendants (of whom there always are, in the royal chamber and the galleries adjacent, a sufficient number in waiting) and carried to the nurseries, which are sometimes four or five feet distant in a straight line.—Here, after they are hatched, the young are attended and provided with every thing necessary, until they are able to shift for themselves, and take their share of the labours of the community."

Many curious and striking particulars are related of the

Termes

great devaſtations committed by this powerful community; which conſtruct roads, or rather covered ways, diverging in all directions from the neſt, and leading to every object of plunder within their reach. Though the miſchiefs they commit are very great, ſuch is the economy of nature, that it is probably counterbalanced by the good produced by them; in quickly deſtroying dead trees and other ſubſtances, which, as the author obſerves, would, by a tedious decay, ſerve only to encumber the face of the earth. Such is their alacrity and diſpatch in this office, that the total deſtruction of deſerted towns is ſo effectually accompliſhed, that in two or three years a thick wood fills the ſpace; and not the leaſt veſtige of a houſe is to be diſcovered.

From the many ſingular accounts here given of the police of theſe inſects, we ſhall mention one reſpecting the different functions of the labourers and ſoldiers, or the civil and military eſtabliſhments in this community, on an attempt to examine their neſt or city.

On making a breach in any part of the ſtructure with a hoe or pick-axe, a ſoldier immediately appears, and walks about the breach, as if to ſee whether the enemy is gone, or to examine whence the attack proceeds. In a ſhort time he is followed by two or three others, and ſoon afterwards by a numerous body, who ruſh out as faſt as the breach will permit them; their numbers increaſing as long as any one continues to batter the building. During this time they are in the moſt violent buſtle and agitation; while ſome of them are employed in beating with their forceps upon the building, ſo as to make a noiſe that may be heard at three or four feet diſtance. On ceaſing to diſturb them, the ſoldiers retire, and are ſucceeded by the labourers, who haſten in various directions towards the breach, each with a burden of mortar in his mouth ready tempered. Though there are millions of them, they never ſtop or embarraſs each other; and a wall gradually ariſes that fills up the chaſm. A ſoldier attends every 600 or 1000 of the labourers, ſeemingly as a director of the works; for he never touches the mortar, either to lift or carry it. One in particular places himſelf cloſe to the wall which they are repairing, and frequently makes the noiſe above-mentioned; which is conſtantly anſwered by a loud hiſs from all the labourers within the dome: and at every ſuch ſignal, they evidently redouble their pace, and work as faſt again.

The work being completed, a renewal of the attack conſtantly produces the ſame effects. The ſoldiers again ruſh out, and then retreat, and are followed by the labourers loaded with mortar, and as active and diligent as before. "Thus, ſays the author, the pleaſure of ſeeing them come out to fight or to work alternately may be obtained as often as curioſity excites or time permits: and it will certainly be found, that the one order never attempts to fight, or the other to work, let the emergency be ever ſo great." The obſtinacy of the ſoldiers is remarkable. "They fight to the very laſt, diſputing every inch of ground ſo well as often to drive away the negroes, who are without ſhoes, and make white people bleed plentifully through their ſtockings."

Such is the ſtrength of the buildings erected by theſe puny inſects, that when they have been raiſed to little more than half their height, it is always the practice of the wild bulls to ſtand as centinels upon them, while the reſt of the herd is ruminating below. When at their full height of 10 or 12 feet, they are uſed by the Europeans as places to look out from over the top of the graſs, which here grows to the height of 13 feet upon an average. The author has ſtood with four men on the top of one of theſe buildings, in order to get a view of any veſſel that might come in ſight.

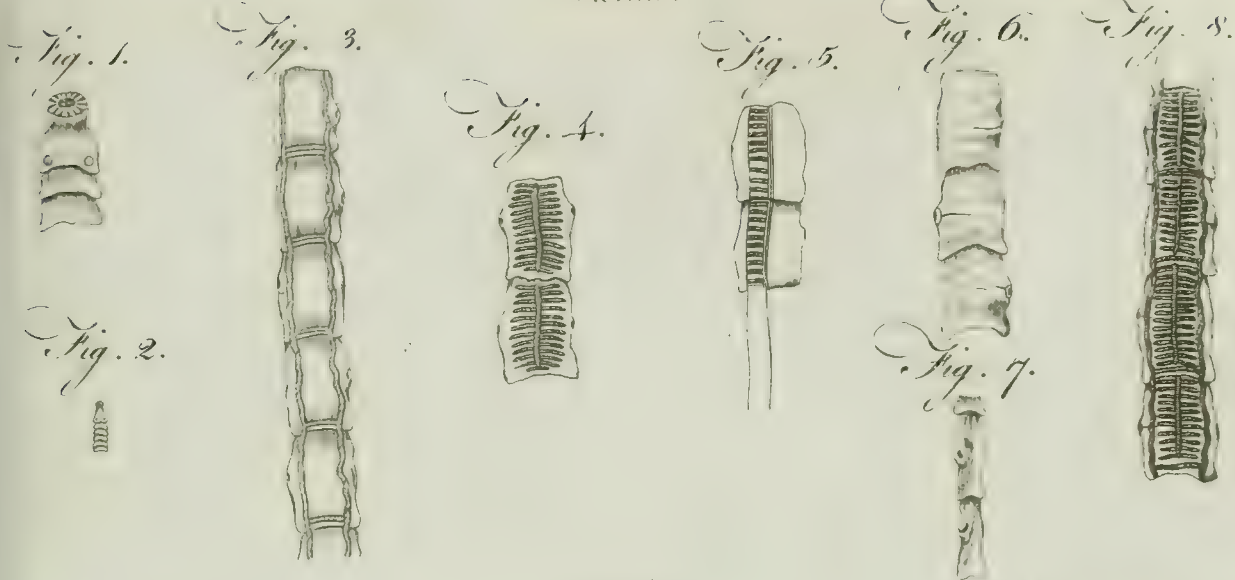
It may appear ſurpriſing how a Being perfectly good ſhould have created animals which ſeem to ſerve no other end but to ſpread deſtruction and deſolation wherever they go. But let us be cautious in ſuſpecting any imperfection in the Father of the Univerſe. What at firſt ſight may ſeem only productive of miſchief, will, upon mature deliberation, be found worthy of that wiſdom which planned the moſt beautiful parts of the world. Many poiſons are valuable medicines; the ſtorms are beneficial; and diſeaſes often promote life. Theſe termites, indeed, are frequently pernicious to mankind, but they are alſo very uſeful and even neceſſary; one valuable purpoſe which they ſerve is, to deſtroy decayed trees and other ſubſtances, which, if left on the ſurface of the ground in hot climates, would in a ſhort time pollute the air. In this reſpect they reſemble very much the common flies, which are regarded by mankind in general as noxious, and at beſt as uſeleſs beings in the creation; but this is certainly for want of conſideration. There are not probably in all nature animals of more importance; and it would not be difficult to prove, that we ſhould feel the want of one or two ſpecies of large quadrupeds much leſs than of one or two ſpecies of theſe deſpicable-looking inſects. Mankind in general are ſenſible that nothing is more diſagreeable, or more peſtiferous, than putrid ſubſtances; and it is apparent to all who have made obſervation, that thoſe little inſects contribute more to the quick diſſolution and diſperſion of putreſcent matter than any other. They are ſo neceſſary in all hot climates, that even in the open fields a dead animal or ſmall putrid ſubſtance cannot be laid upon the ground two minutes before it will be covered with flies and their maggots, which inſtantly entering quickly devour one part, and perforating the reſt in various directions, expoſe the whole to be much ſooner diſſipated by the elements. Thus it is with the termites; the rapid vegetation in hot climates, of which no idea can be formed by any thing to be ſeen in this, is equalled by as great a degree of deſtruction from natural as well as accidental cauſes (A). It ſeems apparent, that when any thing whatever is arrived at its laſt degree of perfection, the Creator has decreed it ſhall be totally deſtroyed as ſoon as poſſible, that the face of nature may be ſpeedily adorned with freſh productions in the bloom of ſpring or the pride of ſummer: ſo when trees, and even woods, are in part deſtroyed by tornadoes or fire, it is wonderful to obſerve how many agents are employed in haſtening the total diſſolution of the reſt; but in the hot climates there are none ſo expert, or who do their buſineſs ſo expeditiouſly and effectually, as theſe inſects, who in a few weeks deſtroy and carry away the bodies of large trees, without leaving a particle behind, thus clearing the place for other vegetables, which ſoon fill up every vacancy; and in places where two or three years before there has been a populous town, if the inhabitants, as is frequently the caſe, have choſen to abandon it, there ſhall be a very thick wood, and not the veſtige of a poſt to be ſeen, unleſs the wood has been of a ſpecies which, from its hardneſs, is called *iron wood*.

Fig.

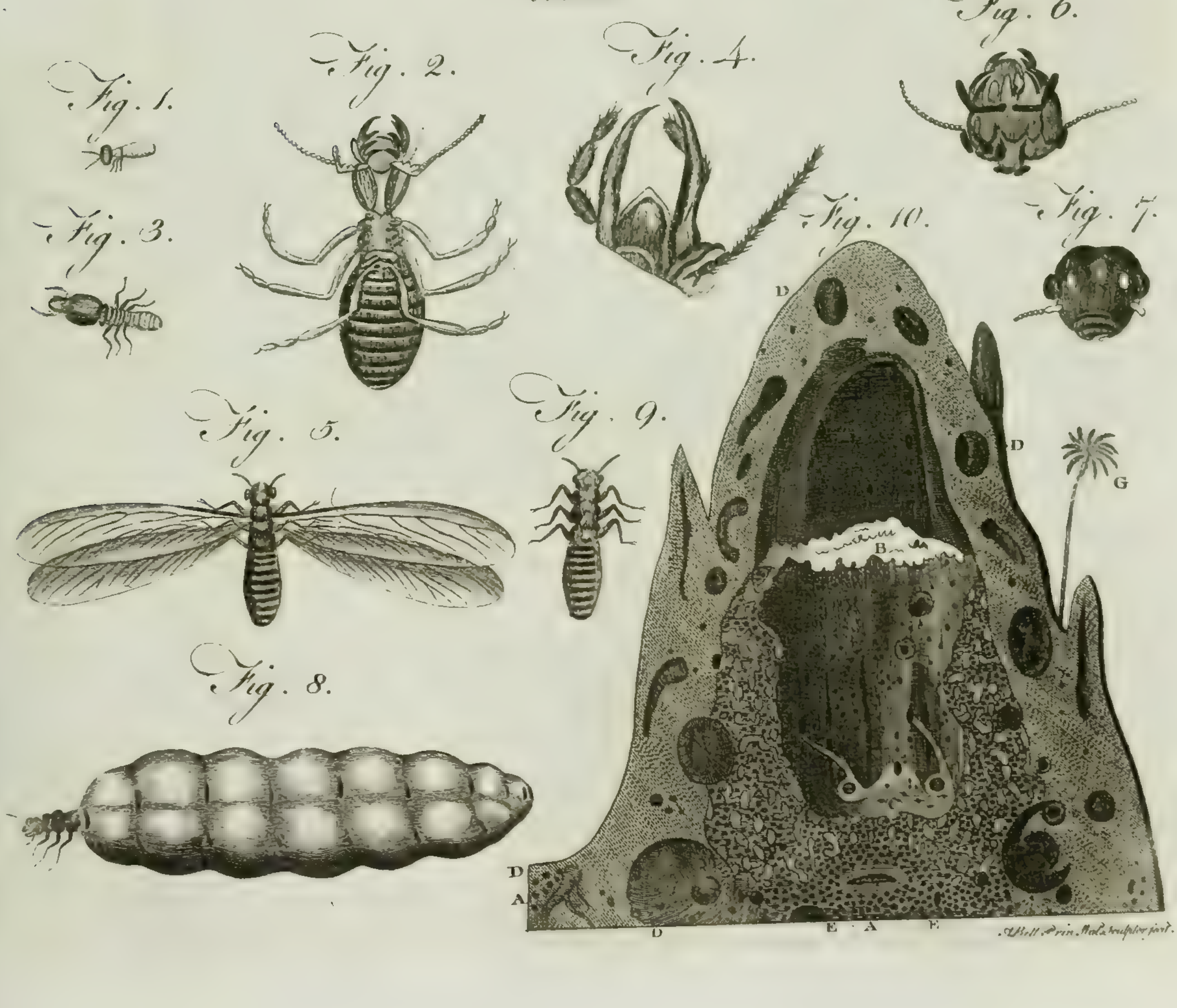
(A) The Guinea graſs, which is ſo well known and ſo much eſteemed by our planters in the Weſt Indies, grows in Africa, as we have already mentioned, thirteen feet high upon an average, which height it attains in about five or ſix months; and the growth of many other plants is as quick.

Plate DI.

Tænia.



Termes.



A.Bell Prin. Wal. sculptor fecit.

Fig. 1. represents a labourer. Fig. 2. a labourer magnified. Fig. 3. a soldier. Fig. 4. a soldier, forceps, and part of his head magnified. Fig. 5. a perfect termes bellicosus. Fig. 6. the head of a perfect insect magnified. Fig. 7. a head with stemmata magnified. Fig. 8. a queen. Fig. 9. a king. Fig. 10. is a section of the building raised by these insects, as it would appear on being cut down through the middle from the top a foot lower than the surface of the ground. AA, an horizontal line from A on the left, and a perpendicular line from A at the bottom, will intersect each other at the royal chamber. The darker shades near it are the empty apartments and passages, which it seems are left so for the attendants on the king and queen, who, when old, may require near 100,000 to wait on them every day. The parts which are the least shaded and dotted are the nurseries, surrounded, like the royal chamber, by empty passages, on all sides, for the more easy access to them with the eggs from the queen, the provision for the young, &c. *N. B.* The magazines of provisions are situated without any seeming order among the vacant passages which surround the nurseries. B, the top of the interior building, which often seems, from the arches carrying upward, to be adorned on the sides with pinnacles. C, the floor of the area or nave. DDD, the large galleries which ascend from under all the buildings spirally to the top. EE, the bridges.

TERMINALIA, in antiquity, feasts celebrated by the Romans in honour of the god Terminus.

Terminalia, in botany; a genus of plants belonging to the class of *polygamia*, and order of *monœcia*. The male calyx is quinquepartite; there is no corolla; the stamina are ten in number. The hermaphrodite flower is the same with that of the male; there is one style; the fruit, which is a drupe or plum, is below, and shaped like a boat. There are two species; the catappa, and angustifolia or benzoin. This species does not, however, yield benzoin. See Styrax.

TERMINI, in architecture, denotes a kind of statues or columns, adorned on the top with the figure of a man's, woman's, or satyr's head, as a capital; and the lower part ending in a kind of sheath or scabbard.

TERMINUS, in Pagan worship, an ancient deity among the Romans, who presided over the stones or land marks, called *termini*, which were held so sacred, that it was accounted sacrilege to move them; and as the criminal became devoted to the gods, it was lawful for any man to kill him. The worship of this deity was instituted by Numa Pompilius, who, to render land-marks, and consequently the property of the people, sacred, erected a temple on the Tarpeian mount to Terminus.

TERN, in ornithology. See Sterna.

TERNATE, the most northerly of the Molucca or Clove Islands in the East Indies. It abounds in cocoa-nuts, bananas, citrons, oranges, almonds, and other fruit proper to the torrid zone; but cloves are the most valuable produce. It is in the possession of the Dutch. Malaya is the capital town. E. Long. 129. 0. N. Lat. 1. 0.

TERNI, a town of Italy in the Pope's territories, and in the duchy of Spoletto, with a bishop's see. It is but a small place; though there are very beautiful ruins of antiquity, it having been a very considerable Roman colony. It is situated on the top of a high mountain, and to the west of it are fields which are extremely fertile. E. Long. 12. 40. N. Lat. 42. 34.

TERNSTROMIA, in botany; a genus of plants belonging to the class of *polyandria*, and order of *monogynia*. The calyx is monophyllous and quinquepartite: the corolla is monopetalous, quinquepartite or sexpartite, globular, and bell-shaped: the berry is dry, bilocular, and valveless. There is only one species, the meridionalis.

TERPANDER, a celebrated Greek poet and musician. The Oxford marbles tell us that he was the son of Derdeneus of Lesbos, and that he flourished in the 381st year of these records; which nearly answers to the 27th Olympiad, and 671st year B. C. The marbles inform us likewise, that he taught the *nomes*, or airs, of the lyre and flute, which he performed himself upon this last instrument, in concert with other players on the flute. Several writers tell us that he added three strings to the lyre, which before his time had but four; and in confirmation of this, Euclid and Strabo quote two verses, which they attribute to Terpander himself.

> The tetrachord's restraint we now despise,
> The seven-string'd lyre a nobler strain supplies.

Among the many signal services which Terpander is said to have done to music, none was of more importance than the notation that is ascribed to him for ascertaining and preserving melody, which before was traditional, and wholly dependent on memory. The invention, indeed, of musical characters has been attributed by Alypius and Gaudentius, two Greek writers on music, and upon their authority by Boethius, to Pythagoras, who flourished full two centuries after Terpander. But Plutarch, from Heraclides of Pontus, assures us that Terpander, the inventor of nomes for the cithara, in hexameter verse, set them to music, as well as the verses of Homer, in order to sing them at the public games: And Clemens Alexandrinus, in telling us that this musician wrote the laws of Lycurgus in verse, and set them to music, makes use of the same expression as Plutarch; which seems clearly to imply a written melody.

After enumerating the airs which Terpander had composed, and to which he had given names, Plutarch continues to speak of his other compositions; among which he describes the proems, or hymns for the cithara, in heroic verse. These were used in after-times by the Rhapsodists, as prologues or introductions to the poems of Homer and other ancient writers. But Terpander rendered his name illustrious, no less by his performances both upon the flute and cithara than by his compositions. This appears by the marbles already mentioned; by a passage in Athenæus, from the historian Hellanicus, which informs us that he obtained the first prize in the musical contests at the Carnean games; and by the testimony of Plutarch, who says, that "no other proof need be urged of the excellence of Terpander in the art of playing upon the cithara, than what is given by the register of the Pythic games, from which it appears that he gained four prizes successively at those solemnities.

Of the works of this poet only a few fragments are now remaining.

TERRA australis incognita, a name for a large unknown continent, supposed to lie towards the South Pole, and which for a long time was sought after by navigators. The late voyages of Captain Cook have ascertained this matter as much as it probably ever will be. (See *South-Sea*, *Cook's Discoveries*, n° 47, 48, 68, 69. and America, n° 4). On this subject Captain Cook expresses himself as follows: "I had now made the circuit of the Southern Ocean in a high latitude, and traversed it in such a manner as to leave not the least room for the possibility of there being a continent, unless near the pole, and out of the reach of navigation. By twice visiting the tropical sea, I had not only settled the situation of some old discoveries, but made there many new ones, and left, I conceive, very little more to be done even in that part. Thus I flatter myself,

Terra.

that the intention of the voyage has in every reſpect been fully anſwered; the ſouthern hemiſphere ſufficiently explored; and a final end put to the ſearching after a ſouthern continent, which has at times engroſſed the attention of ſome of the maritime powers for near two centuries paſt, and been a favourite theory amongſt the geographers of all ages. That there may be a continent, or large tract of land near the pole, I will not deny: on the contrary, I am of opinion there is; and it is probable that we have ſeen a part of it. The exceſſive cold, the many iſlands, and vaſt floats of ice, all tend to prove that there muſt be land to the ſouth; and for my perſuaſion that this ſouthern land muſt lie or extend fartheſt to the north, oppoſite to the ſouthern Atlantic and Indian Oceans, I have already aſſigned ſome reaſons; to which I may add, the greater degree of cold experienced by us in theſe ſeas than in the ſouthern Pacific Ocean under the ſame parallels of latitude."

Terra Firma, in geography, is ſometimes uſed for a continent, in contradiſtinction to iſlands.

Terra Firma, otherwiſe called *New Caſtile*, or *Caſtella del Oro*, a country of America, bounded on the north by the North Sea and part of the Atlantic Ocean, by the ſame ſea and Guiana on the eaſt, by the country of the Amazons and Peru on the ſouth, and by the Pacific Ocean and Veragua on the weſt. It lies between 62 and 83 degrees of weſt longitude, and between the equator and 12 degrees of north latitude; being upwards of 1200 miles in length from eaſt to weſt, and 800 in breadth from north to ſouth. It had the name of *Caſtella del Oro* from the quantity of gold found in the diſtricts of Uraba and other parts; and was firſt diſcovered by the celebrated Columbus in his third voyage.

The climate is neither pleaſant nor healthy; the inhabitants one part of the year being ſcorched by the moſt intenſe and burning heat, and the other almoſt drowned with perpetual floods of rain, pouring from the ſky with ſuch violence as if a general deluge was to enſue.

In ſo large a tract of country the ſoil muſt neceſſarily vary. Accordingly, in ſome parts it is a barren ſand, or drowned mangrove land, that will ſcarce produce any kind of grain; in others it yields Indian corn, balms, gums, and drugs, almoſt all manner of fruits as well of Old as of New Spain, ſugar, tobacco, Braſil wood, and ſeveral other kinds of dyeing woods; a variety of precious ſtones, particularly emeralds and ſapphires; veniſon and other game. The plantations of cacao, or chocolate nuts, in the diſtrict of the Caraccas, are eſteemed the beſt in America. The mountains abound with tygers, and, according to ſome, with lions, and great numbers of other wild beaſts. The rivers, ſeas, and lakes, teem with fiſh, and alſo with alligators; and the bowels of the earth were once furniſhed with the richeſt treaſures, now almoſt exhauſted. The ſame may be ſaid of the pearl fiſheries on the coaſt, which are far from being ſo profitable now as formerly.

Terra Firma is a very mountainous country. Terra Firma Proper, in particular, conſiſts of prodigious high mountains, and deep valleys flooded more than half the year. The mountains in the provinces of Carthagena and St Martha, according to Dampier, are the higheſt in the world; being ſeen at ſea 200 miles off: from theſe run a chain of hills of almoſt equal height, quite through South America, as far as the Straits of Magellan, called the *Cordilleras des Andes*. The province of Venezuela alſo, and diſtrict of the Caraccas, the moſt northerly parts of South America, are almoſt a continued chain of hills, ſeparated by ſmall valleys, pointing upon the coaſt of the North Sea. A chain of barren mountains, almoſt impaſſable, runs through the province of Popayan from north to ſouth, ſome whereof are volcanoes; but towards the ſhores of the Pacific Ocean it is a low country, flooded great part of the year.

The principal rivers of Terra Firma are, the Darien, Chagre, Santa Maria, Conception, Rio Grande or Magdalena, Maricaibo, and Oronoko.

Terra Firma contains the provinces of Terra Firma Proper or Darien, of Carthagena, St Martha, Rio de la Hacha, Venezuela, Comana, New Andaluſia or Paria, New Granada, and Popayan.

Terra Firma Proper lies in the form of a creſcent, about the ſpacious bay of Panama, being the iſthmus which joins South and North America; and extending in length between the two ſeas 300 miles, but in breadth, where the iſthmus is narroweſt, only 60. Here are found gold mines, gold ſands, and fine pearls; and though the land is generally rough, there are ſome fruitful valleys, watered by rivers, brooks, and ſprings. The chief places are Panama and Porto Bello.

The inhabitants of Terra Firma have never been thoroughly ſubdued, and in all probability never will; as they are a brave and warlike people, have retreats inacceſſible to Europeans, and bear an inveterate enmity to the Spaniards. See Darien.

Terra Japonica, more commonly called *catechu*, a drug formerly ſuppoſed to be an extract from the ſeeds of the areca catechu, but lately diſcovered by Mr Kerr, aſſiſtant ſurgeon to the civil hoſpital at Bengal, to be obtained from the *mimoſa catechu*. Mr Kerr gives the following account of the manner in which the extract is made: "After felling the trees, the manufacturer carefully cuts off all the exterior white part of the wood. The interior coloured wood is cut into chips, with which he fills a narrow-mouthed unglazed earthen pot, pouring water upon them until he ſees it among the upper chips; when this is half evaporated by boiling, the decoction, without ſtraining, is poured into a flat earthen pot, and boiled to one third part; this is ſet in a cool place for one day, and afterwards evaporated by the heat of the ſun, ſtirring it ſeveral times in the day. When it is reduced to a conſiderable thickneſs, it is ſpread upon a mat or cloth, which has previouſly been covered with the aſhes of cow-dung; this maſs is divided into ſquare or quadrangular pieces by a ſtring, and completely dried by turning them frequently in the ſun until they are fit for ſale (A)."

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This extract is called *cutt* by the natives, by the Engliſh

(A) "In making the extract, the pale brown wood is preferred, as it produces the fine whitiſh extract; the darker the wood is, the blacker the extract, and of leſs value. They are very careful in drying their pots upon the fire before they are uſed; but very negligent in cutting their chips upon the ground, and not ſtraining the decoction; by which, and the dirty aſhes they uſe, there muſt be a conſiderable quantity of earth in the extract, beſides what avarice may prompt them to put into it.

"The antiſeptic quality of catechu appears from the experiments made by Sir John Pringle. Huxham employed it ſucceſsfully in caſes where a putrid diſſolved ſtate of the blood prevailed. This extract is the principal ingredient in an ointment of great repute in India, compoſed of catechu four ounces, alum nine drams, white reſin four ounces; theſe are reduced

liſh *cutch*, and by different authors *terra japonica*, *catechu*, *khaath*, *cate*, *cutch*, &c. "In its pureſt ſtate it is a dry pulverable ſubſtance, outwardly of a reddiſh colour, internally of a ſhining dark brown, tinged with a reddiſh hue; in the mouth it diſcovers conſiderable aſtringency, ſucceeded by a ſweetiſh mucilaginous taſte." According to Lewis, "it diſſolves almoſt totally in water, excepting the impurities; which are uſually of the ſandy kind, and amounting in the ſpecimens I examined to about one eighth of the maſs. Of the pure matter, rectified ſpirit diſſolves about ſeven eighths into a deep red liquor: the part which it leaves undiſſolved is an almoſt inſipid mucilaginous ſubſtance."

Uſes. Catechu may be uſefully employed for moſt purpoſes where an aſtringent is indicated, provided the moſt powerful be not required. But it is particularly uſeful in alvine fluxes; and where theſe require the uſe of aſtringents, we are acquainted with no one equally beneficial. Beſides this, it is employed alſo in uterine profluvia, in laxity and debility of the viſcera in general, in catarrhal affections, and various other diſeaſes where aſtringents are neceſſary. It is often ſuffered to diſſolve leiſurely in the mouth, as a topical aſtringent for laxities and exulcerations of the gums, for apthous ulcers in the mouth, and ſimilar affections. This extract is the baſis of ſeveral fixed formulæ in our pharmacopœias, particularly of a tincture and an electuary: but one of the beſt forms under which it can be exhibited, is that of a ſimple infuſion in warm water, with a proportion of cinnamon or caſſia; for by this means it is at once freed from its impurities, and improved by the addition of the aromatic.

Terra Puzzolana. See PUZZOLANA.

Terræ Filius, Son of the Earth, a ſtudent of the univerſity of Oxford, formerly appointed in public acts to make ſatirical and jeſting ſpeeches againſt the members thereof, to tax them with any growing corruptions, &c.

Terra Sigillata Lemnia. See ADANSONIA.

TERRACE, a walk or bank of earth, raiſed in a garden or court to a due elevation for a proſpect. The name is alſo given to the roofs of houſes that are flat, and whereon we may walk.

TERRAQUEOUS, in geography, a name given to our globe, becauſe conſiſting of land and water.

TERRAS, or TRASS, in mineralogy, a ſpecies of argillaceous earth. It differs but little in its principles from puzzolana, but is much more compact and hard, porous and ſpungy. It is generally of a whitiſh yellow colour, and contains more heterogeneous particles, as ſpar, quartz, ſhoerl, &c. and ſomething more of calcareous earth; it effervesces with acids, is magnetic, and fuſible *per ſe*. When pulverized, it ſerves as a cement, like puzzolana. It is found in Germany and Sweden.

A ſpecies of red earth has been found in the pariſh of St Elizabeth in Jamaica, which turns out to be an excellent ſubſtitute for terras or puzzolana earth, and may therefore be of great value to the inhabitants of the Weſt Indies.

One meaſure of this earth, mixed with two of well ſlacked lime and one of ſand, form a cement that anſwers extremely well for building any dam or bridge, or any ſtructure in water, for it will ſoon harden and become like a ſtone.

TERRASSON (Abbé John), a French writer born at Lyons in 1669. He diſtinguiſhed himſelf in the diſpute concerning Homer, between La Motte and Madam Dacier, by writing a *Diſſertation contre l'Iliade*. He wrote a political and moral romance called *Sethos*, full of learning and philoſophy; and another capital work of his is a French tranſlation of Diodorus Siculus. He died in 1750.

TERRE *Verte*, in the colour-trade, the name of a green earth much uſed by painters, both ſingly for a good ſtanding green, and in mixture with other colours. The name is French, and ſignifies "green earth."

It is an indurated clay, of a deep bluiſh green colour, and is found in the earth, not in continued ſtrata or beds, as moſt of the other earths are, but in large flat maſſes of different ſizes, imbedded in other ſtrata; theſe break irregularly in the cutting, and the earth is generally brought out of the pit in lumps of different ſizes. It is of a fine, regular, and even ſtructure, and not very hard. It is of an even and gloſſy ſurface, very ſmooth to the touch, and in ſome degree reſembling the morochthus or French chalk, but adhering firmly to the tongue. It does not ſtain the hands in touching it; but being drawn along a rough ſurface, it leaves an even white line, with a greeniſh caſt.

It does not ferment with acids, and it burns to a duſky brown colour. It is dug in the iſland of Cyprus, and in many parts of France and Italy. That from the neighbourhood of Verona has been eſteemed the beſt in the world; but of late there has been ſome dug in France that equals it. There is alſo an earth dug on Mendip Hills, in the ſinking for coal, which, though wholly unobſerved, is nearly, if not wholly, of equal value. When ſcraped, and the finer parts ſeparated, it is ready to be made up with oil for the uſe of the painters, and makes the moſt true and laſting green of any ſimple body they uſe.

TERRESTRIAL, ſomething partaking of the nature of earth, or belonging to the globe of earth; thus we ſay, the terreſtrial globe, &c.

TERRIER, a ſmall hound to hunt the fox or badger; ſo called becauſe he creeps into the ground, as ferrets do into the coney-burrows, after the fox, &c.

TERRITORY, in geography, denotes an extent or compaſs of land, within the bounds or belonging to the juriſdiction of any ſtate, city, or other ſubdiviſion of a country.

TERROR. See FEAR and FRIGHT.

TERTIAN *fever*. See MEDICINE, n° 125.

TERTULLIAN, or QUINTUS SEPTIMUS FLORENS TERTULLIANUS, a celebrated prieſt of Carthage, was the ſon of a centurion in the militia, who ſerved as proconſul of Africa. He was educated in the Pagan religion; but being convinced of its errors, embraced Chriſtianity, and became a zealous defender of the faith. He married, it is thought, after his baptiſm. Afterwards he took orders, and went to Rome; where, during the perſecution under the emperor Severus, he publiſhed his Apology for the Chriſtians, which is, in its kind, a maſterpiece of eloquence and learning; and at the beginning of the third century he embraced the ſect of the Montaniſts. He lived to a very great age, and died under the reign of Antoninus Caracalla, about the year 216. Many of his works are ſtill extant, in all of which he diſcovers a great knowledge of the Holy Scriptures, a lively imagination, a ſtrong, elevated, and impetuous ſtyle, great eloquence and ſtrength of reaſoning; but is ſome-

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reduced to a fine powder, and mixed with the hand, adding olive oil ten ounces, and a ſufficient quantity of water, to bring the maſs to the conſiſtence of an ointment. To all ſores and ulcers in warm climates aſtringent applications of this kind are found to be peculiarly uſeful."

Teruncius || Tessera.

sometimes obscure. His Apology and Prescriptions are most esteemed. The best editions of his works are those of Rigault; especially that of Venice in 1746, folio. Pamelius and Felix, Mr Thomas, and the Sieur du Fossé, have written his life; and Rigault, M. de l'Aube Epine, Father Petau, and other learned men, have published notes on his works.

TERUNCIUS, in antiquity, a very small brass coin in use among the Romans.

The inconvenience of such very small pieces being soon found, the teruncius became disused, but its name is still retained in reckoning, and thus it became a money of account. The teruncius at first was a quarter of the as, or libra; hence, as the as contained twelve ounces, the teruncius contained three, whence the name, which is formed of the Latin *tres unciæ*. Teruncius was also used for the quarter of the denarius; so that when the denarius was at ten ases, the teruncius was worth two and a half; and when the denarius was risen to sixteen, the teruncius was worth four. See Denarius.

TESSELATED pavements, those of rich Mosaic work made of curious square marbles, bricks, or tiles, called *tesselæ* from their resembling dice.

TESSERA, in Roman antiquity, denoted in its primary sense a cube or dye; so called from the Greek word τεσσαρα or τεσσαρες, *four*; respect being had to its number of sides, distinct from the two horizontal planes above and below. And it was thus distinguished from the talus, which being round at each end, contained only four planes or faces on which it could stand; and therefore when thrown had no more than two side faces in view. Hence *ludere talis et ludere tesseris* are spoken of by Roman writers as two different games. The syllable TES. occurs often in Roman inscriptions. The word *tessera* was applied to many other things, not so much from a similitude in the figure, as from the relation they bore to some other thing of which they were the sign or token; as the points on the upper plane of the dye denoted the good or ill success of the cast.

The *tessera hospitalis* was either public or private. As to the former, we find among the inscriptions published by Gruter instances of two municipal towns which put themselves under the patronage of the Roman governor; and the reciprocal engagement between them, engraved on two copper plates, in the form of an oblong square, with a pediment at the top, is called in both *tessera hospitalis*. The design of it was to cultivate or maintain a lasting friendship between private persons and their families; and gave a mutual claim to the contracting parties and their descendants of a reception and kind treatment at each other's houses, as occasion offered. For which end those tesseræ were so contrived as best to preserve the memory of that transaction to posterity. And one method of doing this was by dividing one of them lengthwise into two equal parts; upon each of which one of the parties wrote his name, and interchanged it with the other. From this custom came the prevailing expression *tesseram hospitalem confringere*, applied to persons who violated their engagements.

The *tesseræ frumentariæ* were small tallies given by the emperors to the populace at Rome, entitling them to the reception of a quantity of corn from the public at stated seasons. The person who had the inspection of these was called *tesserarius*. They were made of wood and of stone.

There was another kind of tessera which intitled persons to a sight of the public games and other diversions, usually made in the form of an oblong square.

The *tessera militaris* was a signal given by the general, or chief commander of an army, as a direction to the soldiers for executing any duty or service required of them. This, upon urgent occasions, was only vocal; but, in ordinary cases, it was written on a tablet, commonly made of wood. Beside these civil and military tesseræ, there are others which relate to religious affairs, and may be called *sacred*.

TESSON, or Teston. See Tester.

TESSOUWA, a considerable town in Africa, situated east of Mourzouk, the capital of the kingdom of Fezzan. Near this town a deep and rapid stream is said to have existed, but was overwhelmed by the moving sands so frequent in Africa.

TEST, a vessel used in metallurgy for absorbing the scoriæ of metallic bodies when melted. See Cupel.

Some of the German writers recommend, both for tests and cupels, a sort of friable opake stone, called *white spath*, which appears to be a species of gypsum, or of the stones from which plaster of Paris is prepared. The spath is directed to be calcined with a gentle fire, in a covered vessel, till the slight crackling, which happens at first, has ceased, and the stone has fallen in part into powder: the whole is then reduced into subtle powder, which is passed through a fine sieve, and moistened with so much of a weak solution of green vitriol as is sufficient for making it hold together. Gellert, however, finds, that if the stone is of the proper kind, which can be known only by trials, calcination is not necessary. Scheffer observes, that these kinds of tests are liable to soften or fall asunder in the fire, and that this inconvenience may be remedied by mixing with the uncalcined stone somewhat less than equal its weight, as eight-ninths of such as has been already used and is penetrated by the scoria of the lead, taking only that part of the old test which appears of a green-grey colour, and rejecting the red crust on the top. Tests or cupels made of the spath are said not to requre so much caution in nealing and heating them as the common ones; it appears, however, from Scheffer's account, that they are less durable than those made of the ashes of bones, though greatly superior to those of wood-ashes. Vegetable ashes, which stand pretty well the testing of silver, can scarcely bear any great quantity of gold, this metal requiring a considerably stronger fire than the other; but bone-ashes answer so effectually, and are among us so easily procurable, that it is not needful for the refiner to search for any other materials; though those who work off large quantities of lead, in order to gain a little silver or gold contained in it, may possibly, in places remote from populous cities, avail themselves of substances similar to the spath above-mentioned.

The test, for its greater security, is fixed in the mould in which it was formed; which is sometimes a shallow vessel made of crucible earth or cast-iron, more commonly an iron hoop, with three bars arched downwards across the bottom, about two inches deep, and of different widths, from three or four inches to fifteen or more, according to the quantity of metal to be tested at once. The ashes or earthy powder, moistened as for making cupels, are pressed down in the mould so as to completely fill it or rise a little above the sides; with care to make the mass equally solid, and to put in at once, or at least after the bottom has been pressed close, as much of the matter as will be sufficient for the whole; for any additional quantity will not unite thoroughly with the rest, but be apt to part from it in the fire. The edges are pared smooth, and a portion cut out from the middle with a bent knife, so as to leave a proper cavity, which is smoothed by strewing some dry powder on the surface, and rolling on it a wooden, or rather a glass ball.

The process of testing is often performed in the same manner

Test.

manner as that of cupellation: but where great quantities of base metal are to be worked off from a little gold, recourse is had to a more expeditious method, that of testing before the bellows.

An oval test is placed in a cavity, made in a hearth of a convenient height, and some moistened sand or ashes wetted round it to keep it steady: the nose of a bellows is directed along its surface, in such a manner, that if ashes are sprinkled in the cavity of the test, the bellows may blow them completely out: some have an iron plate fixed before the bellows, to direct the blast downwards. To keep the surface of the test from being injured in putting in the metal, some cloths or pieces of paper are interposed. The fuel consists of billets of barked oak laid on the sides of the test, with others laid crosswise on these: the bellows impel the flame on the metal, clear the surface of ashes or sparks of coal, hasten the scorification of the lead, and blow off the scoria, as fast it forms, to one end of the test, where it runs out thro' a notch made for that purpose. About two thirds of the scorified lead may thus be collected; the rest being partly absorbed by the test, and partly dissipated by the action of the bellows. Care must be taken not to urge the blast too strongly, lest some portion of the gold should be carried away by the fumes impetuously forced off from the lead, and some minute particles of it entangled and blown off with the scoriæ.

Test-Act, in law, is the statute 25 Car. II. cap. 2. which directs all officers, civil and military, to take the oaths, and make the declaration against transubstantiation, in the court of King's Bench or Chancery, the next term, or at the next quarter-sessions, or (by subsequent statutes) within six months after their admission; and also within the same time to receive the sacrament of the Lord's Supper, according to the usage of the church of England, in some public church, immediately after divine service or sermon, and to deliver into court a certificate thereof, signed by the minister and church warden, and also to prove the same by two credible witnesses, upon forfeiture of 500l. and disability to hold the said office.

The avowed object of this act was to exclude from places of trust all members of the church of Rome; and hence the dissenters of that age, if they did not support the bill when passing through the two houses of parliament, gave it no opposition. For this part of their conduct they have been often censured with severity, as having betrayed their rights from resentment to their enemies. But is this a fair state of the case? Were any rights in reality betrayed? That the dread of a popish successor and of popish influence was the immediate and urgent cause of passing the *test-act*, is indeed true; but that the legislature, when guarding against an impending evil, had not likewise a retrospect to another from which they had so recently been delivered, is not so evident. If it be proper to support an established church as a branch of the constitution, and if the test-act be calculated to afford that support to the church of England, it is probable that the deliberations of parliament were as much influenced by the dread of puritanic fury, and a renewal of the covenant, as by apprehensions of a persecution from a popish king and popish councils. That the members of the church established by law in England had as much reason to dread the effects of power in the hands of Puritans as in the hands of Papists, no impartial man will controvert, who is not a stranger to that period of our national history; and that it was the duty of the legislature by every method in their power to provide for the security of the constitution against the machinations of both its enemies, will be admitted by all but such as are in love with anarchy on the one hand, or with despotism on the other.

Test.

Many people, when they talk or write of the *test-act*, seem to think that it was framed in opposition to the religious opinions of the church of Rome; and finding that Protestant dissenters, who abhor these opinions, deprived by it of their civil *rights*, they speak with indignation of a law which confounds the innocent with the guilty. But all this proceeds from a palpable mistake of the purpose of the test. As the legislature had no authority to make laws against *any opinions whatever*, on account of their being false in theology; so it is not to be supposed that, in their deliberations on the TEST-ACT, the members of that august body took into their consideration the comparative orthodoxy of the distinguishing tenets of the Catholics and Puritans. As a religious sect they might esteem the latter much more than the former; but if they found that both had combined with their theological doctrines opinions respecting civil and ecclesiastical government, inconsistent with the fundamental principles of the English constitution, they had an undoubted right to enact a law, by which none should be admitted to offices, in the execution of which they could injure the constitution, without previously giving security that their administration should support it in all its branches. It had not then been doubted, nor is there reason to doubt yet, but that an established religion is necessary, in conjunction with civil government, to preserve the peace of society; and therefore in every well regulated state an established religion must be supported, not because it is the duty of the civil magistrate to conduct his subjects to future happiness, but because he cannot without such an establishment preserve among them present tranquillity. The establishment which must best answer this purpose, is that which, teaching the great and unchangeable duties of morality, is most acceptable in its government and forms of worship to the majority of the people; and therefore in giving a legal establishment to one constitution of the church in preference to all others, it is only this circumstance, and not the comparative purity of the rival churches, viewed merely as ecclesiastical corporations, to which it is the business of the legislature to pay attention. At the time when the *test-act* passed the two houses of parliament, the established church of England was certainly more acceptable to the great body of the people and to all ranks in the state, than any one of the sects, whether Catholic or Protestant, which dissented from her; and therefore it was the duty of the legislature to preserve to that church all her privileges and immunities, and to prevent those hostile sectaries from doing her injury in the discharge of any civil office with which they might be entrusted. It was with this view that the *test-act* was formed; and it is with the same view that the legislature has hitherto rejected every petition for its repeal. In doing so, it deprives no man of his *rights*, far less of rights which *conscience* calls upon him to maintain at every hazard; for the rights of individuals to hold civil offices are not inherent, but derived from the legislature, which of course must be the judge upon what terms they are to be held. The legislature of England has excluded from many offices, civil and military, every man who will not give security, that in the discharge of his public duty he will support the church established by law; and as the test of his intention, it requires him, before he enters upon his office, to renounce the doctrine of transubstantiation, and receive the sacrament of the Lord's Supper in some public church, according to the liturgy of the church of England. Whether this be the most proper test that could have been exacted, may well be questioned; but that in a country abounding with sectaries of various deno-

Test. minations, who agree in nothing but venomous hostility to the religious establishment. Any test is necessary, seems incontrovertible, if it be the business of the legislature to preserve the public peace.

To this it will be replied, That the public peace in Scotland is preserved without a test, and that therefore a test cannot be necessary in England. This is plausible, but not conclusive. For forty years after the Revolution, there was in Scotland no denomination of Christians but those of the Presbyterian church, established by law, the Protestant Episcopalians, whose church had been established prior to that event, and the adherents to the church of Rome. The Episcopalians and Papists were effectually excluded from every office in which they could injure the ecclesiastical establishment, by the several restrictions under which they were laid, on account of their attachment, real or supposed, to the abdicated family of Stuart. The penal laws operated upon them more powerfully than a religious test. It is to be observed too, that in the church of Scotland, though her clergy are better provided for than any other parochial clergy perhaps in Europe (A), there is nothing of that splendor and temporal power which in England excite envy to clamour against the establishment, under the pretence of maintaining the cause of religious liberty. Yet even in Scotland a religious test is occasionally exacted of civil officers. In the royal boroughs of that part of the united kingdom, no man can hold the office of a magistrate without previously swearing the burgess-oath (see SECEDERS, n° 8.); and every instructor of youth, whether in schools or colleges, may be called upon to qualify himself for his office, by subscribing the established Confession of Faith. The burgess-oath is a more effectual test than that which is required of magistrates in England; for a man might with a safe conscience receive the sacrament of the Lord's Supper occasionally in a church, "at which he would not swear to abide and defend the same to his life's end." This test appears to us to be necessary in boroughs, where faction is commonly blended with fanaticism; and if those sectaries which, at their first appearance in 1732, were insignificant, if not contemptible, continue to multiply, and to imbibe principles much more pernicious than those which were held by their fathers, it may perhaps be found expedient to extend some test over the whole country.

We do not, however, by any means, wish to see the sacramental test introduced into Scotland. A test may be necessary to secure to the church all her rights and immunities; but to receive the sacrament can give her no such security, whilst it leads inevitably to the profanation of a sacred ordinance. A much better test would be, to require every man, before he be admitted to an executive office, to swear that in the discharge of it he will be careful to maintain all the rights and privileges of the church established by law. Such an oath no sensible and peaceable dissenter could refuse; for it would not bind him to communicate with the established church; and he cannot be ignorant that it belongs not to the executive government, but to the legislature, to determine what shall be the religion of the state. On this account, we cannot help thinking that the members of the legislative body should be subjected to no religious test whatever, that they may be at freedom to reform the corruptions of the church, or to exchange one establishment for another, should they find such exchange expedient. If this reasoning be just, it will be difficult to vindicate that clause of 25 Car. II. and of 1 Geo. I. in which it is enacted, that no member shall vote or sit in either house of parliament till he hath, in the presence of the house, subscribed and repeated the declaration against transubstantiation, the invocation of saints, and the sacrifice of the mass. The church of Rome is indeed a very corrupt society; but if it be not for the purity of her doctrines and government that any church is established in preference to all others, why should that particular church be precluded from the possibility of obtaining a legal establishment in Great Britain, even though she were to become most acceptable to the majority of all ranks in the kingdom? The English Catholics have unquestionably greater reason to complain of this test, than either they or the dissenters have to complain of the law which requires every civil and military officer to receive the Lord's Supper in the established church.

Test. || Testaceous.

Test for Acids and Alkalis. See CHEMISTRY, p. 595, n° 1549.

Test Liquors for Wines. See LEAD, p. 741. col. 2. and ARSENIC, n° 16.

TESTACEA, in the Linnæan system of natural history, the third order of vermes. This order comprehends all shell-fish arranged by Linnæus under 36 genera. Shell-fish are animals with a soft body, covered by or inclosed in a firm, hard, and as it were stony habitation, composed, according to their three separate orders, 1st, Of many parts which are ranged under the name of *multivalves*; 2d, Of two parts which are called *bivalves*; 3d, Of one part or piece only, which we call *univalves*. Those parts, pieces, or valves, are more or less moveable at the animal's pleasure. The animals included in these hard habitations have most of them the characters of one or other of the genera vermium, and might be reduced under the same genera with the mollusca: but as these characters are few, and the shells very numerous, and different in their form and structure, it will tend more to make this part of natural history easy, to arrange the subjects according to the distinctions of the shells themselves.

Barbut's Genera Vermium.

There is this farther consideration in favour of this arrangement, viz. that the animals themselves are rarely seen, and never can be preserved in cabinets; whereas the shells make a figure in them, and great numbers have been met with empty of the animal.

TESTACEOUS, in natural history, an epithet synonymous with TESTACEA.

In medicine, all preparations of shells, and substances of the like kind, are called *testaceous*. Such are powders of crabs claws and eyes, pearl, &c. Dr Quincy and others suppose the virtue of all testaceous medicines to be alike; that they seldom or never enter the lacteals, but that the chief of their action is in the first passages; in which, however,

(A) There are indeed many livings in the church of England, and probably in other churches, to which nothing in the church of Scotland can be compared in respect of emolument; but these rich benefices bear no proportion to the number of those which, in this age of unavoidable expence, cannot afford to the incumbents the means of decent subsistence as gentlemen. In the church of Scotland many livings amount to L. 200 each annually; and we have reason to hope, that when the present plan for augmenting the stipends of the clergy has been extended over Scotland, very few will be below L. 100; whilst in England the vicarages and small rectories, from which we have reason to believe that the incumbents receive not L. 50 a-year, greatly exceed in number all the livings in Scotland: Nay we doubt if there be not upwards of a thousand livings in England and Wales from which the rector or vicar derives not above L. 50 annually.

Testament ever, they are of great use in absorbing acidities. Hence they become of use in fevers, and especially in rectifying the many distempers in children, which generally owe their origin to such acidities.

TESTAMENT, or LAST WILL. Testaments both Justinian and Sir Edward Coke agree to be so called, because they are *testatio mentis*: an etymon which seems to savour too much of conceit; it being plainly a substantive derived from the verb *testari*, in like manner as *juramentum*, *incrementum*, and others, from other verbs. The definition of the old Roman lawyers is much better than their etymology; *voluntatis nostrae justa sententia de eo, quod quis post mortem suam fieri velit*: which may be thus rendered into English, "the legal declaration of a man's intentions, which he wills to be performed after his death." It is called *sententia*, to denote the circumspection and prudence with which it is supposed to be made: it is *voluntatis nostrae sententia*, because its efficacy depends on its declaring the testator's intention, whence in English it is emphatically styled his *will*; it is *justa sententia*; that is, drawn, attested, and published, with all due solemnities and forms of law: it is *de eo, quod quis post mortem suam fieri velit*, because a testament is of no force till after the death of the testator.

Blackst. Comment. vol. ii.

These testaments are divided into two sorts; written, and verbal or nuncupative; of which the former is committed to writing; the latter depends merely upon oral evidence, being declared by the testator *in extremis*, before a sufficient number of witnesses, and afterwards reduced to writing.

But as nuncupative wills and CODICILS (which were formerly more in use than at present when the art of writing is become more general) are liable to great impositions, and may occasion many perjuries, the statute of frauds, 29 Car. II. c. 3. enacts, 1. That no written will shall be revoked or altered by a subsequent nuncupative one, except the same be in the lifetime of the testator reduced to writing, and read over to him, and approved; and unless the same be proved to have been so done by the oaths of three witnesses at the least, who, by statute 4 & 5 Anne, c. 16. must be such as are admissible upon trials at common law. 2. That no nuncupative will shall in anywise be good, where the estate bequeathed exceeds 30 l. unless proved by three such witnesses, present at the making thereof (the Roman law requiring seven), and unless they or some of them were specially required to bear witness thereto by the testator himself; and unless it was made in his last sickness, in his own habitation or dwelling-house, or where he had been previously resident ten days at the least, except he be surprised with sickness on a journey, or from home, and dies without returning to his dwelling. 3. That no nuncupative will shall be proved by the witnesses after six months from the making, unless it were put in writing within six days. Nor shall it be proved till fourteen days after the death of the testator, nor till process hath first issued to call in the widow, or next of kin, to contest it if they think proper. Thus hath the legislature provided against any fraud in setting up nuncupative wills, by so numerous a train of requisites, that the thing itself has fallen into disuse; and hardly ever heard of, but in the only instance where favour ought to be shown to it, when the testator is surprised by sudden and violent sickness. The testamentary words must be spoken with an intent to bequeath, not any loose idle discourse in his illness; for he must require the bystanders to bear witness of such his intention: the will must be made at home, or among his family or friends, unless by unavoidable accident, to prevent impositions from strangers: it must be in his last sickness; for if he recovers, he may alter his dispositions, and have time to make a written will: it must not be proved at too long a distance from the testator's death, lest the words should escape the memory of the witnesses; nor yet too hastily and without notice, lest the family of the testator should be put to inconvenience or surprised.

Testament.

As to written wills, they need not any witness of their publication. We speak not here of devises of lands, which are entirely another thing, a conveyance by statute, unknown to the feodal or common law, and not under the same jurisdiction as personal testaments. But a testament of chattels, written in the testator's own hand, though it has neither his name nor seal to it, nor witnesses present at its publication, is good; provided sufficient proof can be had that it is his hand writing. And though written in another man's hand, and never signed by the testator, yet if proved to be according to his instructions and approved by him, it hath been held a good testament of the personal estate. Yet it is the safer and more prudent way, and leaves less in the breast of the ecclesiastical judge, if it be signed or sealed by the testator, and published in the presence of witnesses; which last was always required in the time of Bracton; or rather he in this respect has implicitly copied the rule of the civil law.

No testament is of any effect till after the death of the testator; *Nam Omne testamentum morte consummatum est, et voluntas testatoris est ambulatoria usque ad mortem.* And therefore, if there be many testaments, the last will overthrows all the former; but the republication of a former will revoke one of a later date, and establishes the first again.

Regularly, every person hath full power and liberty to make a will, that is not under some special prohibition by law or custom: which prohibitions are principally upon three accounts; for want of sufficient discretion; for want of sufficient liberty and free-will; and on account of criminal conduct.

1. In the first species are to be reckoned infants, under the age of 14 if males, and 12 if females; which is the rule of the civil law. For though some of our common lawyers have held that an infant of any age (even four years old) might make a testament, and others have denied that under 18 he is capable; yet as the ecclesiastical court is the judge of every testator's capacity, this case must be governed by the rules of the ecclesiastical law. So that no objection can be admitted to the will of an infant of 14, merely for want of age; but if the testator was not of sufficient discretion, whether at the age of 14 or 24, that will overthrow his testament. Madmen, or otherwise *non compotes*, idiots or natural fools, persons grown childish by reason of old age or distemper, such as have their senses besotted with drunkenness, —all these are incapable, by reason of mental disability, to make any will so long as such disability lasts. To this class also may be referred such persons as are born deaf, blind, and dumb; who, as they have always wanted the common inlets of understanding, are incapable of having *animum testandi*, and their testaments are therefore void.

2. Such persons as are intestable for want of liberty or freedom of will, by the civil law are of various kinds; as prisoners, captives, and the like. But the law of England does not make such persons absolutely intestable; but only leaves it to the discretion of the court to judge upon the consideration of their particular circumstances of duress, whether or no such persons could be supposed to have *liberum animum testandi*. And, with regard to feme coverts, our laws differ still more materially from the civil. Among the Romans there was no distinction; a married woman was as capable of bequeathing as a feme-sole. But with us a married

Testament.

married woman, is not only utterly incapable of devising lands, being excepted out of the statute of wills, 34 & 35 Hen. VIII. c. 5. but also she is incapable of making a testament of chattels without the licence of her husband. For all her personal chattels are absolutely his own; and he may dispose of her chattels real, or shall have them to himself if he survives her: it would be therefore extremely inconsistent to give her a power of defeating that provision of the law, by bequeathing those chattels to another. The queen consort is an exception to this general rule, for she may dispose of her chattels by will, without the consent of her lord; and any feme-covert may make her will of goods which are in her possession in auter droit, as executrix or administratrix; for these can never be the property of the husband: and if her husband permits her to have separate maintenance, it is said she may dispose of her savings thereout by testament, without the control of her husband. But if a feme-sole makes her will, and afterwards marries, such subsequent marriage is esteemed a revocation in law, and entirely vacates the will.

3. Persons incapable of making testaments on account of their criminal conduct, are in the first place all traitors and felons, from the time of conviction; for then their goods and chattels are no longer at their own disposal, but forfeited to the king. Neither can a *felo de se* make a will of goods and chattels, for they are forfeited by the act and manner of his death; but he may make a devise of his lands, for they are not subject to any forfeiture. Outlaws also, though it be but for debt, are incapable of making a will so long as the outlawry subsists, for their goods and chattels are forfeited during that time. As for persons guilty of other crimes, short of felony, who are by the civil law precluded from making testaments (as usurers, libellers, and others of a worse stamp), at the common law their testaments may be good. And in general the rule is, and has been so at least ever since Glanvil's time, *quod libera sit cujuscunque ultima voluntas*.

Testaments may be avoided three ways: 1. If made by a person labouring under any of the incapacities before-mentioned; 2. By making another testament of a later date; and, 3. By cancelling or revoking it. For though I make a last will and testament irrevocable in the strongest words, yet I am at liberty to revoke it; because my own act or words cannot alter the disposition of law, so as to make that irrevocable which is in its own nature revocable. For this, saith lord Bacon, would be for a man to deprive himself of that which, of all other things, is most incident to human condition; and that is, alteration or repentance. It hath also been held, that, without an express revocation, if a man, who hath made his will, afterwards marries and hath a child, this is a presumptive or implied revocation of his former will which he made in his state of celibacy. The Romans were also wont to lay aside testaments as being *inofficiosa*, deficient in natural duty, if they disinherited or totally passed by (without assigning a true and sufficient reason) any of the children of the testator. But if the child had any legacy, though ever so small, it was a proof that the testator had not lost his memory or his reason, which otherwise the law presumed; but was then supposed to have acted thus for some substantial cause: and in such case no *querela inofficiosi testamenti* was allowed. Hence probably has arisen that groundless vulgar error of the necessity of leaving the heir a shilling, or some other express legacy, in order to disinherit him effectually; whereas the law of England makes no such wild supposition of forgetfulness or infirmity; and therefore, though the heir or next of kin be totally omitted, it admits no *querela* to set aside such a testament.

Testament, in Scots law. See Law, nº clxxxi. 2. &c.

Testament (Old and New). See **Bible** and **Scripture**.

Testament || Testudo.

TESTATOR, the person who makes his will and testament.

TESTER, Teston, the name of a coin struck in France by Louis XII. in 1513, and in Scotland in the time of Francis II. and Mary queen of Scotland, so called from the head of the king, which was engraved upon it. The silver it contained was 10 deniers 18 grains, its weight 7 deniers 1 ½ grains, and its value 10 sols. The coinage of it was prohibited by Henry III. in 1575, when the value of it was augmented to 14 sols six deniers. The teston or testoon was rated at 12d. in the reign of Henry VIII. and afterwards reduced to 6d.

TESTES, in anatomy, the testicles. See the next article.

TESTICLE (*testis*), a double part in animals of the male kind, serving for the office of generation.—See Anatomy, nº 107. They are called *testiculi*, by diminution of *testes*, "witnesses;" as giving testimony of virility. The Greeks call them *didymi*, or "twins."

In man and most animals, the testicles are exterior; in some, as fowls, interior. Some men have only one, ordinarily they have two; some have naturally had three; nay, anatomists observe they have known four.

TESTIMONY. See Logic, nº 29. and Metaphysics, nº 137—138.

Testimony, in law. See Evidence.

TESTUDO, the Tortoise, in zoology; a genus belonging to the class of *amphibia*, and order of *reptilia*. The body has a tail, and is defended with a bony or coriaceous covering. The mouth has naked mandibles without teeth. There are 33 species, of which the *mydas* or common sea-turtle is the most remarkable. It is found in the island of Ascension and other places in the South Sea. The shell is so very strong that it can carry more than 600 lbs. on its back, or as many men as can stand on it loaded. It digs round holes in the sand, in which it lays a vast number of eggs yearly, to the amount of 1000, it is said. It broods on them during the night. Its flesh is of a greenish colour, makes excellent food, and is the favourite dish of sailors as well as of epicures. It lives on cuttle and shell fish, and grows to a prodigious size, some having been found to weigh 400 lbs.

The Americans find so good account in catching turtle, that they have made themselves very expert at it: they watch them from their nests on shore, in moon-light nights; and, before they reach the sea, turn them on their backs, and leave them till morning; when they are sure to find them, since they are utterly unable to recover their former posture: at other times they hunt them in boats, with a peculiar kind of spear, striking them with it through the shell; and as there is a cord fastened to the spear, they are taken much in the same manner as the whales.

Mr White, in his Natural History of Selborne, mentions a land-tortoise which had been kept for 30 years at Ringmer near Lewes. It retired under ground about the middle of November, and came forth again about the middle of April. At its first appearance in spring it showed little inclination for food; in the height of summer it became voracious; its appetite again diminished toward autumn, so that for the last six weeks it scarcely ate any thing at all. It lived chiefly on milky plants, such as lettuces, dandelions, and sow-thistles. Nothing surprised Mr White more than the extreme timidity it always showed for rain; for though it had a shell that would secure it against the wheel of a loaded cart, yet it discovered as much solicitude about rain as a fine lady dressed in her best attire, shuffling away on the first sprinklings,

lines, and running its head up in a corner. It not only slept during winter, but for a great part of the summer; for it went to bed in the longer days at four in the afternoon, and often did not stir in the morning till it was late. There was one season usually about the beginning of June when its exertions were remarkable. It then rose by five in the morning, and walked on tip toe, traversing the garden examining every wicket and interstice in the fences. The motives that led it to these rambles seemed to be of the amorous kind. Mr White says it was an excellent weather-glass; for whenever it walked upright and fed with great avidity in the morning, it rained before night. It showed great sagacity in discerning those who did it kind offices; for whenever the old lady who had fed it for 30 years came in sight, it hobbled towards her with awkward alacrity.

Testudo, in antiquity, was particularly used among the poets, &c. for the ancient lyre; because it was originally made by its inventor Mercury, of the back or hollow of the testudo aquatica, or sea-tortoise, which he accidentally found on the banks of the river Nile. See Lyre.

Testudo, in the military art of the ancients, was a kind of cover or screen which the soldiers, *e. gr.* a whole company, made themselves of their bucklers, by holding them up over their heads, and standing close to each other. This expedient served to shelter them from darts, stones, &c. thrown upon them, especially those thrown from above, when they went to the assault.

Testudo, was also a kind of large wooden tower which moved on several wheels, and was covered with bullock hides, serving to shelter the soldiers when they approached the walls to mine them, or to batter them with rams. It was called *testudo*, from the strength of its roof, which covered the workmen as the shell does the tortoise.

TETANUS, a dreadful spasmodic disorder, in which the whole body becomes rigid and inflexible. It most commonly proves mortal. See Medicine, n° 279.

TETHYS, a genus of insects belonging to the class of *vermes*, and order of *mollusca*. The body is oblong, fleshy, and without feet; the mouth consists of a cylindrical proboscis under the duplicature of a lip; and there are two foramina at the left side of the neck. The species are two, both inhabitants of the ocean.

TETRACERA, in botany; a genus of plants belonging to the class of *polyandria*, and order of *tetragynia*, and in the natural system ranging under the doubtful. The calyx is hexaphyllous, and the capsules four. There is only one species, the volubilis.

TETRADYNAMIA, (τεσσαρες "four," and δυναμις "power"), four powers; the name of the 15th class in Linnæus's Sexual System, consisting of plants with hermaphrodite flowers, having six stamina, four of which are long, and two short; it corresponds to the *siliquosæ* of Ray, and *cruciformes* of Tournefort. All the species belonging to this class are distinguished by cruciform flowers. It comprehends two orders, *gymnospermia*, those plants which have naked seeds, being four in number, (except phryma which is monospermous); and *angiospermia*, which contains those plants the seeds of which are inclosed in a capsule. See Botany, p. 430.

TETRAGONIA, in botany; a genus of plants belonging to the class of *icosandria*, and order of *monogynia*; and in the natural system ranging under the 13th order, *succulentæ*. The calyx is divided into three, four, or five parts. There is no corolla; the drupe is beneath, and the nut three or eight-celled. There are seven species; the puticosa, decumbens, herbacea, echinata, expansa, crystallina, and the japonica.

TETRAGRAMMATON, τετραγραμματον, a denomination given by the Greeks to the Hebrew name of God יהוה, "Jehovah," because in the Hebrew it consists of four letters.

TETRAGYNIA, (τεσσαρες "four," and γυνη "a woman"); the name of an order or secondary division in the 4th, 5th, 6th, 8th, and 13th classes in the Sexual System; consisting of plants which, to the classic character, whatever it is, add the circumstance of having four styles or female organs. Herb paris and grass of Parnassus furnish examples.

TETRANDRIA, (τεσσαρες "four," and ανηρ "a man or husband"); the name of the fourth class in Linnæus's Sexual System, consisting of plants with hermaphrodite flowers, which have four stamina or male organs that are of equal length. In this last circumstance consists the main difference, according to Linnæus, between the plants of the class in question and those of the 14th class *didynamia*, in which the four stamina are of unequal length, two of them being long, and two short.—The orders of this numerous class are three, founded upon the number of styles or female organs. Scabious, teazel, barren-wort, the starry plants of Ray, and the greater number of genera in this class, have one style; dodder and hypecoum have two; holly and a few others have four.

TETRAO, in ornithology; a genus of birds belonging to the order of *gallinæ*, and is thus characterized by Linnæus: There is a spot near the eyes naked or papillose, or covered, though more rarely, with feathers. Gmelin has enumerated about 66 species. The genus tetrao comprehended both the grous, partridge, and quail; but Dr Latham, with great judgment and propriety, has made two genera of them, under the names of *tetrao*, comprehending the grous; and *perdix*, comprehending the partridge and quail. Dr Latham thus distinguishes the genus *tetrao*: The bill is like a crooked cone, with a naked scarlet skin above each eye, and the feet feathered to the toes. The *perdix* he characterizes by a bill convex, strong, and short; the nostrils are covered above with a callous prominent rim; the orbits are papillose; the feet naked, and most of the species are furnished with spurs. He reckons 20 species under the *tetrao*, and 45 under the *perdix*. As we highly approve of this new arrangement of Dr Latham, we are disposed to follow it; but as a reference has been made from Perdix to this place, it is proper that we should also give some account of that genus.

I. Tetrao. Of this genus the following species are found in Britain: 1. The *urogallus*, or wood-cock, inhabits woody and mountainous countries; in particular, forests of pines, birch-trees, and junipers; feeding on the tops of the former and berries of the latter; the first often infects the flesh with such a taste as to render it scarcely eatable. In the spring it calls the females to its haunts with a loud and shrill voice; and is at that time so very inattentive to its safety, as to be very easily shot. It is then perched on a tree, and descends to the females on their first appearance. They lay from 8 to 16 eggs; eight at the first, and more as they advance in age.

This bird is common to Scandinavia, Germany, France, and several parts of the Alps.—It is found in no other part of Great Britain than the Highlands of Scotland, north of Inverness; and is very rare even in those parts. It is there known by the name of *capercalzie*, *auer-calzie*, and in the old law-books *caperkally*; the last signifying the horse of the woods: this species being, in comparison of others of the genus, pre-eminently large.

The length of the male is two feet nine inches: its weight sometimes 14 pounds. The female is much less, the

Tetrao. the length being only 26 inches. The ſexes differ alſo greatly in colours. The bill of the male is of a pale yellow; the head, neck, and back, are elegantly marked, ſlender lines of grey and black running tranſverſely. The upper part of the breaſt is of a rich gloſſy green: the reſt of the breaſt and the belly black, mixed with ſome white feathers; the ſides are marked like the neck; the coverts of the wings croſſed with undulated lines of black and reddiſh brown; the exterior webs of the greater quill feathers are black: the tail conſiſts of 18 feathers, the middle of which is the longeſt; their are black, marked on each ſide with a few white ſpots. The legs are very ſtrong, and covered with brown feathers; the edges of the toes are pectinated. —Of the female, the bill is duſky; the throat red; the head, neck, and back, are marked with tranſverſe bars of red and black: the breaſt has ſome white ſpots on it, and the lower part is of a plain orange colour: the belly is barred with pale orange and black; the tips of the feathers are white. The tail is of a deep ruſt-colour barred with black, tipped with white, and conſiſts of 16 feathers.

2. The *tetrix*, black grous, or black cock, like the former ſpecies, is fond of woody and mountainous ſituations; feeding on bilberries and other mountain fruits, and in the winter on the tops of the heath. In the ſummer they frequently deſcend from the hills to feed on corn. They never pair; but in the ſpring the male gets upon ſome eminence, crows and claps his wings; on which ſignal all the females within hearing reſort to him. The hen lays ſeldom more than ſix or ſeven eggs. When the female is obliged, during the time of incubation, to leave her eggs in queſt of food, ſhe covers them up ſo artfully with moſs or dry leaves, that it is very difficult to diſcover them. On this occaſion ſhe is extremely tame and tranquil, however wild and timorous at other times. She often keeps to her neſt, though ſtrangers attempt to drag her away. As ſoon as the young ones are hatched, they are ſeen running with extreme agility after the mother, though ſometimes they are not entirely diſengaged from the ſhell. The hen leads them forwards for the firſt time into the woods, to ſhow them ant's eggs and the wild mountain-berries, which, while young, are their only food. As they grow older their appetites grow ſtronger, and they then feed upon the tops of heather and the cones of the pine-tree. In this manner they ſoon come to perfection: they are hardy birds, their food lies every where before them, and it would ſeem that they ſhould increaſe in great abundance. But this is not the caſe; their numbers are thinned by rapacious birds and beaſts of every kind, and ſtill more by their own ſalacious conteſts.—As ſoon as the hatching is over, which the female performs in the manner of an hen, the whole brood follows the mother for about a month or two; at the end of which the young males entirely forſake her, and keep in great harmony together till the beginning of ſpring. At this ſeaſon they begin for the firſt time to feel the amorous paſſions; and then adieu to all their former friendſhips! They begin to conſider each other as rivals; and the rage of concupiſcence quite extinguiſhes the ſpirit of ſociety. They fight each other like game cocks; and at that time are ſo inattentive to their own ſafety, that it often happens that two or three of them are killed at a ſhot. It is probable, that in theſe conteſts the bird which comes off victorious takes poſſeſſion of the female ſeraglio, as it is certain they have no faithful attachments.

An old black cock is in length 22 inches, and weighs near four pounds. The bill is duſky; and the plumage of the whole body black, gloſſed over the neck and rump with a ſhining blue. The coverts of the wings are of a duſky brown; the inner coverts white; the thighs and legs are covered with dark brown feathers; the toes reſemble thoſe of the former ſpecies. The tail conſiſts of 16 black feathers, and is much forked; the exterior feathers bend greatly outwards, and their ends ſeem as if cut off.—The female weighs only two pounds; and its length is one foot ſix inches. The head and neck are marked with alternate bars of dull red and black; the breaſt with duſky black and white; but the laſt predominates. The back, coverts of the wings, and tail, are of the ſame colours as the neck, but the red is deeper. The tail is ſlightly forked; it conſiſts of 18 feathers variegated with red and black. The feathers under the tail are white, marked with a few bars of black and orange. This bird hatches its young late in the ſummer. It lays from ſix to eight eggs, of a dull yellowiſh white colour, marked with numbers of very ſmall ferruginous ſpecks; and towards the ſmaller end with ſome blotches of the ſame hue.

3. The *ſcoticus*, red game, or moor fowl, is peculiar to the Britiſh iſlands. The male weighs about 19 ounces; and is in length 15½ inches. The bill is black; the irides hazel-coloured. The throat is red. The plumage on the head and neck is of a light tawny red; each feather is marked with ſeveral tranſverſe bars of black. The back and ſcapular feathers are of a deeper red; and on the middle of each feather is a large black ſpot; the breaſt and belly are of a dull purpliſh brown, croſſed with numerous narrow duſky lines; the quill-feathers are duſky; the tail conſiſts of 16 feathers of an equal length, all of them (except the four middlemoſt) are black, and the middle feathers are barred with red: the thighs are of a pale red, barred obſcurely with black; the legs and feet clothed to the very claws with thick ſoft white feathers. The claws are whitiſh, very broad and ſtrong. The female weighs only 15 ounces.—The colours in general are duller than thoſe of the male: the breaſt and belly are ſpotted with white; and the tips of ſome of the coverts of the wings are of the ſame colour.—Theſe birds pair in the ſpring, and lay from ſix to ten eggs. The young brood follow the hen the whole ſummer; in the winter they join in flocks of 40 or 50, and become remarkably ſhy and wild; they always keep on the tops of the hills, are ſcarce ever found on the ſides, and never deſcend into the valleys. Their food is the mountain-berries and tops of the heath.

4. The *lagopus*, white game or ptarmigan, is 15 inches in length, and weighs 19 ounces. Its plumage is of a pale brown or aſh colour, elegantly croſſed or motled with ſmall duſky ſpots and minute bars; the head and neck with broad bars of black, ruſt colour, and white: the belly and wings are white, but the ſhafts of the greater quill feathers black. In the male, the grey colour predominates, except on the head and neck, where there is a great mixture of red, with bars of white. The females and young birds have a great deal of ruſt colour in them. The tail conſiſts of 16 feathers; the two middle of which are aſh-coloured, motled with black, and tipped with white; the two next black, ſlightly marked with white at their ends, the reſt wholly black: the feathers incumbent on the tail are white, and almoſt entirely cover it.

Ptarmigans are found in theſe kingdoms only on the ſummits of the higheſt hills of the Highlands of Scotland, of the Hebrides, and Orkneys; and a few ſtill inhabit the lofty hills near Keſwick in Cumberland as well as the mountains of Wales. They live amidſt the rocks, perching on the grey ſtones, the general colour of the ſtrata in thoſe exalted ſituations. They are very ſilly birds; ſo tame as to bear driving like poultry; and, if provoked to riſe, take very ſhort flights, making a great circuit like pigeons. Like

Like the grous, they keep in ſmall packs; but never, like thoſe birds, take ſhelter in the heath, but beneath looſe ſtones. To the taſte they ſcarce differ from a grous.

Theſe birds are called by Pliny *lagopi*, their feet being clothed with feathers to the claws, as the hare's are with fur: the nails are long, broad, and hollow. The firſt circumſtance guards them from the rigour of the winter; the latter enables them to form a lodge under the ſnow, where they lie in heaps to protect themſelves from the cold. The feet of the grous are clothed in the ſame manner; but thoſe of the two firſt ſpecies here deſcribed, which perch upon trees, are naked, the legs only being feathered, not being in want of ſuch a protection.

II. Perdix, comprehends both the partridge and quail.

The common partridge is ſo well known that a deſcription of it is unneceſſary, and we have not room to deſcribe the foreign ſpecies. We refer thoſe who wiſh complete information to the accurate and valuable Syſtem of Ornithology publiſhed by Dr Latham. The ſcientific ornithologiſt will find much ſatisfaction in his *Index Ornithologicus*, publiſhed in 2 vols 4to; and he who wiſhes to be acquainted with the nature and diſpoſitions of birds, will read his *Synopſis* with pleaſure, publiſhed in 7 vols 4to.

The following general account of the partridge will ſuffice: "Theſe birds (ſays Willoughby) hold the principal place in the feaſts and entertainments of princes; without which their feaſts are eſteemed ignoble, vulgar, and of no account. The Frenchmen do ſo highly value, and are ſo fond of the partridge, that if they be wanting, they utterly ſlight and deſpiſe the beſt ſpread tables; as if there could be no feaſt without them." But however this might be in the times of our hiſtorian, the partridge is now too common in France to be conſidered as a delicacy; and this, as well as every other ſimple diſh, is exploded for luxuries of a more compound invention. In England, where the partridge is much ſcarcer, and a great deal dearer, it is ſtill a favourite delicacy at the tables of the rich; and the deſire of keeping it to themſelves has induced them to make laws for its preſervation, no way harmoniſing with the general ſpirit of Engliſh legiſlation.

The partridge ſeems to be a bird well known all over the world, as it is found in every country and in every climate; as well in the frozen regions about the pole, as the torrid tracks under the equator. It even ſeems to adapt itſelf to the nature of the climate where it reſides. In Greenland, the partridge, which is brown in ſummer, as ſoon as the icy winter ſets in, begins to take a covering ſuited to the ſeaſon: it is then clothed with a warm down beneath; and its outward plumage aſſumes the colour of the ſnow among which it ſeeks its food. Thus it is doubly fitted for the place, by the warmth and the colour of its plumage; the one to defend it from the cold, the other to prevent its being noticed by the enemy. Thoſe of Barakonda, on the other hand, are longer legged, much ſwifter of foot, and chooſe the higheſt rocks and precipices to reſide in.—They all, however, agree in one character, of being immoderately addicted to venery; and, as ſome writers affirm, often to an unnatural degree. It is certain, the male will purſue the hen even to her neſt; and will break her eggs rather than not indulge his inclinations. Though the young ones have kept together in flocks during the winter, when they begin to pair in ſpring their ſociety diſperſes; and combats, very terrible with reſpect to each other, enſue. Their manners in other circumſtances reſemble all thoſe of poultry in general; but their cunning and inſtinct ſeem ſuperior to thoſe of the larger kinds. Perhaps, as they live in the very neighbourhood of their enemies, they have more frequent occaſion to put their little arts in practice, and learn by habit the means of evaſion or ſafety. Whenever therefore a dog or other formidable animal approaches their neſt, the female uſes every means to draw him away. She keeps juſt before him, pretends to be incapable of flying, juſt hops up, and then falls down before him, but never goes off ſo far as to diſcourage her purſuer. At length, when ſhe has drawn him entirely away from her ſecret treaſure, ſhe at once takes wing, and fairly leaves him to gaze after her in deſpair. After the danger is over, and the dog withdrawn, ſhe then calls her young, who aſſemble at once at her cry, and follow where ſhe leads them. There are generally from 10 to 15 in a covey; and, if unmoleſted, they live from 15 to 17 years. There are ſeveral methods of taking them, as is well known; that by which they are taken in a net with a ſetting dog is the moſt pleaſant, as well as the moſt ſecure. The dog, as every body knows, is trained to this exerciſe by a long courſe of education: by blows and careſſes he is taught to lie down at the word of command; a partridge is ſhown him, and he is then ordered to lie down; he is brought into the field, and when the ſportſman perceives where the covey lies, he orders his dog to crouch: at length the dog, from habit, crouches wherever he approaches a covey; and this is the ſignal which the ſportſman receives for unfolding and covering the birds with his net. A covey thus caught is ſometimes fed in a place proper for their reception; but they can never be thoroughly tamed like our domeſtic poultry. See Partridge and Shooting.

2. The *coturnix*, or common quail, is not above half the ſize of the partridge. The feathers of the head are black, edged with ruſty brown; the breaſt is of a pale yellowiſh red, ſpotted with black; the feathers on the back are marked with lines of pale yellow, and the legs are of a pale hue. Except in the colours thus deſcribed, and the ſize, it every way reſembles a partridge in ſhape, and, except that it is a bird of paſſage, it is like all others of the poultry kind in its habits and nature.

The quail ſeems to ſpread entirely throughout the old world, but does inhabit the new; is ſeen from the Cape of Good Hope quite to Iceland, and is ſaid to be found in Falkland Iſles: alſo in New Zealand, throughout Ruſſia, Tartary, and China*; and in ſhort is mentioned by ſo many travellers, and in ſo many places, that we may almoſt call it an inhabitant of all. It is obſerved to ſhift quarters according to the ſeaſon, coming northward in ſpring, and departing ſouth in autumn, and in vaſt flocks, like other migrating birds. Twice in a year it comes in ſuch vaſt quantities into Capri, that the biſhop of the iſland draws the chief part of his revenue from them; hence he is called the *quail Biſhop*. But this does not ſtand alone; almoſt all the iſlands in the Archipelago, on the oppoſite coaſts, are at times covered with theſe birds, and ſome of them obtain a name from this circumſtance. On the weſt coaſt of the kingdom of Naples, within the ſpace of four or five miles, an hundred thouſand have been taken in a day, which have been ſold for eight livres *per* hundred to dealers who carry them for ſale to Rome. Great quantities alſo ſometimes alight in ſpring on the coaſts of Provence, eſpecially in the dioceſe of the biſhop of Frejus, which is near the ſea, and appear, at their firſt landing, ſo much fatigued that they are often taken by the hand. Theſe circumſtances then leave not a doubt of their being the ſame kind of birds which the divine hand of providence thought right to direct in ſuch quantities as to cover the camp of the murmuring Iſraelites.

"In the autumn, great quantities are frequently imported into England from France for the table; which we have frequently ſeen (ſays Dr Latham†) on their paſſage to London by the ſtage-coaches, about an hundred in a large ſquare box, divided into five or ſix partitions one above another, juſt high

* See Forſter's Obſ. p. 199.

† Latham's Synopſis, vol. iv.

Tetrao || Tetrao. enough to admit of the quails standing upright; these boxes have wires on the fore-part, and each partition furnished with a little trough for food; and I have been told, says our author, they may be conveyed thus to great distances without difficulty."

[illegible] they may be [illegible] to be plenty at any time. They breed with us, and the [illegible] part migrate south in [illegible] the rest only shift their quarters, as they have been met with on the coasts of Essex, and in Hampshire, in the winter [illegible] them in October.

It feeds like the partridge, and like that bird makes no nest, except a few dry leaves or stalks scraped together may be [illegible] an hollow on the bare ground [illegible] lays her eggs to the number of [illegible] a whitish colour, marked with irregular rust-coloured spots: the young follow the mother as soon as hatched, like young partridges. They have but one brood in a year.

Quail-fighting was a favourite amusement among the Athenians. They abstained from the flesh of this bird, deeming it unwholesome, as supposing that it fed upon the white hellebore; but they reared great numbers of them for the pleasure of seeing them fight; and staked sums of money, as we do with regard to cocks, upon the success of the combat. Fashion, however, has at present changed with regard to this bird: we take no pleasure in its courage, but its flesh is considered as a very great delicacy.—Quails are easily caught by a call: the fowler early in the morning having spread his net, hides himself under it among the corn; he then imitates the voice of the female with his quail pipe, which the cock hearing, approaches with the utmost assiduity; when he has got under the net, the fowler then discovers himself, and terrifies the quail, who attempting to get away, entangles himself the more in the net, and is taken.

TETRODON, in ichthyology; a genus of fishes arranged by Linnæus under the class of *amphibia*, and order of *nantes*; but placed by Gmelin under the class of *pisces*, and order of *branchiostegi*. The jaws are bony, stretched out, and cloven at the point; the aperture of the gills is linear; the body is muricated beneath, and there are no ventral fins. There are 13 species; of which the most remarkable is the lineatus, called by Mr Hasselquist *fahaka*, which is the Egyptian and Arabic name. It has of late been found in the Nile about Cairo, but was never known in former times. It is said to grow to a prodigious size. When just caught, it pricks the skin if it is taken in the bare hands, and produces small pustules in the same manner as nettles. The flesh is poisonous. Mr Forster confirms the account of the poisonous nature of a species of tetrodon, in his account of New Caledonia.

TETRARCH, a prince who holds and governs a fourth part of a kingdom. Such originally was the import of the title *tetrarch*; but it was afterwards applied to any petty king or sovereign; and became synonymous with ethnarch, as appears from the following considerations: 1. That Pliny makes mention of six tetrarchies within the city of Decapolis. 2. That Herod's kingdom was only divided into three parts, which yet were called *tetrarchies*, and the sovereigns thereof, Luke iii. 1. *tetrarchs*. 3. Josephus tells us, that, after the battle of Philippi, Antony, going into Syria, constituted Herod *tetrarch*; and on medals the same Herod is called *ethnarch*.

[illegible] xiv. [illegible]

TETRASTYLE, in the ancient architecture, a building, and particularly a temple, with four columns in its front.

TETUAN, an ancient and pleasant town of Africa, in the kingdom of Fez, and in the province of Habata. It is pretty well built, and the inhabitants are about 15,000 in number, who call themselves *Andalusians*, and almost all speak Spanish; but they are great pirates. Some say there are 30,000 Moorish inhabitants, and 5000 Jews. W. Long. 5. 26. N. Lat. 35. 27.

Teucrium || Teuton.

TEUCRIUM, GERMANDER, in botany: A genus of plants belonging to the class of *didynamia*, and order of *gymnospermia*; and in the natural system ranging under the 42d order, *Verticillatæ*. The corolla has no upper lip, is divided into two parts beyond the base, and is divaricated where the stamina issue out. There are 30 species; of which the scorodonia, scordium, and chamædrys, are natives of Great Britain.

1. The *scorodonia*, wood sage, or germander, is distinguished by leaves which are heart-shaped, serrated, and petiolated; by racemi, which are lateral and ranged in one row; and by an erect stem. The flowers are straw coloured, and the filaments red. The plant has a bitter taste, and smells like hops with a little mixture of garlic. It is used in brewing in the isle of Jersey instead of hops. 2. The *scordium*, or common water-germander, hath creeping perennial roots, sending up many square, procumbent, or trailing stalks, branching diffusely; oblong, indented, serrated, close sitting, opposite leaves; and small reddish flowers, generally two together, from the sides of the stalks and branches, in July and August. This plant was formerly considered as medicinal, but has now fallen into disuse. It grows naturally in marshy places, in the isle of Ely and other parts of England, and most parts of Europe; and is sometimes admitted into gardens, in moist places, for variety, and as a medical plant. 3. The *chamædrys*, or smaller creeping germander, hath fibrous, very creeping, spreading roots; many four-cornered, very branchy, trailing stalks, near a foot long; oval, cuneiform, cut, crenated leaves on short footstalks; and reddish flowers, growing almost in a verticillus, or whorls, round the stalk, three on each peduncle; appearing in June and July.

TEUTHIS, in ichthyology, a genus of fishes belonging to the order of *abdominales*. The head is somewhat truncated on the forepart; the branchil membrane has five rays; the teeth equal, rigid near each other, forming a regular series. There are two species, the hepatus and java.

TEUTONES, or TEUTONI, (anc. geog.) a people always by historians joined with the Cimbri; both seated, according to Mela, beyond the Elbe, on the Sinus Codanus, or Baltic; and there, it is supposed, lay the country of the Teutones, now *Denmark*; diversity of dialects producing the different terms *Teut*, *Tut*, *Dit*, *Tid*, and *Thud*, which in the ancient German language signified *people*. Of these Teutones, Virgil is to be understood in the epithet *Teutonicus*, an appellation which more lately came to be applied to the Germans in general, and later still the appellation *Alemanni*.

The Teutones, in conjunction with the Cimbri and Ambrones, made war on the Romans, and marched towards Italy in the year 101 B. C. We are told, that the Teutones alone were so numerous, that they were six whole days without intermission in passing by the Roman camp. In Transalpine Gaul they engaged the Roman consul Marius; but were defeated with incredible slaughter; 100,000 of them, according to the lowest calculations, being killed on the spot. According to others, the number of those killed and taken prisoners amounted to 290,000. The inhabitants of the neighbouring country made fences for vineyards of their bones. Their king Teutobochus, said to be a monstrous giant, was taken prisoner and carried to Rome. See the article GIANT.

TEUTONIC, something belonging to the Teutones. The

The Teutonic language is supposed to have been the language of the ancient Germans, and hence is reckoned amongst the mother-tongues. See PHILOLOGY, n° 219.

TEUTONIC Order, an order of military knights, established towards the close of the twelfth century, on the following occasion.—When the emperor Barbarossa engaged in a crusade for the recovery of the Holy Land out of the hands of Saladin, he was followed by great numbers of German volunteers, who from various motives enlisted under his banners. After the death of Barbarossa, the Germans, who had signalized themselves before Acre or Ptolemais, resolved to choose another leader; and at last fixed their choice upon Frederic duke of Suabia, second son to the emperor, and Henry duke of Brabant. Under these generals they behaved with so much bravery, that Henry king of Jerusalem, the patriarch, and several other princes, determined to reward their valour by instituting an order of knighthood in their favour. This was accordingly done; and our new knights had at first the title of the *knights of St George;* afterwards it was thought proper to put them under the tutelage of the Virgin Mary, to whom there was already an hospital dedicated on Mount Zion, for the relief of German pilgrims. From this time they were called *Equites Mariani*, or knights of St Mary. Laws, regulations, and statutes, were drawn up for them by the Christian kings in Syria and the patriarch; and among other obligations it was required, that every person admitted to the privileges of the order should be of noble parentage; that the order should defend the Christian religion and the Holy Land; that they should exercise hospitality towards the Christians in general, but particularly those of their own country; and that they should with all their power endeavour to propagate and extend the Christian faith and the religion of JESUS. In the year 1190, having become rich by donations from the superstitious, they elected their first grandmaster, Henry Walpot, a German, who had distinguished himself by his zeal and valour; and their choice was confirmed by the emperor. The following year, pope Celestine III. confirmed their privileges already granted, giving them the title of the *Teutonic knights of the hospital of St Mary the Virgin.* By the conditions of this bull, they vowed perpetual continence, obedience, and poverty; obligations which it may well be imagined were not very strictly kept. See POLAND, n° 59, 61, 67—69. and PRUSSIA, n° 3, 4.

TEWKESBURY, a town in Gloucestershire, formerly noted for its monastery. It is now a large handsome corporation, containing about 500 houses, with a magnificent church. It is seated at the confluence of the rivers Severn and Avon, has a cotton manufactory, and sends two members to parliament. W. Long. 2. 13. N. Lat. 52. 0.

TEXEL, a town of the United Provinces, in north Holland, seated at the mouth of the Zuyder-Zee, with a good harbour, and a strong fort. It is seated in a fruitful island, known all over the world by the great number of ships that pass this way every day from all parts; it is about six miles long, and five broad, lying a little northward to the continent of Holland, between which and the island is one of the principal passages out of the Zuyder-Zee into the ocean. It is defended from the sea by sand-hills and strong banks. Most of the soil is applied to feed sheep, of which they have great flocks; and the cheese made of their milk is said to vie with the Parmesan. This island contains several fair villages, and a town on the east side, called *Burch*, strongly fortified and garrisoned, and inhabited chiefly by fishermen. N. Lat. 53. 8. E. Long. 4. 51.

TEXT, a relative term, contradistinguished to gloss or commentary, and signifying an original discourse exclusive of any note or interpretation. This word is particularly used for a certain passage of scripture, chosen by a preacher to be the subject of his sermon.

TEXTURE, properly denotes the arrangement and cohesion of several slender bodies or threads interwoven or entangled among each other, as in the webs of spiders, or in the cloths, stuffs, &c.

Texture is also used in speaking of any union or constituent particles of a concrete body, whether by weaving, hooking, knitting, tying, chaining, indenting, intruding, compressing, attracting, or any other way. In which sense we say, a close compact texture, a lax porous texture, a regular or irregular texture, &c.

TEWIT, in ornithology. See TRINGA.

THABOR. See TABOR.

THALES, a celebrated Greek philosopher, and the first of the seven wise men of Greece, was born at Miletus about 640 B. C. In order to improve himself in the knowledge of the sciences, he travelled into Egypt, where he discoursed with the priests and other learned men. Some say that he married; but others observe, that he eluded the solicitations of his mother on this head, by telling her, when he was young, that it was too soon; and afterwards, that it was too late. Thales acquired great reputation by his wisdom and learning: he was the first among the Greeks who foretold eclipses of the sun, and made extraordinary discoveries in astronomy. Thales was the author of the Ionian sect of philosophers, who were thus called from his being born at Miletus, a city of Ionia. He maintained that water was the principle of which all the bodies in the universe are composed; that the world was the work of God; and that God sees the most secret thoughts in the heart of man. He said, "That the most difficult thing in the world is to know ourselves; the most easy to advise others; and the most sweet to accomplish our desires. That, in order to live well, we ought to abstain from what we find fault with in others. That the bodily felicity consists in health, and that of the mind in knowledge. That the most ancient of beings is God, because he is uncreated: that nothing is more beautiful than the world, because it is the work of God; nothing more extensive than space, quicker than spirit, stronger than necessity, wiser than time." It was also one of his sentences, "That we ought never to say that to any one that may be turned to our prejudice; and that we should live with our friends as with persons that may become our enemies." He thanked God for three things; that he was born of the human, not of the brute species; a man, and not a woman; a Greek, and not a barbarian. None of the ancient philosophers ever applied themselves more earnestly to the study of astronomy than Thales. Diogenes Laertius reports, that leaving his lodging with an old woman to contemplate the stars, he fell into a ditch; on which the good woman cried, "How canst thou know what is doing in the heavens, when thou canst not perceive what is at thy feet?" He went to see Crœsus, who was marching with a powerful army into Cappadocia, and enabled him to pass the river Halys without making a bridge. Thales died soon after, at about 90 years of age. He composed several treatises in verse, on meteors, the equinoxes, &c. but they are all lost.

THALIA, in Pagan mythology, one of the nine muses. She presided over Comedy; and is represented crowned with a garland of ivy, holding a mask in her hand, and wearing buskins on her feet.

THALIA, in botany: A genus of plants belonging to the class of *monandria*, and order of *monogynia*; and in the natural system ranging under the 8th order, *Scitamineæ*. The corolla is pentapetalous and undulated; and the drupe has a bilo-

Thalictrum. bilocular kernels. There is only one species, the geniculata.

Thalictrum. THALICTRUM, meadow-rue, in botany: A genus of plants belonging to the class of *polyandria*, and order of *polygynia*; and in the natural system ranging under the 26th order, *Multisiliquae*. There is no calyx; the petals are four or five in number, and the seeds are naked and without a tail. There are 15 species; three of which are indigenous, the *flavum*, *minus*, and *alpinum*.

1. The *flavum*, or common meadow-rue, has a leafy furrowed stalk and a many-flowered panicle. It has commonly 24 flowers, and from 1 to 16 pistils. The root and leaves of this plant dye a yellow colour, and cattle are fond of it. It grows on the banks of some rivers: It is found at North Queensferry, Fifeshire. 2. The *minus*, or small meadow-rue, has sexpartite leaves, and bending flowers. The stalk is striated, and about a foot high; the leaves are lax and divaricated, having rigid footstalks; they are smooth and glaucous, and their lobes generally trifid; the panicle is branched and open, and the flowers nod: the petals are pale green, tinged with red; the stamina are from 15 to 20; the seeds deeply striated, and from two to seven in number. This plant is frequent in sandy soils and mountainous pastures. 3. The *alpinum*, or alpine meadow-rue, has a very simple stalk, and almost naked; and a racemes simple and terminal. It is a pretty little plant, about a finger-length in height; the leaves all rise from the root, the stalk being naked and branched; the flowers nod, and have 4 petals, 12 stamina, and 8 pistils. It is frequent on the sides of rivulets in the highland mountains and other places.

THAMES, the finest river in Great Britain, which takes its rise from a copious spring, called *Thames Head*, two miles south-west of Cirencester in Gloucestershire. It has been erroneously said, that its name is Isis till it arrives at Dorchester, 15 miles below Oxford, when, being joined by the Thame or Tame, it assumes the name of the Thames, which, it has been observed, is formed from a combination of the words Thame and Isis. What was the origin of this vulgar error, cannot now be traced. Poetical fiction, however, has perpetuated this error, and invested it with a kind of classical sanctity. "It plainly appears (says Camden), that the river was always called *Thames* or *Tems*, before it came near the Thame; and in several ancient charters granted to the abbey of Malmsbury, as well as that of Ensham, and in the old deeds relating to Cricklade, it is never considered under any other name than that of *Thames*." He likewise says, that it occurs nowhere under the name of Isis. All the historians who mention the incursions of Ethelwold into Wiltshire in the year 905, or of Canute in 1016, concur likewise in the same opinion, by declaring, that they passed over the Thames at Cricklade in Wiltshire. It is not probable, moreover, that Thames Head, an appellation by which the source has usually been distinguished, should give rise to a river of the name of Isis; which river, after having run half its course, should reassume the name of Thames, the appellation of its parent spring. About a mile below the source of the river is the first corn-mill, which is called *Kemble Mill*. Here the river may properly be said to form a constant current; which, though not more than nine feet wide in the summer, yet in the winter becomes such a torrent as to overflow the meadows for many miles around. But, in the summer, the Thames Head is so dry, as to appear nothing but a large dell, interspersed with stones and weeds. From Somerford the stream winds to Cricklade, where it unites with many other rivulets. Approaching [illegible]ford, it now enters its native county, dividing it from [illegible]. It widens considerably in its way to [illegible]; and being there joined by the Lech and Coln, at the distance of 138 miles from London, it becomes navigable for vessels of 90 tons. At Ensham, in its course north east, to Oxford, is the first bridge of stone; a handsome one, of three arches, built by the earl of Abingdon. Passing by the ruins of Godstow nunnery, where the celebrated Fair Rosamond was interred, the river reaches Oxford, in whose academic groves its poetical name of Isis has been so often invoked. Being there joined by the Charwell, it proceeds south east to Abingdon, and thence to Dorchester, where it receives the Tame. Continuing its course south-east by Wallingford to Reading, and forming a boundary to the counties of Berks, Bucks, Surry, Middlesex, Essex, and Kent, it washes the towns of Henley, Marlow, Maidenhead, Windsor, Eton, Egham, Staines, Laleham, Chertsey, Weybridge, Shepperton, Walton, Sunbury, East and West Moulsey, Hampton, Thames Ditton, Kingston, Teddington, Twickenham, Richmond, Isleworth, Brentford, Kew, Mortlake, Barnes, Chiswick, Hammersmith, Putney, Fulham, Wandsworth, Battersea, Chelsea, and Lambeth. Then, on the north bank of the river, are Westminster and London, and, on the opposite side, Southwark; forming together one continued city, extending to Limehouse and Deptford; and hence the river proceeds to Greenwich, Erith, Greenhithe, Gray's Thurrock, Gravesend, and Leigh, into the ocean. It receives in its course from Dorchester the rivers Kennet, Loddon, Coln, Wey, Mole, Wandle, Lea, Roding, Darent, and Medway. The jurisdiction of the lord mayor of London over the Thames extends from Coln Ditch, a little to the west of Staines, to Yendal or Yenleet to the east, including part of the rivers Medway and Lea; and he has a deputy, named the water-bailiff, who is to search for and punish all offenders against the laws for the preservation of the river and its fish. Eight times a year the lord mayor and aldermen hold courts of conservance for the four counties of Surry, Middlesex, Essex, and Kent. Though the Thames is said to be navigable 138 miles above the bridge, yet there are so many flats, that in summer the navigation westward would be intirely stopped, when the springs are low, were it not for a number of locks. But these are attended with considerable expence; for a barge from Lechlade to London pays for passing through them 13l. 15s. 6d. and from Oxford to London 12l. 18s. This charge, however, is in summer only, when the water is low; and there is no lock from London Bridge to Bolter's Lock; that is, for 51½ miles above the bridge. The plan of new cuts has been adopted, in some places, to shorten and facilitate the navigation. There is one near Lechlade, which runs nearly parallel to the old river, and contiguous to St John's Bridge; and there is another a mile from Abingdon, which has rendered the old stream toward Culham Bridge useless. But a much more important undertaking has lately been accomplished; namely, the junction of this river with the Severn. A canal had been made, by virtue of an act of parliament in 1730, from the Severn to Wall Bridge, near Stroud. A new canal now ascends by Stroud, through the Vale of Chalford, to the height of 343 feet, by means of 28 locks, and thence to the entrance of a tunnel near Sapperton, a distance of near eight miles. The canal is 42 feet in width at top and 30 at the bottom. The tunnel (which is extended under Sapperton Hill, and under that part of earl Bathurst's grounds called *Haley Wood*, making a distance of two miles and three furlongs) is near 15 feet in width, and can navigate barges of 70 tons. The canal descending hence 134 feet, by 14 locks, joins the Thames at Lechlade, a distance of above 20 miles. In the course of this vast undertaking, the canal, from the Severn at Froomlade to Inglesham, where it joins the Thames, is a distance of more than 30 miles.

The expence of it exceeded the sum of 200,000l. of which 80,000l. are said to have been expended in gunpowder alone, used for the blowing up of the rock. This new canal was completed in 1789, in less than seven years from its commencement. A communication, not only with the Trent, but with the Mersey, has likewise been effected by a canal from Oxford to Coventry; and an act of parliament has passed to extend another canal from this, at Braunston, to the Thames at Brentford. This is to be called *The Grand Junction Canal*. On the extensive advantages resulting from these navigable communications from the metropolis with the ports of Bristol, Liverpool, Hull, &c. and the principal manufacturing towns in the inland parts of the kingdom, it is needless to expatiate. The tide flows up the Thames as high as Richmond, which, following the winding of the river, is 70 miles from the ocean; a greater distance than the tide is carried by any other river in Europe. The water is esteemed extremely wholesome, and fit for use in very long voyages, during which it will work itself perfectly fine.

Thames. Canal.

THAMES is also the name of a river in the state of Connecticut in America. See the article CONNECTICUT.

THANE, or THANUS, a name given to the nobility in Britain before the time of William the Conqueror. It signifies a minister or honourable retainer, from the verb *thenian* "to minister." There were several degrees of nobility among the Anglo-Saxons; but those most commonly mentioned are the king's thanes and the alderman's thanes. The king's thanes seem to have been of three different degrees, according to their different degrees of wealth or favour at court. The alderman's thanes seem to have been of the lowest degree of nobility, and next to them those who were promoted to that dignity from their advancement in the church, from their valour, success in agriculture or commerce: for if a ceorl or farmer applied to learning and attained to priests orders, if he acquitted himself so well as to obtain from a nobleman five hythes of land, or a gilt sword, helmet, and breast-plate, the reward of his valour; or if by his industry he had acquired the property of five hythes of land; or if he applied to trade, and made three voyages beyond sea in a ship of his own, and a cargo belonging to himself—he was denominated a *thane*.

The thanes, who were the only nobility among the Anglo-Saxons, were a very numerous body of men, comprehending all the considerable landholders in England, and filling up that space in society between the ceorls or yeomanry on the one hand, and the royal family on the other; which is now occupied both by the nobility and gentry. In times of war, they constituted the flower of their armies, and in times of peace they swelled the trains of their kings, and added greatly to the splendour of their courts, especially at the three great festivals of Christmas, Easter, and Whitsuntide. From this body all the chief officers, both civil and military, as aldermen, greeves, earls, heretogens, &c. were taken; and to obtain some of these offices was the great object of their ambition. Before they obtained an office, their lands were their only support: and they lived in greater or less affluence, according to the extent of their estates. These they divided into two parts; one of which they called their *inlands*, and the other their *outlands*. Their inlands they kept in their own immediate possession, and cultivated them by the hands of their slaves and villains, in order to raise provisions for their families; their outlands they granted to ceorls or farmers, either for one year, or for a term of years; for which they received a certain stipulated proportion of their produce annually. These customs had long prevailed among their ancestors in Germany, and were adhered to by their posterity in England till the conquest.

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The thanes were under no obligations on account of their lands, except the three following, which were indispensably necessary to the defence and improvement of their country: To attend the king with their followers in military expeditions, to assist in building and defending the royal castles, and in keeping the bridges and highways in proper repair. To these obligations all proprietors of land (even the churchmen for a long time not excepted) were subjected; and these services were considered as due to their country, rather than to the persons of their kings; and were agreed to by all as being necessary to their own preservation and conveniency.

This title of thane was abolished in England at the conquest, upon the introduction of the feudal system by William. The titles of earl and baron were about the same period introduced into Scotland by Malcolm Canmore, and the title of thane fell into disuse.

Thanet. Thea.

THANET, an island of the county of Kent, surrounded by the sea except on the north-east side, where it is bounded by the branches of the river Stour, now inconsiderable to what they were formerly. It contains several villages, and the sea-port towns of Margate and Ramsgate, and has the title of an earldom. It is celebrated for being the spot through which arts, sciences, and divine knowledge, came into this happy isle. The Britons called it *Richborough*, from its vicinity to the city of that name, now only a venerable ruin; but the Saxons called it *Thanet*, from fire, having so many beacons erected on it. It is in the north-east part of the county, lies open to the sea on the north and east, with the river Wantsum on the west and south, is about 10 miles long from the North Foreland to Sarre-Bridge, and about 8 broad from Westgate to Sandwich-Ferry. The north part of it is all arable, except some barren land, that is sown with saintfoin, which produces a load and sometimes two loads of hay upon an acre: by which means, the land that otherwise is not worth half-a crown an acre yields 30s. or 40s. The south and west parts of the island are most of them marsh or pasture lands. The soil is generally very fertile, especially in the best of barley, and other sorts of grain, of which it is computed above 20,000 quarters are sent hence to London in a year, besides what is sold to other places. The *alga marina*, or sea-ore, as they call it, is their chief manure. This they dry on the shore, and burn, in order to make kelp, which the potters use in glazing their ware. But the smell of the rotten ore upon the soil, and the smoke of it when burning, is very noisome. The gentlemen's families are for the most part gone from this part of the county, having sold their estates; so that their mansion seats are converted into farm-houses; but then, on the other hand, many of the yeomen and farmers have good estates, on which they live very genteelly. In this island are ten parishes, but seven parish-churches, and one chapel.

England's Gazetteer.

THAPSIA, the DEADLY CARROT, in botany: A genus of plants belonging to the class of *pentandria*, and order of *digynia*; and in the natural system ranging under the 45th order, *umbellatæ*. The fruit is oblong and girt with a membrane. There are five species; the villosa, fœtida, asclepium, garganica, and trifoliata. The roots of the fœtida were formerly ordered in medicine, but are now entirely disused; a small dose operating with extreme violence both upwards and downwards.

THAWING, the resolution of ice into its former fluid state by the warmth of the air. See CONGELATION and FROST.

THEA, in botany. See TEA.

Theatines, Theatre.

THEATINES, a religious order in the Romiſh church, ſo called from their principal founder John Peter Caraffa, then biſhop of Theate, or Chieti, in the kingdom of Naples, and afterwards pope, under the name of *Paul* IV. The names of the other founders were Gaetan, Boniface, and Conſiglieri. Theſe four pious men deſiring to reform the eccleſiaſtical ſtate, laid the foundation of an order of regular clerks at Rome in the year 1524. Pope Clement VII. approved the inſtitution, and permitted the brethren to make the three religious vows, to elect a ſuperior every three years, and to draw up ſtatutes for the regulation of the order. They firſt endeavoured, by their example, to revive among the clergy the poverty of the apoſtles and firſt diſciples of our Saviour, and were the firſt who aſſumed the title of *regular clerks*.

THEATRE, a place in which ſhows or dramatic repreſentations are exhibited.

For the origin of the dramatic art we always turn our eyes to Greece, the nurſery of the arts and ſciences. It may indeed have been known among more ancient nations, but no records remain ſufficient to ſupport this opinion. The different ſtates of Greece aſſerted their claim to the honour of having given it birth, but the account of the Athenians is moſt generally received. It derived its origin from the hymns which were ſung in the feſtivals of Bacchus in honour of that deity. While theſe reſounded in the ears of the multitude, choruſes of Bacchants and Fauns, ranged round certain obſcene images which they carried in triumphal proceſſion, chanted laſcivious ſongs, and ſometimes ſacrificed individuals to public ridicule.

This was the practice in the cities; but a ſtill greater licentiouſneſs reigned in the worſhip paid to the ſame divinity by the inhabitants of the country, and eſpecially at the ſeaſon when they gathered the fruits of his beneficence. Vintagers, beſmeared with wine-lees, and intoxicated with joy and the juice of the grape, rode forth in their carts, and attacked each other on the road with groſs ſarcaſms, revenging themſelves on their neighbours with ridicule, and on the rich by publiſhing their injuſtice.

Anacharſis' Travels, vol. i.

Among the poets who flouriſhed at that time, ſome celebrated the great actions and adventures of gods and heroes, and others attacked with aſperity the vices and abſurdities of individuals. The former took Homer for their model, and ſupported themſelves by his example, of which they made an improper uſe. Homer, the moſt tragic of poets, the model of all who have ſucceeded him, had in the Iliad and the Odyſſey brought to perfection the heroic poem, and in his Margites had employed pleaſantry. But as the charm of his works depends in a great meaſure on the paſſions and motion with which he knew to animate them, the poets who came after him endeavoured to introduce into theirs an action which might excite emotion or mirth in the ſpectators: ſome even attempted to produce both, and ventured certain rude eſſays, which have ſince been ſtyled indifferently either tragedies or comedies, becauſe they unite the characters of thoſe two dramas. The authors of theſe ſketches have been diſtinguiſhed by no diſcovery; they only form in the hiſtory of the art a ſucceſſion of names which it would be uſeleſs to recal to light.

The neceſſity and power of theatrical intereſt was already known. The hymns in honour of Bacchus, while they deſcribed his rapid progreſs and ſplendid conqueſts, became imitative; and in the conteſts of the Pythian games, the players on the flute who entered into competition were enjoined by an expreſs law to repreſent ſucceſſively the circumſtances that had preceded, accompanied, and followed the victory of Apollo over Python.

Some years after this regulation, Suſarion and Theſpis, both born in a ſmall borough of Attica, named *Icaria*, appeared each at the head of a company of actors, the one on a kind of ſtage, the other in a cart (A). The former attacked the vices and abſurdities of his time; and the latter treated more noble ſubjects, which he took from hiſtory.

The comedies of Suſarion were in the ſame taſte with thoſe indecent and ſatirical farces which were afterwards performed in ſome of the cities of Greece. They were long the favourite entertaintment of the country people. Athens did not adopt this ſpecies of exhibition until after it was brought to perfection in Sicily.

Theſpis had more than once ſeen in the feſtivals, in which as yet hymns only were ſung, one of the ſingers, mounted on a table, form a kind of dialogue with the chorus. From this hint he conceived the idea of introducing into the tragedies an actor who, by ſimple recitals introduced at intervals, ſhould give relief to the chorus, divide the action, and render it more intereſting. This happy innovation, together with ſome other liberties in which he had allowed himſelf, gave alarm to the legiſlator of Athens, who was more able than any other perſon to diſcern the value or danger of the novelty. Solon condemned a ſpecies of compoſition in which the ancient traditions were diſguiſed by fictions. "If we applaud falſehood in our public exhibitions (ſaid he to Theſpis), we ſhall ſoon find that it will inſinuate itſelf into our moſt ſacred engagements."

The exceſſive approbation and delight with which both the city and country received the pieces of Theſpis and Suſarion, at once juſtified and rendered uſeleſs the ſuſpicious foreſight of Solon. The poets, who till then had only exerciſed their genius in dithyrambics and licentious ſatire, ſtruck with the elegant forms which theſe ſpecies of compoſition began to aſſume, dedicated their talents to tragedy and comedy. Soon after a greater variety was introduced in the ſubjects of the former of theſe poems. Thoſe who judge of their pleaſures only from habit exclaimed, that theſe ſubjects were foreign to the worſhip of Bacchus; but the greater number thronged with ſtill more eagerneſs after the new pieces.

Phrynichus, the diſciple of Theſpis, made choice of that kind of verſe which is moſt ſuitable to the drama, was the author of ſome other changes, and left tragedy in its infancy.

Æſchylus received it from his hands enveloped in a rude veſtment, its viſage covered with falſe colours, or a maſk inexpreſſive of character, without either grace or dignity in its motions, inſpiring the deſire of an intereſt which it with difficulty excited, ſtill attached to the buffooneries which had amuſed its infant years, and expreſſing its conceptions ſometimes with elegance and dignity, but frequently in a feeble and low ſtyle, polluted with groſs obſcenities.

In his firſt tragedies he introduced a ſecond actor; and afterward, copying the example of Sophocles, who had juſt entered on his theatrical career, he admitted a third, and ſometimes even a fourth. By this multiplicity of perſonages, one of his actors became the hero of the piece, and attracted to himſelf the principal intereſt; and as the chorus now held only a ſubaltern ſtation, Æſchylus took care to ſhorten

(A) Suſarion repreſented his firſt pieces towards the year 580 before Chriſt. Some years after, Theſpis made his firſt attempts in tragedy, and acted his Alceſtis in 536.

shorten its part, and perhaps even carried this precaution too far.

He is censured for having admitted mute characters into his drama. Achilles, after the death of his friend, and Niobe, after the destruction of her children, appear on the stage, and remain during several scenes motionless, with their heads covered with a veil, and without uttering a word; but if their eyes had overflown with tears, and they had poured forth the bitterest lamentations, could they have produced an effect so terrible as this veil, this silence, and this abandonment to grief?

It was not sufficient that the noble and elevated style of tragedy should leave in the minds of the auditors a strong impression of grandeur; to captivate the multitude, it was requisite that every part of the spectacle should concur to produce the same effect. It was then the general opinion that nature, by bestowing on the ancient heroes a more lofty stature, had impressed on their persons a majesty which procured them as much respect from the people as the ensigns of dignity by which they were attended. Æschylus therefore raised his actors on high stilts or buskins. He covered their features, which were frequently disagreeable, with a mask that concealed their irregularity. He clothed them in flowing and magnificent robes, the form of which was so decent, that the priests of Ceres have not blushed to adopt it. The inferior actors were also provided with masks and dresses suited to their parts.

Instead of those wretched scaffolds which were formerly erected in haste, he obtained a theatre furnished with machines, and embellished with decorations. Here the sound of the trumpet was reverberated, incense was seen to burn on the altars, the shades of the dead to arise from the tomb, and the furies to rush from the gulphs of Tartarus. In one of his pieces these infernal divinities appeared, for the first time, with masks of a horrid paleness, torches in their hands, serpents intertwined in their hairs, and followed by a numerous retinue of dreadful spectres. It is said that, at the sight of them, and the sound of their terrific howlings, terror seized on the whole assembly, women miscarried, and children expired with fear; and that the magistrates, to prevent similar accidents in future, commanded that the chorus should consist only of fifteen actors instead of fifty.

The effect of so many new objects could not but astonish the spectators; nor were they less surprised and delighted at the intelligence displayed in the performance of the actors, whom Æschylus almost always exercised himself. He regulated their steps, and taught them to give additional force to the action by new and expressive gestures.

The progress of the art was extremely rapid. Æschylus was born 525 years before Christ, 11 years after Thespis had acted his Alcestis. He had for competitors Chœrilus Pratenas, and Phrynichus, whose glory he eclipsed, and Sophocles, who rivalled his own. Sophocles was born about the year 497 B. C. about 14 years before Euripides. These carried tragedy to the highest perfection to which it attained among the Greeks. Æschylus painted men greater than they can be, Sophocles as they ought to be, and Euripides as they are.

Invented towards the 50th Olympiad (about 580 B. C.), and adapted to the rude manners of the rustics, comedy ventured not to approach the capital; and if by chance some companies of actors, who were unconnected with any others, found their way into the city, and performed their indecent farces, they were less authorised than tolerated by the government. It was not till after a long infancy that this species of drama began suddenly to make a rapid improvement in Sicily. Instead of a succession of scenes without connection or tendency, the philosopher Epicharmus introduced an action, all the parts of which had a dependence on each other; and conducted his subject, without wandering from it, through a just extent to a determinate end. His pieces, subjected to the same laws as tragedy, were known in Greece, where they were considered as models; and comedy soon shared with her rival the suffrages of the public, and the homage due to genius. The Athenians, especially, received her with the same transports as they would have testified at the news of a victory: many of their poets exercised their genius in this novel species of composition; and their names adorn the numerous list of writers who have been distinguished in comedy from the time of Epicharmus. Such were, among the more ancient, Magnes, Cratinus, Crates, Pherecrates, Eupolis, and Aristophanes. They all flourished in the age of Pericles.

If we peruse the comic pieces which have come down to us, we shall be convinced that the sole object of the authors was to please the multitude. The gods and heroes were travestied, gross and obscene language was often employed, and virulent invectives were often thrown out against individuals of the first rank for genius and virtue. Towards the end of the Peloponnesian war the licentiousness of comedy was restrained. The chorus was laid aside, because the rich citizens were alarmed, and would no longer contribute money to support it, nor provide masks with portraits for exposing individuals.

The poets being thus restrained from mentioning names of living persons on the stage, invented false names. They still exposed real and known characters; and thus gave a more exquisite gratification to the spectators, who were highly amused with finding out the persons intended. The consequence of the law was only to make that done with delicacy which was formerly done in the most indecent and scurrilous manner. Aristophanes, in some of his latest pieces, has given us some good examples of this kind of comedy, which is sometimes called the middle comedy.

Comedy was still liable to abuse, and therefore required farther reformation. As the use of real names had formerly been prohibited, real subjects were also forbidden; and comedy from that time was no longer a fury armed with torches, or a firebrand scattering mischief, but a pleasing and instructive companion. This is called the new comedy. The most eminent among the Greeks in this improved species was Menander. His writings are now lost; but we may form a good estimate of their merit from the comedies of Terence, which are said to have been borrowed from Menander, and to have nearly resembled the original, though inferior in that *vis comica* by which the elegant Grecian was distinguished. The comedy of Menander is that which has been cultivated in modern times.

To give some idea of a Grecian theatre, we shall describe very shortly the theatre of Bacchus in Athens, which was built by the famous architect Philos in the time of Pericles. The part intended for the spectators was of a semicircular form, at the diameter of which was erected the stage. The orchestra occupied the space where the pit in modern theatres is situated, where the music, the chorus, and the mimi were placed. It was four feet elevated above the ground. The spectators were arranged in three galleries round all the sides of the orchestra except that next the stage, each gallery containing eight rows of seats. At the farther end of the orchestra, where the stage is erected in modern theatres, stood the thymele or logeon, but projecting a little towards the audience. It was a little higher than the orchestra, and did not extend the whole breadth of it. In some theatres it was only six feet square. Here the principal part of the chorus made their recitations, and in comical interludes the mimi performed. Behind the thy-

6

Theatre. [illegible] the stage or proscenium, considerably elevated. No part of this theatre was covered except the stage, and a single gallery called [illegible] for the women. The Athenians, being exposed to the weather, came usually with great cloaks, to secure them from the rain or the cold; and to defend them against the sun, they had the *sciadion*, a kind of parasol, which the Romans used also in their theatres by the name of *umbella*; but when a sudden storm arose, the play was interrupted, and the spectators dispersed.

A net or framework over the entire area of the edifice might have been contrived as a shelter from the rain and a shade from the sun. Such a covering would have obviated the inconveniences of roofed theatres, which obstruct the free communication of the air, and of uncovered theatres, which do not keep out the weather. At Athens the plays were always represented in the day-time, which made the [illegible] inconvenient.

Plays were represented only during the three festivals solemnized in honour of Bacchus. The first of these was celebrated at the Piraeus, where some of Euripides's pieces were first performed. The second, which lasted only one day, was kept at the end of January or beginning of February. The third, called the greater *Dionysia*, was celebrated a month after. It continued several days, and attracted a great multitude of spectators. In the festivals which lasted only one day, five or six dramatic pieces, either tragedies or comedies, were performed. But in the greater Dionysia, which continued longer, 12 or 15, and sometimes more, were acted. The performance began early in the morning, and sometimes lasted the whole day.

The chorus, according as the subject demanded, was composed of men and women, old men or youths, citizens or slaves, priests, soldiers, &c. to the number of 15 in tragedy, and 24 in comedy. The chorus came upon the stage preceded by a flute-player, who regulated their steps; sometimes one after the other, but in tragedy more frequently three in front and five in depth, or five in front and three in depth.

The same persons performed both in tragedy and comedy; but, as among ourselves, it was rare to meet with any who excelled in both. The pay of those who had acquired great reputation was considerable. Polus gained a talent in two days (equal to L. 225 Sterling *). Players of eminence were solicited by different actors of Greece to attend their festivals. If, after making an engagement, they failed, they were obliged to pay a certain sum of money: and if they were absent during the festivals of their own republic, they were condemned to a heavy fine.

* Plut. in X. Rhet.

The actors had habits and symbols suited to their parts. Kings wore a diadem, leaned on a sceptre which supported an eagle on its top, and were dressed in long robes of purple or other splendid colours ornamented with gold. Heroes, besides having their stature frequently increased to six feet English, and their bulk in proportion, were frequently covered with the skin of a lion or a tyger, and armed with swords, quivers, and clubs. All who laboured under misfortunes wore a black, brown, or dirty white garment, which frequently hung in tatters. There were various kinds of masks for tragedy, comedy, and satire. These certainly took away the pleasure arising from the expression of the countenance; but there was little pleasure could be derived from this circumstance in a Grecian theatre, from its immense size, and the great distance of the audience from the stage.

† Ar. in Ant. v. 146. Athen. lib. v. cap. 7.

Dramatic entertainments were introduced at Rome in the year of the city 391. They were called *ludi scenici*, because they were first acted in a shade formed by the branches and leaves of trees. They were borrowed immediately from Etruria, whence also they received their first players. These Etrurians at first only danced to a flute, without either singing or acting. The Roman youth soon imitated them at their solemn festivals, adding raillery in rude verses, and gestures adapted to the subject. These verses were called *Fescennini*, from Fescennia, a city of Etruria. Livius Andronicus was the first poet who wrote a regular play in Latin. This happened in the year of Rome 512 or 514, about 160 years after the death of Sophocles and Euripides, and 52 after that of Menander. The Grecian model was afterwards introduced and cultivated much by succeeding dramatic writers. This was the model of Menander, for the old and middle comedy was unknown at Rome. As the Romans were only imitators of the Greeks in the dramatic art, as well as in most of the arts and sciences, nothing more is necessary to be said in addition to the account which we have already given of the Grecian stage.

The origin of the English stage is hid in obscurity. It was not, however, copied from the Grecian or Roman; for it was evidently different in form as well as in matter, and may with more propriety be deduced from a Gothic original. It appears that there were theatrical entertainments in England almost as early as the conquest; for we are told by William Stephanides or Fitz-Stephen, a monk, who in the reign of Henry II. wrote his *Descriptio Nobilissimæ Civitatis Londoniæ*, that "London, instead of the common interludes of the theatre, had plays of a more holy kind; representations of the miracles of confessors, and the sufferings of martyrs. At this time there were also certain sets of idle people, who travelled the countries and were called *Mummers*, a kind of vagrant comedians, whose excellence consisted altogether in mimickry and humour.

Gentleman's Magazine for 1761.

It is probable that, soon after this time, the dramatic representations called *Mysteries* were exhibited: These mysteries were taken from scripture-history: some represented the creation of the world, with the fall of Adam and Eve; some the story of Joseph; and others even the incarnation and sufferings of the Son of God. These pieces were exhibited in a manner so ridiculous as to favour libertinism and infidelity, as appears by a petition of the chaunters of St Paul's cathedral to Richard II. in 1378, praying, that "some unexpert people might be prohibited from representing the history of the Old Testament to the prejudice of the said clergy, who had been at great expence to represent it publicly at Christmas."

Cibber's Apology for his Life.

In the year 1390, the parish clerks of London are said to have played interludes at Skinner's-well on three successive days in July; and, in 1409, to have acted for eight days successively a play concerning the creation of the world, at the same place which thence acquired the name of *Clerkenwell*.

These Mysteries were succeeded by Moralities, in which there were some rude traces of a fable and a moral; and some also of poetry, the virtues, vices, and other affections of the mind being frequently personified.

After these Moralities came what were called Interludes, which made some approaches to wit and humour. Many of these pieces were written by John Heywood, jester to Henry VIII.

In the time of Henry VIII. one or two pieces had been published under the classical names of *Comedy* and *Tragedy*, but they appear not to have been intended for popular use. It was not till the religious ferments had subsided that the public had leisure to attend to dramatic poetry. In the reign of Elizabeth, tragedies and comedies began to appear in form, and could the poets have persevered, the first models were good. *Gorboduc*, a regular tragedy, was acted in 1561; and Gascoigne, in 1566, exhibited *Jocasta*, a translation from Euripides, as also *The Supposes*, a regular comedy,

Percy's Reliques of Ancient English Poetry.

Theatre.

comedy, from Ariosto, near thirty years before any of Shakespeare's were printed.

The people however still retained a relish for their old mysteries and moralities, and the popular dramatic poets seem to have made them their models. The graver sort of moralities appear to have given birth to our modern tragedy; as our comedy evidently took its rise from the lighter interludes of that kind. And as most of these pieces contain an absurd mixture of religion and buffoonery, an eminent critic has well deduced from thence the origin of our unnatural tragi-comedies. Even after the people had been accustomed to tragedies and comedies, moralities still kept their ground. One of them intitled *The New Custom*, was printed so late as 1573. At length they assumed the name of *masques*, and, with some classical improvements, became in the two following reigns the favourite entertainments of the court.

As for the old mysteries, which ceased to be acted after the reformation, they seem to have given rise to a third species of stage exhibition; which, though now confounded with tragedy or comedy, were by our first dramatic writers considered as quite distinct from them both: these were historical plays, or histories; a species of dramatic writing which resembled the old mysteries in representing a series of historical events simply in the order of time in which they happened, without any regard to the three great unities. These pieces seem to differ from tragedy just as much as historical poems do from epic: as the Pharsalia does from the Æneid. What might contribute to make dramatic poetry take this turn was, that soon after the mysteries ceased to be exhibited, there was published a large collection of poetical narratives, called *the Mirror for Magistrates*, wherein a great number of the most eminent characters in English history are drawn relating their own misfortunes. This book was popular and of a dramatic cast; and therefore, as an elegant writer has well observed, might have its influence in producing historic plays. These narratives probably furnished the subjects, and the ancient mysteries suggested the plan.

That our old writers considered historical plays as somewhat distinct from tragedy and comedy, appears from numberless passages of their works. "Of late days (says Stow in his Survey of London), instead of those stage plays have been used comedies, tragedies, interludes, and histories, both true and feigned." Beaumont and Fletcher, in the prologue to the *Captain*, say,

"This is nor comedy, nor tragedy,
"Nor *history*."——

Polonius in *Hamlet* commends the actors as the best in the world, either for tragedie, comedie, historie, pastorall, &c. And Shakespeare's friends, Heminge and Condell, in the first follio edition of his plays, in 1623, have not only intitled their book "Mr William Shakespeare's Comedies, Histories, and Tragedies," but, in their table of contents, have arranged them under those three several heads; placing in the class of histories, "King John, Richard II. Henry IV. 2 pts, Henry V. Henry VI. 3 pts, Richard III. and Henry VIII."

This distinction deserves the attention of the critics: for if it be the first canon of sound criticism to examine any work by those rules the author prescribed for his first observance; then we ought to try Shakespeare's histories by the general laws of tragedy and comedy. Whether the rule itself be vicious or not, is another inquiry; but certainly we ought to examine a work only by those principles according to which it was composed. This would save much impertinent criticism.

Not fewer than 19 playhouses had been opened before the year 1633, when Prynne published his *Histriomastix*. From this writer we learn that tobacco, wine, and beer, were in those days the usual accommodations in the theatre, as now at Sadlers Wells. With regard to the ancient prices of admission, the playhouse called the *Hope* had five different priced seats, from sixpence to half-a-crown. Some houses had penny benches. The two penny gallery is mentioned in the prologue to Beaumont and Fletcher's *Woman Hater*; and seats of threepence and a groat in the passage of Prynne last referred to. But the general price of what is now called the *Pit* seems to have been a shilling. The time of exhibition was early in the afternoon, their plays being generally acted by day light. All female parts were performed by men, no actress being ever seen on the public stage before the civil wars. And as for the playhouse furniture and ornaments, they had no other scenes nor decorations of the stage, but only old tapestry, and the stage strewed with rushes, with habits accordingly; as we are assured in a short Discourse on the English Stage, subjoined to Flecknoe's *Love's-Kingdom*, 1674, 12mo.

(B) For the state of the theatre during the time of Shakespeare, see PLAYHOUSE; where a full account of it is given from the late valuable edition of our illustrious poet's works by Mr Malone. During the whole reign of James I. the theatre was in great prosperity and reputation: dramatic authors abounded, and every year produced a number of new plays; it became a fashion for the nobility to celebrate their weddings, birth-days, and other occasions of rejoicing, with masques and interludes, which were exhibited with surprising expence; our great architect, Inigo Jones, being frequently employed to furnish decorations, with all the luxuriance of his invention and magnificence of his art. The king and his lords, and the queen and her ladies, frequently performed in these masques at court, and the nobility at their private houses; nor was any public entertainment thought complete without them. This taste for theatrical entertainments continued during great part of the reign of King Charles the first; but, in the year 1633, it began to be opposed by the Puritans from the press; and the troubles that soon after followed entirely suspended them till the restoration of king Charles the second in 1660.

The king, at his restoration, granted two patents, one to Henry Killigrew, Esq; and the other to Sir William Davenant, and their heirs and assigns, for forming two distinct companies of comedians. Killigrew's were called the *King's Servants*, and Davenant's the *Duke's Company*. About ten of the company called the *King's Servants* were on the royal household establishment, having each ten yards of scarlet cloth, with a proper quantity of lace allowed them for liveries; and in their warrants from the lord chamberlain they were styled *gentlemen of the great chamber*.

Till this time no woman had been seen upon the English stage, the characters of women having always been performed by boys, or young men of an effeminate aspect, which probably

(B) We have been anxious to give as full an account of the ancient English drama as we could: we must not omit, however, to inform our readers what Mr Malone says of the old plays, *viz*. that not one play published before 1592 will bear a second reading; and that exclusive of mysteries, moralities, and translations, there are but 34 pieces extant which were published before that period.

which obliged Shakespeare to make so few of his plays depend upon female characters, as they must have been performed to great disadvantage. The principal characters of his women are innocence and simplicity, such are Desdemona and Ophelia; and his specimen of fondness and virtue in Portia is very short. But the power of real and beautiful women was now added to the stage; and all the capital plays of Shakespeare, Fletcher, and Ben Jonson, were divided between the two companies, by their own alternate choice, and the approbation of the court.

The king's servants seem to have been allowed to be the best company; and when the variety of plays began to be exhausted, they drew the greater audiences. Davenant, therefore, to make head againſt them, firſt added ſpectacle and music to action, and introduced a new ſpecies of plays, since called *dramatic operas*; among these were, *The Tempeſt*, *Psyche*, and *Circe*; which, with many others, were ſet off with the moſt expenſive decorations of ſcenes and habits, and with the beſt voices and dancers.

In 1684 the two houſes united, and continued together for ten years. In 1690 the play began at four o'clock; and, we are told, the ladies of faſhion uſed to take the evening air in Hyde-park after the repreſentation; by which it appears that the exhibitions were in ſummer too. The principal actors were, Betterton, Montfort, Kynaſton, Sandford, Nokes, Underhill, and Leigh, commonly called *Tony Leigh*; the actreſſes were, Mrs Betterton, Barry, Leigh, Butler, Montfort, and Bracegirdle; and to this company, in this year, old Cibber was admitted as a performer in the loweſt rank. It was a rule with the patentees, that no young perſon, who offered himſelf as an actor, ſhould be admitted into pay till after at leaſt half a year's probation; and Cibber waited full three quarters of a year before he was taken into a ſalary of 10s. a week.

In 1695 a new theatre was opened with Mr Congreve's comedy of Love for Love, which had ſuch extraordinary ſucceſs (ſays Cibber) that ſcarce any other play was acted there till the end of the ſeaſon; but when the ſeaſon ended, which appears to have begun in June, he does not tell us, and it is indeed difficult to gueſs; for though the company acted in ſummer, it ſeems improbable that they ſhould ſhut up the houſe in winter, as it is difficult to conceive any reaſon for ſo doing. Congreve was then in ſuch high reputation, that this company offered him a whole ſhare (but into how many ſhares the whole was divided Colley has not told us) upon condition he would give them a new play every year. This offer he accepted, and received the advantage, though he never fulfilled the condition; for it was three years before he produced the *Mourning Bride*, and three more before he gave them *the Way of the World*.

It is not neceſſary that we give in detail the remaining hiſtory of the Engliſh ſtage: thoſe who are anxious to be acquainted with it may conſult Cibber's hiſtory of the ſtage, continued by Victor, under the title of *A Hiſtory of the Theatres of London and Dublin from the year 1730*. We ſhall only mention a few facts reſpecting the ſalaries of the players about that period, and the riſe of the price of play-tickets.

A difference having ariſen in 1733 between the managers and actors, moſt of the actors ſet up for themſelves at the little theatre in the Haymarket. Upon this the managers publiſhed the following account of their ſalaries, to ſhew the public how little room they had to mutiny. To Mr Colley Cibber, from the time of letting his ſhare till he left the ſtage, 12l. 12s. *per* week. Mr The. Cibber 5l. and his wife's whole ſalary till her death, without doing the company any ſervice the greateſt part of the winter; and his own alſo, during the time of his being ill, who performed but ſeldom till after Chriſtmas. Mr Mills jun. 3l. under the ſame circumſtances with regard to his wife. Mr Mills ſen. 1l. *per* day for 200 days certain, and a benefit clear of all charges. Mr Johnſton 5l. Mr Miller 5l. paid him eight weeks before he acted, beſides a preſent of 10 guineas. Mr Harper 4l. and a preſent of 10 guineas. Mr Griffin 4l. and a preſent. Mr Shepard 3l. Mr Hallam, for himſelf and father (though the latter is of little or no ſervice) 3l. Mrs Heron 5l. raiſed from 40s. laſt winter, yet refuſed to play ſeveral parts aſſigned her, and acted but ſeldom this ſeaſon. Mrs Butler 3l. *per* week. By theſe and other ſalaries, with the incident charges (beſides clothes and ſcenes), the patentees are at the daily charge of 49l. odd money, each acting-day.

Till about the ſame time, the prices at the theatre were 4s. the boxes, 2s. 6d. the pit, 1s. 6d. the firſt gallery, and 1s. the ſecond, except upon the firſt run of a new play or pantomime, when the boxes were 5s. the pit 3s. the firſt gallery 2s. and the ſecond 1s. But Fleetwood thought fit to raiſe the prices for an old pantomime, which was revived without expence. This produced a riot for ſeveral nights, and at laſt a number deputed by the pit had an interview with the manager in the green room, where it was agreed, that the advanced prices ſhould be conſtantly paid at the doors, and that ſuch perſons as did not chooſe to ſtay the entertainment ſhould have the advanced part of their money returned. This was a very advantageous agreement for the manager; becauſe, when the audience had once paid their money, and were ſeated, very few went out at the end of the play, and demanded their advanced money; the few that did it at firſt, ſoon grew tired, and at laſt it ſettled in the quiet payment of the advanced price, as at this day.

It has been frequently a ſubject of debate, whether the ſtage be favourable to morals. We do not mean to enter into the controverſy; but we ſhall make an obſervation or two. It will be allowed by all, that the intention of the players in acting, is to procure money; and the intention of the audience in attending the theatre, is to ſeek amuſement. The players then will only act ſuch plays as they believe will anſwer their intention. And what ſort of plays are theſe? They are ſuch as correſpond with the opinions, manners, and taſte, of the audience. If the taſte of the audience be groſs, therefore the plays will be groſs; if delicate and refined, they will be the ſame. And if we go back to the time of Shakeſpeare, we ſhall find that this has been uniformly the caſe. The concluſion, then, which we draw, is this, if the taſte of the audience be pure, free from licentiouſneſs, the plays will be the ſame, and the ſtage will be favourable to virtue.

THEBAIC Powder. See *Pharmacy-Index*.

THEBAID, a celebrated heroic poem of Statius, the ſubject whereof is the civil war of Thebes, between the two brothers Eteocles and Polynices; or Thebes taken by Theſeus.

THEBES, the name of a celebrated city of ancient Greece. It is ſuppoſed to have been built by Cadmus, about the year of the world 2555. This Cadmus, according to the Greeks, was the ſon of Agenor king of Sidon or of Tyre; but the Sidonians allow him to have been of no higher quality than his cook, and tell us that his wife was a muſician at court, with whom he ran away into Greece. The Greek writers tell us, that being commanded by his father to go in ſearch of his daughter Europa, whom Jupiter in the ſhape of a bull had carried off, and forbid to return without her, he built, or rebuilt, the city of Thebes, after having long ſought her in vain. He was at firſt oppoſed by the Hyantes and Aones; the former of whom he defeated in battle, and forced to retire into Locris: the

1 Account of Cadmus the founder of Thebes.

Thebes.

the latter fubmitted, and were incorporated among his fubjects.

2 Supposed to be one of the exiled Canaanites.

Thofe who endeavour to extract fome truth from the multitude of fables in which the early part of the Grecian hiftory is obfcured, are of opinion that Cadmus was one of the Canaanites expelled by Jofhua; and that he was of the family of the Cadmonites mentioned by Mofes and Jofhua. He is univerfally allowed to have introduced the Phœnician letters into Greece, fet up the firft fchools, and introduced brafs; which, from him, had the name of *Cadmean* given to it. The government of Thebes continued for a long time monarchical; and the names of a number of its kings have been tranfmitted to us, with fome account of their tranfactions; but fo much obfcured by fable, that little or nothing can be determined concerning them. We fhall therefore pafs over this fabulous part of their hiftory, and only take notice of that period of it when the Thebans emerged from their obfcurity, and for a time held the fovereignty of Greece.

3 The Thebans a degenerate ftupid people.

Though the Thebans had been famed in the early period of their hiftory for their martial atchievements, yet in procefs of time they feem to have degenerated. At the time of the invafion of Xerxes, they were the firft people in Greece who were gained over to the Perfian intereft. On account of this mifbehaviour, they were become very obnoxious to the other ftates, efpecially to the Athenians, whofe power and renown increafed every day, and threatened at laft to fwallow them up altogether. The Thebans being in no condition to oppofe fuch a formidable power, put themfelves under the protection of the Spartans, who, out of jealoufy of the Athenians, readily forgave them; and fo grateful were the Thebans for the kindnefs fhown them at this time, that during the whole of the Peloponnefian war Sparta had not a more faithful ally. By thefe means they not only recovered the government of Bœotia, of which they had been formerly in poffeffion, till deprived of it on account of their fiding with the Perfians, but their city became one of the firft in Greece. By this profperity the Thebans were fo much elated, that, when the peace of Antalcidas came to be figned, they refufed to agree to it, as they were thus once more deprived of the government of Bœotia; fo that it was not without the utmoft difficulty that they were overawed into it by the other ftates. Not content with forcing them to give up this point, however, the Spartans undertook to change the form of the Theban government, which at this time was a democracy, and accomplifhed through the treachery of thofe who had the care of the citadel.

4 Put themfelves under the protection of the Spartans.

5 The form of government changed and the citadel feized by the Spartans.

6 The Thebans recover their liberty under Pelopidas.

The Thebans continued under the power of the Spartans for four years; at the end of which term a confpiracy being formed againft them by fome of the principal people in the city, among whom was a young nobleman named *Pelopidas*, the Spartans were maffacred and driven out, and the citadel regained. During the tumult Epaminondas, afterwards the celebrated general, with a number of the beft citizens, joined the party of Pelopidas; and the latter having called a general affembly of the Thebans, proclaimed liberty to them, and exhorted them in the ftrongeft manner to fight for their country. This fpeech was received with the greateft acclamations; Pelopidas was unanimoufly proclaimed the preferver of Thebes, and was charged with the management of the war which was then to be declared againft Sparta.

7 War with Sparta.

Thefe tranfactions fo much exafperated the Spartans, that they immediately fent their king Cleombrotus againft them, though it was then the depth of winter. The Athenians, in the mean time, who had hitherto affifted the Thebans, declined any farther connection, left they fhould draw upon themfelves the refentment of the Spartans. But they were foon after determined to act again on the fame fide, by an attempt which the Spartan general, Sphodrias, had rafhly made on the Pyræum or harbour of Athens. Thus, by means of the Athenians, a powerful diverfion was made in favour of the Thebans, who gradually recovered all the towns of Bœotia, and at length began to act offenfively againft their enemies, and made a powerful invafion in Phocis. They had now many fharp encounters with them; which, though they did not amount to decifive battles, yet did not fail to raife their courage, and diftrefs that of the Spartans. In thefe encounters Pelopidas always fignalized himfelf; and in the battle of Tanagra, where the Lacedæmonians were entirely defeated by the Athenians and their allies, Pelopidas had a principal fhare in the victory, and killed the Spartan general with his own hand. Soon after this, with a body of only 300 Thebans, he entirely routed and difperfed near 1000 Spartans; which was the greateft difgrace the latter had ever known; for till that time, whether in war with the Greeks or Barbarians, they had never been overcome by an equal, much lefs by fuch an inferior, number of troops.

8 The Spartans defeated by Pelopidas.

9 Platæa and Thefpia razed by the Thebans.

Thefe fucceffes of the Thebans greatly alarmed the Athenians, who continually fought to oppofe their growing power. In this oppofition they were joined by the Platæans, who on this account became extremely obnoxious to the Thebans, fo that they at laft came to a refolution to furprife their city. This they accomplifhed, and entirely deftroyed it, together with Thefpia, another city extremely well affected to Athens. Soon after this, the Thebans, encouraged by their fuccefs, began to think of enlarging their territories, and of making encroachments on their neighbours, as they faw other ftates had done before them. This fpirit of conqueft is faid to have been raifed by their general Pelopidas; in which he was feconded by Epaminondas, a perfon who, though like him endowed with all the neceffary qualities to make a complete captain or patriot, had till then preferred a private life, and lived in a conftant courfe of virtue and the ftudy of philofophy. He had as yet feldom appeared in public, except to get himfelf excufed from thofe ftate-employments which were fo eagerly courted by others. This, however, had not hindered him from contracting an intimate friendfhip with Pelopidas, which had been daily improved by the correfpondence of their tempers and principles, as well as by that zeal which both difplayed for the good of their country; which laft had made them, even before this time, appear together in action, and to fuch advantage, that Epaminondas's merit could be no longer concealed, nor indeed fuffer him to continue longer in his beloved retirement: fo that he faw himfelf, at length, defervedly placed at the head of the Theban troops; where he gave fuch early proofs of his future prowefs and abilities, as juftly gave him the next rank to Pelopidas. Both came now to be confidered in the fame light, as generals in the field, as governors at home, and as complete ftatefmen in the council. When the general treaty for reftoring peace to Greece came to be propofed by the Athenians, and was upon the point of being executed by the reft of the ftates, the Thebans refufed to agree to it, unlefs they were comprehended in it under the name of *Bœotians*. This demand was as ftrenuoufly oppofed by the other contracting powers as infifted on by Epaminondas, who was there as ambaffador on the part of the Thebans. Agefilaus, in particular, told him in plain terms, that the Thebans ought to evacuate Bœotia, and leave the cities of it free and independent. To which he was anfwered by him, that the Lacedæmonians would do well to fet them the example, by reftoring Meffenia to its ancient proprietors, and Laconia to its ancient freedom; for that

10 Account of Epaminondas.

11 His difference with Agefilaus king of Sparta.

that the pretensions of the city of Thebes to Bœotia were as well founded, at least, as those of Sparta to these two countries. After this he went on, and showed how far Sparta had aggrandized herself at the expence of her neighbours: that peace might be indeed obtained, and upon a solid and lasting footing; but that this could not be otherwise than by bringing all to an equality. This bold, though just remonstrance, in which not only Thebes, but Greece in general was concerned, failed not, however, to exasperate the haughty Spartan monarch; and the Athenians, who had till now looked upon the Thebans as dependents either on them or on the Macedonians, were not a little offended to hear their ambassadors talk in such high terms. The result of the conference was, that Agesilaus struck the name of *Thebes* out of the treaty, and declared war against them, about the year 371 B. C.

12 The The Thebans were in no small consternation to see themselves engaged in a war with the powerful Spartans, without any ally to assist them; and the rest of the Grecian states having made peace with the latter, began to look upon the ruin of the former as unavoidable. However, they resolved to make the best defence they could; and put their army under the command of Epaminondas, assigning him, at his own request, six others to act as counsellors or assistants. The Theban army consisted at most but of 6000 men, whereas that of the enemy was at least thrice that number; but Epaminondas trusted most to his horse, wherein he had much the advantage both in quality and good management: the rest he endeavoured to supply by the disposition of his men, and the vigour of the attack. He even refused to suffer any to serve under him in the engagement, but such as he knew to be fully resolved to conquer or die. The two armies met at LEUCTRA, where the Spartans were defeated with great slaughter, as related under that article.

The victorious general, desirous to improve this great victory, sent an herald, crowned with garlands, to communicate it in form to the Athenians, in hopes that this would be an effectual means to reunite them to the Theban interest. But it proved quite otherwise. Athens, which now looked upon them with a jealous eye, and had then in view the sovereignty of Greece, chose rather, if they could not wholly obtain it, to share it with Sparta, than to let the Thebans into the whole; and therefore even declined giving their herald audience. However, the Thebans took care to strengthen themselves by alliances; and, besides the Arcadians and Eleans, had got the Phocians, Locrians, Acarnanians, Eubœans, and other states, under their dependence: so that they were now in a condition to act offensively against the Spartans. Accordingly, under pretence of assisting the Arcadians, they entered Peloponnesus with a gallant army, with Epaminondas and Pelopidas at their head. Here they were joined by the Arcadian and other confederate forces; so that the whole amounted to 40,000, some say 50,000 men, besides great numbers of those who followed the camp, rather for plunder than fighting, and were computed about 20,000 more. The army was divided into four columns, and moved straight towards Sellasia, the place of their rendezvous, from which they pursued their country with fire and sword towards Sparta. But here they were repulsed by Agesilaus, who was then returned to that metropolis.

To repair, in some measure, this disgrace, and at the same time to leave some lasting monument which should redound as much to his glory as to the mortification of the Spartans, Epaminondas left not their territories till he had restored the posterity of the old Messenians to their ancient dominions, out of which they had been banished near 300 years; rebuilt their capital, and left a strong garrison for its defence. He was, however, like to have been stopped in his return by Iphicrates, whom the Athenians had sent with 12,000 men to intercept him; but this last loitered so long at Corinth, that the Thebans had passed the defiles of Cenchreæ, the chief place where he could have obstructed his retreat had he taken possession of it in proper time. Epaminondas continued his march till he came in full view of the city of Corinth. He found the roads choaked up with trees, rocks, stones, and every thing that could render them impassable; and the Corinthians well fortified, and resolute on a stout defence. But he came so furiously upon them, notwithstanding all these difficulties, that they abandoned all their entrenchments and outworks to the Thebans, and fled into the city. Thither these pursued them sword in hand, and made an horrid slaughter of them; insomuch that Corinth must have unavoidably fallen into their hands, had their generals thought fit to pursue these advantages; but whether they were afraid of the Athenians falling upon them, or apprehended some dangerous ambush in a country with which they were but indifferently acquainted, or whether the army was too much weakened through so many fatigues, or lastly, whether the coldness of the season, it being then the depth of winter, would not permit them to proceed farther, they immediately marched towards Bœotia. This gave such an handle to their enemies, that they met with a very mortifying reception at their return to Thebes, where they were both arrested, and clapped up as state-prisoners, for having presumed to prolong their command four months longer than the time limited by law, which time took in almost the whole of their expedition from their first entrance into Peloponnesus. However, at last, the judges being ashamed to proceed any farther, they were both honourably acquitted.

18 The Messenians restored to their ancient dominions.

19 The Corinthians defeated.

20 Epaminondas and Pelopidas disgraced at Thebes.

This prosecution had been chiefly carried on and encouraged by Meneclides, a discontented Theban, and a bold and able speaker, who, by his artful calumnies at the trial, had so far prevailed with the judges as to get Epaminondas deprived of the government of Bœotia for a whole year, though he could not gain the same advantage against Pelopidas, who was a greater favourite of the people, as being his senior.

21 War renewed with Sparta.

By this delay the Spartans, with much difficulty, had recovered themselves from their great defeat at Leuctra, and settled their affairs in as good a posture as they could: but though they had repulsed the Thebans in Peloponnesus, yet from the exploits they had performed there, especially in the dismembering the whole kingdom of Messenia from them, they had still cause to fear what their forces might do under two such generals; and had accordingly taken due care to strengthen themselves against them, and to provide themselves with a great number of auxiliaries from other states, especially from that of Athens, with whom they had renewed their old treaty, and had agreed that each should have the command five days alternately. Soon after this treaty the Arcadians renewed the war, and took Pallene in Laconia by storm, put the garrison to the sword, and were presently assisted by the Argives and Eleans, and especially by the Thebans, who sent to them 7000 foot and 500 horse under the command of Epaminondas. This so alarmed the Athenians likewise, that they immediately sent Gobrias with some forces to oppose his passage in good earnest; and he so behaved himself against the Thebans, that they were forced to abandon Peloponnesus a second time. This ill-success gave fresh occasion to the enemies of Epaminondas to blame his conduct in the highest terms, notwithstanding the singular bravery with which he and his troops had forced the pass. Even his friends could not but suspect him of

22 The Thebans repulsed.

Thebes.

of partiality for the Spartans, in not pursuing his advantage over them, and making a greater slaughter of them when he had it in his power; whilst his enemies made it amount to no less than treachery to his country: so that their brave general was once more deprived of the government of Bœotia, and reduced to the condition of a private man. He did not continue long under this disgrace, before an occasion offered to make his services again of such necessity to the state, as to give him an opportunity to retrieve his fame, and wipe off the stain which his enemies had thrown upon him.

23 Epaminondas degraded.

The Thessalians, who had groaned some time under the tyranny of the usurper Alexander, surnamed the *Pheræan*, sent an embassy to Thebes to implore their aid and protection; upon which Pelopidas was immediately sent as ambassador to expostulate with him on their behalf. He was then in Macedon, from whence he took the young prince Philip, afterwards the celebrated monarch, in order to protect and educate him; and, upon his return, marched directly to Pharsalus in Thessaly, in order to punish the treachery of some mercenaries, who had deserted the Thebans in that expedition; but when he came thither, he was surprised to be met by the tyrant at the head of a numerous army before that city, whilst his own was but as an handful of men in comparison of it. However, whether he supposed, or would be thought to do so, that Alexander came thither to justify himself, and answer to the complaints alleged against him, he went, with Ismenias his colleague, to him unarmed and unattended, not doubting but his character as ambassador from so powerful a republic, joined to his own character and authority, would protect them from insult or violence: but he found himself mistaken; for Alexander had no sooner got them in his hands, than he caused them to be seized, and sent prisoners to Pheræ.

24 Pelopidas seized by Alexander of Pheræ.

The Thebans, highly resenting the indignity offered to their ambassadors, sent immediately an army into Thessaly: but the generals were repulsed with great loss by the Pheræan usurper; and it was owing to Epaminondas, who was among them only as a private centinel, that they were not totally cut off. For the Thebans, finding themselves in such imminent danger, which they attributed to the incapacity of their generals, had immediately recourse to him, whose valour and experience had been so often tried; and, partly by persuasions and intreaties, and partly by threats, obliged him to take the command. This soon gave a different turn to their affairs, and converted their flight into a safe and regular retreat; for he took the horse and light-armed foot, and placed himself at their head in the rear, and charged the enemy with such vigour and bravery, that he obliged them to desist from their pursuit.

25 A Theban army sent to rescue him, defeated.

26 Epaminondas restored.

However, as the army had suffered such loss before as not to be able to pursue them in their turn, he was obliged to return with them to Thebes, with their pusillanimous generals; where the latter were fined 12,000 drachms each, and the former was reinstated in the command, and sent with a new reinforcement to repair the late dishonour, and prosecute their revenge. The news of his being in full march on this errand greatly alarmed the tyrant; but Epaminondas, preferring the safety of his imprisoned colleague to all other considerations, forbore pushing hostilities to extremes, for fear of provoking the enemy to wreak all his fury on him: to prevent which, he contented himself for a while hovering about with his army, and now and then with such slight skirmishes as should intimidate the tyrant, and bring him the sooner to make some satisfactory offers. Alexander being fully convinced of the superiority of the Theban general, was glad to accept of a truce of 30 days, and to restore Pelopidas and Ismenias to him; upon which he immediately withdrew his forces, and returned with them to Thebes.

27 Rescues Pelopidas.

By this time Thebes was raised to a sufficient height of reputation and glory to begin to aim in earnest at the sovereignty of Greece. The main obstacle to it was, that the other states grew so jealous of her present greatness, as to enter into the strongest alliances and confederacies to prevent its farther growth; so that not being able now to procure many allies at home, they made no difficulty to seek for them abroad; and the Lacedæmonians, by leading the van, gave them a plausible pretence to follow their steps, and to procure an alliance with Persia, which at that time they found was ready to accept of the offers on any terms; the only question was, which of the three states should be preferred, Sparta, Athens, or Thebes. At the same time, the Thebans proposed to their new confederates to send likewise proper deputies to the Persian court, in order to support their respective interests; which they readily agreed to. These were the Arcadians, Eleans, and Argives; at the head of whose deputation Pelopidas was sent on the behalf of the Thebans; which the Athenians being apprised of, appointed two on their part. These being all arrived at the Persian court, began to pursue each their respective interests; but Pelopidas had by that time gained such credit there, both for his singular address and his extraordinary exploits, that he was distinguished in a particular manner from all the other deputies, and was received by the king with the most manifest marks of honour and esteem, who freely owned himself convinced that the Thebans were the people on whom he could most safely depend; and after having greatly applauded the equity of his demands, ratified and confirmed them with great readiness, to the no small mortification of the other states. The substance of them was, that the liberties formerly granted to the other towns of Greece should be confirmed; that Messenia, in particular, should continue free and independent on the jurisdiction of Sparta; that the Athenians should lay up their fleet; and that the Thebans should be looked upon as the ancient and hereditary friends of Persia.

28 Success of Pelopidas at the Persian court.

The Thebans took advantage of the dissensions which prevailed among the Greeks as a pretence for increasing their forces; and Epaminondas thought it a proper opportunity for his countrymen to make a bold effort to obtain the dominion at sea, as they had obtained it in a great measure at land. He proposed it to them in a public assembly, and encouraged their hopes from the experience of the Lacedæmonians, who in Xerxes's time had, with ten ships only at sea, gained the superiority over the Athenians, who had no fewer than 200; and added, that it would be a disgrace now to Thebes to suffer two such republics to engross the empire of so extensive an element, without putting in at least for their share of it. The people readily came into his proposal, not without extraordinary applause, and immediately ordered 100 galleys to be equipped; and in the meanwhile sent him to Rhodes, Chios, and Byzantium, to secure those states in their interest, and get what assistance he could from them. His negotiations had all the success that could be wished for, notwithstanding the strenuous opposition of the Athenians, and of their admiral Laches, who was sent with a powerful squadron against him. But what more effectually thwarted all his measures, was the work that they found for him at land, and the obliging the Thebans to take part in the quarrels that then reigned among their neighbours: so that whatever projects they had concerted, proved abortive for the present; and the death of Epaminondas, which happened not long after, put an effectual stop to them.

29 The Thebans propose to build a fleet.

During the absence of that general, and of his colleague

Thebes. Pelopidas, the Orchemenians, being spirited up by some Theban fugitives, had formed a design to change the Theban government into an aristocracy; and 300 horsemen of the former had been actually sent to put it in execution. Their project, however, was timely discovered by the vigilance of the magistrates, who caused them to be seized, and
30 The city of Orchomenus razed. put immediately to death. They next sent a sufficient force against the city of Orchomenus, with orders to put all the men to death, and to sell the women and children for slaves, which was punctually done; after which they razed that noble city to the ground. Pelopidas was then on his way
31 Pelopidas marches against the Thessalian tyrant. to Thessaly, at the head of a powerful army, whither he had been sent to assist the Thessalians, who still groaned under the tyranny of Alexander the Pheraean, and had made several brave efforts to recover their liberty, but had been still overpowered by that usurper. Being joined by the Thessalians, he encamped in the face of the enemy, though far superior in number, and consisting of above 20,000 men. A fierce engagement soon ensued, in which both sides fought with uncommon bravery. The place where the battle was fought was called *Cynocephala*, from several little hills on it, between which there ran a large plain. Both sides endeavoured at first to post themselves on these eminences with their foot, whilst Pelopidas ordered his cavalry to charge that of the enemy below; which they did with such success, that they soon put them to the rout, and pursued them over the plain. This obliged the tyrant to gain the tops of the hills, where he greatly annoyed the Thessalians that endeavoured to force those ascents; so that Pelopidas was obliged to give over his pursuit to come to their relief. This immediately inspired the Thessalians with fresh courage, who began again to charge the enemy at several onsets; and soon threw them into such disorder, that they were forced to give way. Pelopidas no sooner perceived the advantage, than he began to look about for Alexander, with a design of engaging him. Having found him out as he was commanding his right wing, and endeavouring to rally his men, he moved directly to him; and being got near enough to be heard by him, challenged him to decide the battle by single combat with him. Alexander, instead of accepting the offer, turned about, and with all the speed he could ran to screen himself amongst his guards. Upon this Pelopidas charged him with such furious speed, that he obliged him to retire farther, and shelter himself within the thickest ranks; the sight of which made him attack with fresh vigour, and fight more desperately against him. He tried in vain several times to break through their ranks to reach him, cutting down great numbers of those that came forward to oppose him: his earnestness at length exposed him so far to
32 He is killed. the darts that were shot at him at a distance, that some of them went quite through his armour, and gave him a desperate wound or two, while the rest advanced and stabbed him in the breast with their spears.

It is scarce possible for words to express the grief and despair which not only his brave Thebans, but likewise the Thessalians and other allies, shewed at the sight of their slain general: some of the latter, who had perceived the danger he was exposed to, came down the hill with all possible speed to his relief; but when they perceived that they were come too late to save him, both they and the rest of the little army thought on nothing now but to revenge his death. They rallied accordingly, both horse and foot, as quick as possible, and began to charge the enemy afresh, and
33 Alexander defeated, with such desperate fury, that they at length gained a complete victory over them, and killed above 3000 of them in their pursuit, besides a much greater number which they had slain on the field of battle, though they still looked upon all these advantages as vastly too small to compensate the loss of their brave general. Thebes.

The news of his death had no sooner reached Thebes, than the whole city was seen in as deep a mourning as his army. However, they sent a reinforcement to it of 7000 foot and 700 horse, as well to revenge the death of that general, as to improve the victory he had gained over the enemy; by the help of which they fell so furiously on them, that they quickly broke and totally defeated the shattered remains of Alexander's army. Hereupon he was forced to sue for peace, and to accept it on such conditions as the 34
conquerors thought fit to impose. He was at length dispatched in his bed by his wife Thebe, assisted by her brothers, about seven years after his defeat. His body was afterwards dragged along the streets, trodden under foot, and left a prey to the dogs. And at last murdered.

35 Ambition of the Thebans.
All this while the Thebans were watching to improve every commotion that happened, every success they met with, to the forwarding of their then reigning and favourite project, of increasing their power above all the rest, and in their turn to give laws to Greece. Their late success in Thessaly, and the rupture between the Arcadians and Mantineans at the same time, about some consecrated money which the former had taken out of the temple of Olympias to pay their troops employed against the Eleans, and which the latter called a downright sacrilege, besides other discords that reigned in the other states of Greece, gave fresh encouragement to Thebes to set up for arbitress in those disputes; and so much the more, as those who had embezzled the sacred money, and wanted rather to embroil matters than to have them brought to light, sent that republic word that the Arcadians were just upon the point of revolting to the Spartans, and advised them to come and put an immediate stop to it. At the same time they dispatched some private directions to a Theban officer at Tegea, to apprehend several of their own people as disturbers of the peace. This was accordingly done, and several eminent persons were confined as prisoners of state: they were soon after discharged, and loud complaints were made against such arbitrary and unjust proceedings. The officer was accused before the Theban senate for having intermeddled in their affairs, and endeavoured to interrupt the good correspondence between the two states. It was even insisted on by some of the Tegeans, that he should be indicted and proceeded against by his principals; whilst the more moderate sort, who foresaw the consequences that were likely to attend such appeals, and that it would infallibly bring the Thebans upon them, loudly protested against their marching into their territories, and did all they could to prevent it. The Thebans, however, were become too powerful and ambitious to miss so fair an opportunity of getting once more footing in Peloponnesus, as they had long ago premeditated; and Epaminondas was so far from making a secret of their design, that he told the Arcadian deputies in justification of it, that as it was on their account that the Thebans engaged in the war, they had acted treacherously with them in making peace with Athens without their consent: however, that when he was got with his army on his march into Peloponnesus to assist his friends, he would soon see what proofs the Arcadians would give of their fidelity. This speech did not fail to alarm them greatly; especially as it was spoken in such a magisterial style and threatening tone. Even those who were best affected to the Thebans could not forbear expressing their dislike of it; and all that had the welfare of Peloponnesus at heart readily agreed with the Mantineans, that there was no time to be lost to use all proper means to prevent the impending storm.
36 Epaminondas dispeases the states of Greece.

Athens and Sparta were accordingly applied to, and were eaſily prevailed upon to aſſiſt the Mantineans, and to come into a ſtrict confederacy againſt the Thebans; and to prevent all diſputes about the command of the army, it was agreed that each ſtate ſhould have it in its own territories; which plainly ſhows how terrified they all were at the apprehenſion of a freſh invaſion of the Thebans: for this was a point which neither the Spartans nor Athenians would have ſo readily given up to the Arcadians, though theſe had formerly as ſtrenuouſly inſiſted upon it, even when they were almoſt reduced to the laſt extremity, and had never been able to obtain it till now. But Epaminondas was then in full march at the head of his Bœotian troops, with ſome Eubœan auxiliaries, and a body of ſtout Theſſalian horſe; and was moreover to be joined by the Meſſenians, Argives, and ſeveral other nations, as ſoon as he had entered Peloponneſus. The confederate army againſt him had ordered their rendezvous at Mantinea, the place which they naturally concluded would be firſt attacked, as being the chief ſeat of thoſe who had revolted from the Thebans. But whilſt they were ſecuring themſelves on that ſide, Epaminondas, who wiſely conſidered how far this confederacy and expedition muſt have drained the city of Sparta of its main ſtrength, broke up privately from Nemæa, where he had lain for ſome time encamped, and marched all that night with a deſign to have ſurpriſed that important capital: but his project being timely diſcovered, the vigilant king took care to diſconcert it; ſo that, though the Theban general made ſeveral vigorous aſſaults on that city, he was ſo ſtoutly repulſed, and the Spartans behaved with ſuch intrepid valour, that he was forced to retire and turn his thoughts againſt Mantinea, which he judged by this time to have been quite defenceleſs. He judged rightly indeed; for the place was not only drained of its troops, but likewiſe of its inhabitants, who took that opportunity, whilſt the ſcene of war was in Lacedæmon, to gather in their harveſt, and were ſcattered all over the country; ſo that he would not have met with any difficulty in gaining the town, had not the Athenian auxiliaries come unexpectedly to its relief, and given him a freſh repulſe.

Theſe two laſt defeats greatly exaſperated the Theban general, who had never till now been uſed to them, and could not but foreſee that they would not only leſſen his reputation with his allies, but, if not timely retrieved, would ſully the glory of all his former exploits. What added to his preſent difficulties was, that the time allotted him for his expedition was almoſt expired; ſo that he had but a ſhort ſpace left to undertake ſome brave atchievement, which might recover his and his country's honour, and keep up the ſpirits of his auxiliaries and thoſe under his protection. He was moreover got very far into the enemy's country, and ſaw plainly enough how narrowly they watched all his motions, and how well prepared they were to oppoſe him whatever attempt he reſolved upon, whether to attack them or to retreat. Under all theſe difficulties, he rightly conſidered, that he muſt immediately reſolve upon a deciſive battle; in which, if his priſtine fortune followed him, he might at once retrieve his affairs, and make himſelf maſter of Peloponneſus; or, if that failed him, as it lately had done, fall honourably in the attempt. In this engagement Epaminondas made the wiſeſt diſpoſition of his troops, attacked and fought with the moſt intrepid courage and conduct, and had opened himſelf a way through the Spartan phalanxes, thrown them into the utmoſt confuſion, and made a terrible ſlaughter of them, inſomuch that the field of battle was covered with their wounded and ſlain, when, in the heat of the fight, having ventured himſelf too far in order to give them a total overthrow, the enemy rallied again, pouring with their whole fury three volleys of darts at him, ſome of which he drew out and returned to them, till at length, being covered with wounds, and weakened with the loſs of ſo much blood, he received a mortal wound from a javelin, and was with great difficulty reſcued from the enemy by his brave Thebans, and brought alive, though ſpeechleſs, into his tent. As ſoon as he had recovered himſelf, he aſked his friends that were about him what was become of his ſhield; and being told that it was ſafe, he beckoned to have it brought to him, and kiſſed it. He next inquired which ſide had gained the victory; and being anſwered, The Thebans; he replied, Then all is well: and upon obſerving ſome of his friends bewail his untimely death, and leaving no children behind him, he is ſaid to have anſwered, Yes; I have left two fair daughters, the victory of Leuctra, and this of Mantinea, to perpetuate my memory. Soon after this, upon drawing the point of the javelin out of his body, he expired.

Thebes. 41 Epaminondas killed.

The conſequence of this great general's fall, and of this bloody fight, in which neither ſide could boaſt any great advantage over the other, but a great loſs of men on both ſides, inſomuch that Xenophon makes it a drawn battle, was, that both parties agreed on a ceſſation of arms, and parted, as it were by conſent, to take care of their wounded and ſlain. The Thebans indeed thus far gained the greater ſhare of glory, that they renewed the fight, and after a moſt deſperate conteſt, gained the victory over thoſe Spartans that oppoſed them, and reſcued the body of their dying general out of their hands. However, an effectual end was put to this bloody war, and a general peace agreed on by all but Sparta; who refuſed it only becauſe the Meſſenians were included in it. But as to the Thebans, they had no great reaſon to boaſt of this dear-bought victory, ſince their power and glory began to decline from that very time; ſo that it may be truly ſaid, that it roſe and ſet with their great general.

42 Peace concluded.

43 State of Thebes to the preſent time.

On the death of Epaminondas, the Thebans relapſed into their former ſtate of inactivity and indolence; and at laſt having ventured to oppoſe Alexander the Great, their city was taken, and the inhabitants ſlaughtered for ſeveral hours, after which the buildings were deſtroyed. It was rebuilt by Caſſander, but never afterwards made any conſiderable figure among the ſtates of Greece. About the year 146 B. C. it fell under the power of the Romans, under which it continued till the extinction of their empire by the Turks. It is now called *Thive*, and is nothing to what it was formerly; yet it is four miles in circumference, but ſo full of ruins, that there are not above 4000 Turks and Chriſtians in it. It is now famous for a fine ſort of white clay, of which they make bowls for pipes after the Turkiſh faſhion. They are never burnt, but dry naturally, and become as hard as a ſtone. There are two moſques in Thebes, and a great many Greek churches. It is ſeated between two ſmall rivers, in E. Long. 23. 40. N. Lat. 38. 17.

Thebes, in Egypt, one of the moſt renowned cities of the ancient world. It was alſo called *Dioſpolis*, or the city of Jupiter, and was built, according to ſome, by Oſiris, according to others by Buſiris. Its length, in Strabo's time, was 80 furlongs, or ten miles; but this was nothing in compariſon of its ancient extent, before it was ruined by Cambyſes, which, we are told, was no leſs than 420 ſtadia, or 52 miles and an half. The wealth of this city was ſo great, that, after it had been plundered by the Perſians, what was found, on burning the remains of the pillage, amounted to above 300 talents of gold and 2300 of ſilver.

Ancient [illegible] Hiſtory, vol. i.

Mr Bruce viſited the ruins of this celebrated city; but informs us that nothing now remains except four temples, and theſe neither ſo entire nor magnificent as ſome others at

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Thebes, a place called *Dendra*. Thebes has been celebrated by Homer for its hundred gates; but Mr Bruce informs us, that no vestiges of them are now remaining, neither can we discover the foundation of any wall it ever had; "and as for the horsemen and chariots it is said to have sent out, all the Thebaid sown with wheat would not have maintained one half of them. The whole of the ruins of the temples called *Medinet Tabu*, are built in a long stretch of about a mile broad, most parsimoniously chosen at the sandy foot of the mountains. The *Horti Pensiles*, or hanging gardens, were surely formed upon the sides of these hills, then supplied with water with mechanical devices. The utmost is done to spare the plain, and with great reason; for all the space of ground this ancient city has had to maintain its myriads of horses and men, is a plain of three quarters of a mile broad between the town and the river, upon which plain the water rises to the height of four and five feet. All this pretended populousness of ancient Thebes I therefore believe to be fabulous."

Bruce's Travels.

Mr Bruce, after examining the ground on which Thebes is supposed to have stood, thinks that it had no walls, and that consequently Homer's story of its having an hundred gates is misunderstood. The mountains of the Thebaid stand close behind the town, not in a ridge, but standing single, so that you can go round each of them. A hundred of these are said to be hollowed out for sepulchres and other purposes. These, he thinks, were the hundred gates of Homer; in proof of this they are still called by the natives *Beeban el Meluke*, "the ports or gates of the kings."

All that is said of Thebes by poets or historians after the days of Homer is meant of Diospolis, which was built by the Greeks long after Thebes was destroyed, as its name testifies; though Diodorus says it was built by Busiris. It was on the east side of the Nile, whereas ancient Thebes was on the west, though both are considered as one city; and Strabo says, that the river runs through the middle of Thebes, by which he means between Old Thebes and Diospolis.

THEFT, or SIMPLE LARCENY, is "the felonious taking and carrying away of the personal goods of another." This offence certainly commenced then, whenever it was that the bounds of property, or laws of *meum* and *tuum*, were established. How far such an offence can exist in a state of nature, where all things are held to be common, is a question that may be solved with very little difficulty. The disturbance of any individual in the occupation of what he has seized to his present use, seems to be the only offence of this kind incident to such a state. But, unquestionably, in social communities, when property is established, any violation of that property is subject to be punished by the laws of society; though how far that punishment should extend is matter of considerable doubt.

By the Jewish law it was only punished with a pecuniary fine, and satisfaction to the party injured; and in the civil law, till some very late constitutions, we never find the punishment capital. The laws of Draco at Athens punished it with death: but his laws were said to be written with blood; and Solon afterwards changed the penalty to a pecuniary mulct. And so the Attic laws in general continued; except that once, in a time of dearth, it was made capital to break into a garden and steal figs: but this law, and the informers against the offence, grew so odious, that from them all malicious informers were styled *sycophants*; a name which we have much perverted from its original meaning. From these examples, as well as the reason of the thing, many learned and scrupulous men have questioned the propriety, if not lawfulness, of inflicting capital punishment for simple theft. And certainly the natural punishment for injuries to property seems to be the loss of the offender's own property; which ought to be universally the case, were all mens fortunes equal. But as those who have no property themselves are generally the most ready to attack the property of others, it has been found necessary, instead of a pecuniary, to substitute a corporal punishment; yet how far this corporal punishment ought to extend, is what has occasioned the doubt. Sir Thomas More and the Marquis Beccaria, at the distance of more than two centuries, have very sensibly proposed that kind of corporal punishment which approaches the nearest to a pecuniary satisfaction, viz. a temporary imprisonment, with an obligation to labour, first for the party robbed, and afterwards for the public, in works of the most slavish kind; in order to oblige the offender to repair, by his industry and diligence, the depredations he has committed upon private property and public order. But, notwithstanding all the remonstrances of speculative politicians and moralists, the punishment of theft still continues throughout the greatest part of Europe to be capital: and Puffendorf, together with Sir Matthew Hale, are of opinion that this must always be referred to the prudence of the legislature; who are to judge, say they, when crimes are become so enormous as to require such sanguinary restrictions. Yet both these writers agree, that such punishment should be cautiously inflicted, and never without the utmost necessity.

The Anglo Saxon laws nominally punished theft with death, if above the value of twelvepence: but the criminal was permitted to redeem his life by a pecuniary ransom; as, among their ancestors the Germans, by a stated number of cattle. But in the 9th year of Henry I. this power of redemption was taken away, and all persons guilty of larceny above the value of twelvepence were directed to be hanged; which law continues in force to this day. For though the inferior species of theft, or petit larceny, is only punished by whipping at common law, or (by stat. 4 Geo. I. c. 11.) may be extended to transportation for seven years, as is also expressly directed in the case of the Plate-glass Company; yet the punishment of grand larceny, or the stealing above the value of twelvepence (which sum was the standard in the time of king Athelstan, 800 years ago), is at common law regularly death: which, considering the great intermediate alteration in the price or denomination of money, is undoubtedly a very rigorous constitution; and made Sir Henry Spelman (above a century since, when money was at twice its present rate) complain, that while every thing else was risen in its nominal value, and become dearer, the life of man had continually grown cheaper. It is true, that the mercy of juries will often make them strain a point, and bring in larceny to be under the value of twelvepence, when it is really of much greater value: but this, though evidently justifiable and proper when it only reduces the present nominal value of money to the ancient standard, is otherwise a kind of pious perjury, and does not at all excuse our common law in this respect from the imputation of severity, but rather strongly confesses the charge. It is likewise true, that by the merciful extensions of the benefit of clergy by our modern statute-law, a person who commits a simple larceny to the value of thirteen pence or thirteen hundred pounds, though guilty of a capital offence, shall be excused the pains of death; but this is only for the first offence. And in many cases of simple larceny the benefit of clergy is taken away by statute: as from horse-stealing in the principals and accessories both *before* and *after* the fact; theft by great and notorious thieves in Northumberland and Cumberland; taking woollen cloth from off the tenters, or linens, fustians, calicoes, or cotton goods, from the place of manufacture (which extends, in the last case, to aiders, assisters,

sisters, procurers, buyers, and receivers); feloniously driving away, or otherwise stealing one or more sheep or other cattle
14. specified in the acts, or killing them with intent to steal the whole or any part of the carcase, or aiding or assisting therein; thefts on navigable rivers above the value of forty shillings, or being present, aiding and assisting thereat; plundering vessels in distress, or that have suffered shipwreck; stealing letters sent by the post; and also stealing deer, hares, and conies, under the peculiar circumstances mentioned in the Waltham black act. Which additional severity is owing to the great malice and mischief of the theft in some of these instances; and, in others, to the difficulties men would otherwise lie under to preserve those goods, which are so easily carried off. Upon which last principle the Roman law punished more severely than other thieves the *Abigei* or stealers of cattle, and the *Balnearii* or such as stole the clothes of persons who were washing in the public baths; both which constitutions seem to be borrowed from the laws of Athens. And, so too, the ancient Goths punished with unrelenting severity thefts of cattle, or of corn that was reaped and left in the field: such kind of property (which no human industry can sufficiently guard) being esteemed under the peculiar custody of heaven.

Theft-Bote (from the Saxon *theof*, i. e. *fur*, and *bote*, *compensatio*), is the receiving of a man's goods again from a thief, after stolen, or other amends not to prosecute the felon, and to the intent the thief may escape; which is an offence punishable with fine and imprisonment, &c.

THELIGONUM, in botany: A genus of plants belonging to the class of *monœcia*, and order of *polyandria*; and in the natural system ranging under the 53d order, *Scabridæ*. The male calyx is bifid; there is no corolla; the stamina are generally 12. The female calyx is also bifid; there is no corolla; only one pistil; the capsule is coriaceous, unilocular, and monospermous. There is only one species, the *Cynocrambe*, which is indigenous in the south of Europe.

THEME, denotes the subject of an exercise for young students to write or compose on.

THEMISON, a physician of Laodicea, a disciple of Asclepiades. He founded the methodic sect, with a view to the more easily teaching and practising the art of medicine. (See Medicine, n° 37). Themison gave the first account of diacodium, which was prepared of the juice and decoction of poppy-heads and honey. He invented a purging medicine called *hiera*.

THEMISTIUS, an ancient Greek orator and philosopher, a native of Paphlagonia, who flourished in the 4th century. He had great interest and favour with the emperors in his time, and though a heathen, was of a very tolerating spirit. He taught for many years at Constantinople, of which city he was made præfect by Julian and Theodosius; and lived to be exceeding old. More than 30 of his orations are still extant, beside commentaries on several parts of Aristotle's works.

THEMISTOCLES, the renowned Athenian admiral, general, and patriot, who gained the battle of Salamis against the Persians. Being banished his country by his ungrateful fellow-citizens, he fled to Artaxerxes king of Persia: but, in order to avoid taking up arms against his country, he slew himself, 464 B. C. See Attica, n° 76, *et seq.*

THEOBALD (Lewis), the son of an attorney at Sittingbourn in Kent, was a well-known writer and critic in the early part of the present century. He engaged in a paper called the *Censor*, published in Mist's Journal, wherein, by delivering his opinions with too little reserve concer[illegible] eminent wits, he exposed himself to their re[illegible] on the publication of Pope's Homer, he prai[illegible] of extravagant admiration, yet afterwards thought proper to abuse it as earnestly; for which Pope at first made him the hero of his Dunciad, though he afterward laid him aside for another. Mr Theobald not only exposed himself to the lashes of Pope, but waged war with Mr Dennis, who treated him more roughly, though with less satire. He nevertheless published an edition of Shakespeare, in which he corrected, with great pains and ingenuity, many faults that had crept into that poet's writings. This edition is still in great esteem; being in general preferred to those published by Pope, Warburton, and Hanmer. He also wrote some plays, and translated others from the ancients.

THEOBROMA, in botany: A genus of plants belonging to the class of *polyadelphia*, and order of *pentandria*; and in the natural system ranging under the 37th order, *Columniferæ*. The calyx is triphyllous; the petals, which are five in number, are vaulted and two-horned; the nectarium is pentaphyllous and regular; the stamina grow from the nectarium, each having five antheræ. There are three species; the *cacao*, *guazuma*, and *angusta*.

The *cacao*, or chocolate tree, we shall describe in the words of Dr Wright: "In all the French and Spanish islands and settlements in the warmer parts of America, the chocolate tree is carefully cultivated. This was formerly the case also in Jamaica; but at present we have only a few straggling trees left as monuments of our indolence and bad policy. *London Medical Journal*, vol. viii.

"This tree delights in shady places and deep valleys. It is seldom above 20 feet high. The leaves are oblong, large, and pointed. The flowers spring from the trunk and large branches; they are small, and pale red. The pods are oval and pointed. The seeds or nuts are numerous, and curiously stowed in a white pithy substance.

"The cocoa-nuts being gently parched in an iron pot over the fire, the external covering separates easily. The kernel is levigated on a smooth stone; a little arnotto is added, and with a few drops of water is reduced to a mass, and formed into rolls of one pound each. This simple preparation is the most natural, and the best. It is in daily use in most families in Jamaica, and seems well adapted for rearing of children." See Chocolate.

THEOCRACY, in matters of government, a state governed by the immediate direction of God alone: such was the ancient government of the Jews before the time of Saul.

THEOCRITUS, the father of pastoral poetry, was born at Syracuse in Sicily. Two of his poems ascertain his age; one addressed to Hiero king of Syracuse, who began his reign about 275 years before Christ; and the other to Ptolemy Philadelphus king of Egypt. Hiero, though a prince distinguished in arms and political wisdom, does not seem to have been a patron of learning. This is supposed to have given birth to the 16th Idyllium. From Syracuse Theocritus went to Alexandria, where he seems to have found a munificent patron in Ptolemy Philadelphus, if we may judge from the panegyric which he composed on that prince (the 17th Idyllium). It has been said that Theocritus was strangled by Hiero, but we have not found evidence of this.

The compositions of this poet are distinguished, among the ancients, by the name of *Idylliums*, in order to express the smallness and variety of their natures: they would now be called *Miscellanies*, or *Poems on several occasions*. The first nine and the eleventh are confessed to be true pastorals, and hence Theocritus has usually passed for nothing more than a pastoral poet; yet he is manifestly robbed of a great part of his fame, if his other poems have not their proper laurels. For though the greater part of his Idylliums cannot be called the songs of shepherds, yet they have certainly

their refpective merits. His paftorals ought to be confidered as the foundation of his credit; upon this claim he will be admitted for the father as well as the inventor of his art, and will be acknowledged to have excelled all his imitators as much as originals ufually do their copies.

The works of this poet were firft publifhed in folio by Aldus Manutius at Venice in 1495. A more elegant and correct edition was printed by Henry Stephens at Paris in 1566. An edition was publifhed at Leipfic in 1765, with valuable notes by the learned Reifke. But what will moft highly gratify the admirers of paftoral poetry, is an edition publifhed in 1770, 2 vols 4to, by Mr Thomas Warton. It is accompanied by the fcholia of the beft editors, and the different readings of 15 MSS.

THEODOLITE, a mathematical inftrument for meafuring heights and diftances. See GEOMETRY, p 679.

THEODORE, king of Corfica, baron Nieuhoff in the county of La Marc in Weftphalia. He had his education in the French fervice, and afterwards went to Spain, where he received fome marks of regard from the duke of Riperda and cardinal Alberoni; but being of an unfettled difpofition, he quitted Spain, and travelled into Italy, England, and Holland, in fearch of fome new adventure. He at laft fixed his attention on Corfica, and formed the fcheme of rendering himfelf fovereign of that ifland. He was a man of abilities and addrefs; and having fully informed himfelf of every thing relating to Corfica, went to Tunis, where he fell upon means to procure fome money and arms; and then went to Leghorn, from whence he wrote a letter to the Corfican chiefs Giafferi and Paoli, offering confiderable affiftance to the nation if they would elect him as their fovereign. This letter was configned to Count Domenico Rivarola, who acted as Corfican plenipotentiary in Tufcany; and he gave for anfwer, that if Theodore brought the affiftance he promifed to the Corficans, they would very willingly make him king.

Upon this he, without lofs of time, fet fail, and landed at Tavagna in the fpring of the year 1736. He was a man of a very ftately appearance, and the Turkifh drefs he wore added to the dignity of his mien. He had a few attendants with him; and his manners were fo engaging, and his offers fo plaufible, that he was proclaimed king of Corfica before Count Rivarola's difpatches arrived to inform the chiefs of the terms upon which he had agreed. He brought with him about 1000 zequins of Tunis, befide fome arms and ammunition, and made magnificent promifes of foreign affiftance; whence the Corficans, who were glad of any fupport, willingly gave into his fchemes. Theodore inftantly affumed every mark of royal dignity. He had his guards and his officers of ftate; he conferred titles of honour, and ftruck money both of filver and copper. The filver pieces were few in number, and can now hardly be met with; the copper coins have on one fide T. R. that is, "Theodorus Rex," with a double branch croffed, and round it this infcription, PRO BONO PUBLICO RE CO. that is, "For the public good of the kingdom of Corfica:" on the other fide is the value of the piece; *Cinque folidi*, or five fous.

The Genoefe were not a little confounded with this unexpected adventurer. They publifhed a violent manifefto againft Theodore, treating him with great contempt; but at the fame time fhowing they were alarmed at his appearance. Theodore replied, in a manifefto, with all the calmnefs and dignity of a monarch; but after being about eight months in Corfica, perceiving that the people began to cool in their affections towards him, he affembled his chiefs, and declared he would keep them no longer in a ftate of uncertainty, being determined to feek in perfon the fupport he fo long expected. He fettled an adminiftration during his abfence, recommended unity in the ftrongeft terms, and left the ifland with reciprocal affurances of fidelity and affection. He went to Holland, where he was fo fuccefsful as to obtain credit from feveral rich merchants, particularly Jews, who trufted him with cannon and other warlike ftores to a great value, under the charge of a fupercargo. With thefe he returned to Corfica in 1739; but by this time the French, as auxiliaries to the Genoefe, had become fo powerful in the ifland, that though Theodore threw in his fupply of warlike ftores, he did not incline to venture his perfon, the Genoefe having fet a high price on his head. He therefore again departed; and after many unavailing attempts to recover his crown, at length chofe for retirement a country where he might enjoy the participation of that liberty which he had fo vainly endeavoured to give his Corficans; but his fituation in England by degrees grew wretched, and he was reduced fo low as to be feveral years before his death a prifoner for debt in the King's Bench. At length, to the honour of fome gentlemen of rank, a charitable contribution was fet on foot for him in the year 1753. Mr Bofwell obferves, that Mr Horace Walpole generoufly exerted himfelf for the unhappy Theodore, and wrote a paper in *The World* with great elegance and humour, foliciting a contribution for the unhappy monarch in diftrefs, to be paid to Mr Robert Dodfley bookfeller, as lord high treafurer. This brought him a very handfome fum, and he was fet at liberty. That gentleman adds, that Mr Walpole has the original deed, by which Theodore made over the kingdom of Corfica in fecurity to his creditors, and that he has alfo the great feal of the kingdom. Theodore died in 1756, and was buried in St Anne's churchyard, Weftminfter; where, in 1757, a fimple unadorned monument of marble was erected to his memory by a gentleman, with an infcription; which, after mentioning fome of the above particulars, concludes with the following lines:

> The grave, great teacher, to a level brings
> Heroes and beggars, galley-flaves and kings;
> But Theodore this moral learn'd ere dead,
> Fate pour'd its leffon on his living head,
> Beftow'd a kingdom and deny'd him bread.

Theodore left a fon, who was an accomplifhed gentleman.

THEODORET, bifhop of St Cyricus in Syria, in the 4th century, and one of the moft learned fathers of the church, was born in the year 386, and was the difciple of Theodorus Mopfueftia and St John Chryfoftom. Having received holy orders, he was with difficulty perfuaded to accept of the bifhopric of St Cyricus, about the year 420. He difcovered great frugality in the expences of his table, drefs, and furniture, but fpent confiderable fums in improving and adorning the city of Cyricus. He erected two large bridges, public baths, fountains, and aqueducts, and laboured with great zeal and fuccefs in his diocefe. Yet his zeal was not confined to his own church: he went to preach at Antioch and the neighbouring towns; where he became admired for his eloquence and learning, and had the happinefs to convert multitudes of people. He wrote in favour of John of Antioch and the Neftorians, againft Cyril's Twelve Anathemas: he afterwards attacked the opinions of Neftorius, and was depofed in the fynod held by the Eutychians at Ephefus; but was again reftored by the general council of Chalcedon, in which he was prefent, in 451. It is thought that he died foon after; though others fay that he lived till the year 457. There are ftill extant Theodoret's excellent Commentary on St Paul's Epiftles, and on feveral other books of the Holy Scriptures. 2. His Ecclefiaftical Hiftory from the time of Arius to Theodofius the

Theodosius, Theogony. the Younger. 3. The history of the famous Anchorites of his time. 4. Epistles. 5. Discourses on Providence. And, 6. An excellent treatise against the Pagans, intitled, *De Curandis Græcorum Affectibus*; and other works. The best edition of all which is that of Father Sirmond in Greek and Latin, in 4 vols folio.

THEODOSIUS I. called the *Great*, was a native of Spain. The valour he had shown, and the great services he had done to the empire, made Gratian, attacked by the Goths and Germans, to admit him as a partner in the government. He received the purple in 379, aged 43. See CONSTANTINOPLE, n° 77—88.

THEOGONY, formed from Θεος *God*, and γονη *genitura*, "seed, offspring," that branch of the heathen theology which taught the genealogy of their gods. Theognis.

Hesiod gives us the ancient theogony, in a poem under that title. Among the most ancient writers, Dr Burnet observes, that theogony and cosmogony signified the same thing. In effect, the generation of the gods of the ancient Persians, fire, water, and earth, is apparently no other than that of the primary elements.

THEOGNIS, an ancient Greek poet of Megara in Achaia, flourished about the 59th Olympiad, 144 B. C. We have a moral work of his extant, containing a summary of precepts and reflections, usually to be found in the collections of the Greek minor poets.

THEOLOGY

1 Definition. IS a Greek word (θεολογια), and signifies that science which treats of the being and attributes of God, his relations to us, the dispensations of his providence, his will with respect to our actions, and his purposes with respect to our end. The word was first used to denote the systems, or rather the heterogeneous fables, of those poets and philosophers who wrote of the genealogy and exploits of the gods of Greece. Hence Orpheus, Museus, Hesiod, Pherecydes, and Pythagoras, were called *theologians*; and the same epithet was given to Plato, on account of his sublime speculations on the same subject. It was afterwards adopted by the earliest writers of the Christian church, who styled the author of the apocalypse, by way of eminence, ὁ θεολογος, the *Divine*.

Although every pagan nation of antiquity had some tutelary deities peculiar to itself, they may yet be considered as having all had the same theology, since an intercommunity of gods was universally admitted, and the heavenly bodies were adored as the *dii majorum gentium* over the whole earth. This being the case, we are happily relieved from treating, in the same article, of the truths of Christianity and the fictions of paganism, as we have elsewhere traced idolatry from its source, and shewn by what means "the foolish hearts of men became so darkened that they changed the glory of the incorruptible God into an image made like to corruptible man, and to birds, and four-footed beasts, and creeping things." See POLYTHEISM.

The absurdities and inconsistency of the pretended revelation of the Arabian impostor have been sufficiently exposed under the words ALCORAN and MAHOMETANISM: so that the only theology of which we have to treat at present is

2 Christian theology, *Christian* theology, which comprehends that which is commonly called *natural*, and that which is *revealed* in the scriptures of the Old and New Testaments. These taken together, and they ought never to be separated, compose a body of science so important, that in comparison with it all other sciences sink into insignificance; for without a competent knowledge of the attributes of God, of the several relations in which he stands to us, and of the ends for which we were created, it is obvious that we must wander through life like men groping in the dark, strangers to the road on which we are travelling, as well as to the fate awaiting us at the end of our journey.

3 To be studied carefully by those intended for the service of the church. But if this knowledge be necessary to all Christians, it is doubly so to those who are appointed to feed the flock of Christ, and to teach the ignorant what they are to believe, and what to do, in order to work out their own salvation. The wisdom and piety of our ancestors have accordingly founded professorships of theology in all our universities, where the principles of our religion are taught in a systematic and scientific manner; and the church has ordained, that no man shall be admitted to the office of a preacher of the gospel who has not attended a regular course of such theological lectures.

It must not, however, be supposed, that, by merely listening to a course of lectures however able, any man will become an accomplished divine. The principles of this science are to be found only in the word and works of God; and he who would extract them pure and unsophisticated, must dig for them himself in that exhaustless mine. To fit a man for this important investigation, much previous knowledge is requisite. He must study the works of God scientifically before he can perceive the full force of that testimony which they bear to the power, the wisdom, and the goodness of their author. Hence the necessity of a general acquaintance with the physical and mathematical sciences before a man enter upon the proper study of theology, for he will not otherwise obtain just and enlarged conceptions of the God of the universe. See PHYSICS, n° 1. 4 Previous knowledge requisite for the proper study.

But an acquaintance with the physical and mathematical sciences is not alone a sufficient preparation for the study of theology. Indeed it is possible for a man to devote himself so wholly to any of these sciences, as to make it counteract the only purposes for which it can be valuable to the divine; for he who is constantly immersed in matter, is apt to suspect that there is no other substance; and he who is habituated to the routine of geometrical demonstration, becomes in time incapable of reasoning at large, and estimating the force of the various degrees of moral evidence. To avert these untoward consequences, every man, before he enter upon the study of that science which is the subject of the present article, should make himself acquainted with the principles of logic, the several powers of the human mind, and the different sources of evidence; in doing which he will find the greatest assistance from Bacon's *Novum Organum*, Locke's *Essay on the Human Understanding*, Reid's *Essays on the Intellectual and Active Powers of Man*, and Tatham's *Chart and Scale of Truth*. These works, of which the young student ought to make himself master, will teach him to think justly, and guard him against a thousand errors, which those who have not laid such a foundation are apt to embrace as the truths of God.

The man who proposes to study theology ought to have it in view, as the ultimate end of his labours, to impart to others that knowledge which he may procure for himself. "Amongst the many marks which distinguish the *Christian* philosopher from the *Pagan*, this (says a learned writer*) is one of the most striking—the *Pagan* sought knowledge in a selfish way, to secrete it for his own use; the *Christian* seeks it with the generous purpose (first in view, though last in execution)

* Warburton.

[illegible] [illegible] The Pagan philoſopher, [illegible] art of thinking, proceeds to that [illegible] in the dexterous uſe of [illegible]. On the other hand, the *Chriſtian philoſopher* culti-vates [illegible] for the ſole purpoſe of diſſemina-ting the [illegible] goſpel."

[illegible] upon the proper ſtudy of theology [illegible] in this country, the rudiments of a [illegible], it may perhaps be ſuperfluous to recommend here any [illegible] proper to teach him the art of ſpeaking: we cannot however forbear to recommend to our ſtudent the attentive peruſal of Quintilian's *Inſtitutions*, and Dr Blair's *Lectures on Rhetoric and the Belles Lettres*. A fa-miliar acquaintance with theſe works will enable him, if he be endowed by nature with talents fit for the office in which he propoſes to engage, to expreſs his thoughts with correct-neſs and elegance; "without which, it has been well obſer-ved, that ſcience, eſpecially in a clergyman, is but learned lumber, a burden to the owner, and a nuiſance to every body elſe."

No man can proceed thus far in the purſuits of general ſcience without having been at leaſt initiated in the learned languages; but he who intends to make theology his pro-feſſion ſhould devote himſelf more particularly to the ſtudy of Greek and Hebrew, becauſe in theſe tongues the origi-nal ſcriptures are written. By this we do not mean to in-ſinuate that it is neceſſary for the man whoſe views aſpire no farther than to the office of paſtor of a Chriſtian con-gregation, to make himſelf a profound critic in either of theſe ancient languages. The time requiſite for this purpoſe is ſo long, that it would leave very little for other ſtudies of infinitely more importance to him, whoſe proper buſineſs it is to inſtruct the ignorant in thoſe plain and ſimple truths which are ſufficient to guide all men in the way to ſalva-tion. Still, however, it is obvious, that he who is incapable of conſulting the original ſcriptures, muſt reſt his faith, not upon the ſure foundation of the word of God, but upon the credit of fallible tranſlators; and if he be at any time called upon to vindicate revelation againſt the ſcoffs of infidelity, he will have to ſtruggle with many difficulties which are eaſily ſolved by him who is maſter of the original tongues.

Caution to be obſerved in attending the lectures of a profeſſor.

The ſtudent having laid in this ſtock of preparatory knowledge, is now qualified to attend with advantage the theological lectures of a learned profeſſor; but in doing this, he ſhould be very careful neither to admit nor reject any thing upon the bare authority of his maſter. Right prin-ciples in theology are of the utmoſt importance, and can reſt upon no authority inferior to that of the word of God. On this account we have long been of opinion, that a pro-feſſor cannot render his pupils ſo much ſervice by a ſyſte-matical courſe of lectures, as by directing their ſtudies, and pointing out the road in which they may themſelves arrive in the ſhorteſt time at the genuine ſenſe of the ſacred ſcrip-tures. In this opinion we have the honour to agree with the ableſt lecturer * in theology that we have ever heard. The authors of all ſyſtems are more or leſs prejudiced in behalf of ſome particular and artificial mode of faith. He, therefore, who begins with the ſtudy of them, and after-wards proceeds to the ſacred volume, ſees with a jaundiced eye every text ſupporting the peculiar tenets of his firſt maſter, and acts as abſurd a part as he who tries not the gold by the mind, but the mind by the gold. Before our young divine, therefore, ſit down to the ſerious peruſal of any one of thoſe *inſtitutes* or *bodies of theology* which abound in all languages, and even before he read that which the nature of our work compels us to lay before him, we beg leave, with the utmoſt deference to the ſuperior judgment of our more learned readers, to recommend to his conſideration the following

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* The late Dr [illegible] of Aberdeen.

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6

Chriſtian theology divided into two great parts.

Christian theology is divided into two great parts, *natural* and *revealed*; the former comprehending that which may be known of God from the creation of the world, even his eternal power and Godhead; the latter, that which is diſ-covered to man nowhere but in the ſacred volume of the Old and New Teſtaments.

7

Firſt principles of theology communicated.

Concerning the extent of natural theology many opi-nions have been formed, whilſt ſome have contended that there is no ſuch thing. Into theſe diſputes we mean not at preſent to enter. We believe that one of them could have had no exiſtence among ſober and enlightened men, had the contending parties been at due pains to define with accuracy the terms which they uſed. Whatever be the origin of religion, which we have endeavoured to aſcertain elſewhere (ſee Religion, n° 6—17.), it is obvious, that no man can receive a written book as the word of God till he be convinced by ſome other means that God exiſts, and that he is a Being of power, wiſdom, and goodneſs, who watches over the conduct of his creature man. If the progenitor of the human race was inſtructed in the principles of reli-gion by the Author of his being (a fact of which it is diffi-cult to conceive how a conſiſtent theiſt can entertain a doubt), he might communicate to his children, by natural means, much of that knowledge which he himſelf could not have diſcovered had he not been ſupernaturally enlightened. Between illuſtrating or proving a truth which is already talked of, and making a diſcovery of what is wholly un-known, every one perceives that there is an immenſe dif-ference (A).

8

To the earlieſt mortals by repeated revelations.

To beings whoſe natural knowledge originates wholly from ſenſation, and whoſe minds cannot, but by much diſ-cipline, advance from ſenſe to ſcience, a long ſeries of re-velations might be neceſſary to give them at firſt juſt notions of God and his attributes, and to enable them to perceive the

(A) The diſcriminating powers of Ariſtotle will not be queſtioned; and in the following extract made by Cicero from ſome of his works which are now loſt, he expreſſes our ſentiments on this important ſubject with his uſual preciſion:——"Præclare ergo Ariſtoteles, SI ESSENT, inquit, qui ſub terra ſemper habitaviſſent, bonis, et illuſtribus domiciliis, quæ eſſent ornata ſignis atque picturis, inſtructaque rebus iis omnibus, quibus abundant ii, qui beati putantur, nec tamen exiſſent unquam ſupra terram: ACCEPISSENT AUTEM FAMA ET AUDITIONE, ESSE QUODDAM NUMEN, ET VIM DEORUM; deinde aliquo tempore, patefactis terræ faucibus, ex illis abditis ſedibus evadere in hæc loca, quæ nos incolimus, atque exire potuiſſent: cum repente terram, et maria, cœlumque vidiſſent: nubium magnitudinem, ventorumque vim cognoviſ-ſent, adſpexiſſentque ſolem, ejuſque tum magnitudinem, pulchritudinemque, tum etiam efficientiam cognoviſſent, quod is diem efficeret, toto cœlo luce diffuſa: cum autem terras nox opacaſſet, tum cœlum totum cernerent aſtris diſtinctum et ornatum, lunæque luminum varietatem tum creſcentis, tum ſeneſcentis, eorumque omnium ortus et occaſus, atque in omni æternitate ratos, immutabileſque curſus: hæc cum viderent, PROFECTO ET ESSE DEOS, et HÆC TANTA OPERA DEORUM ESSE arbitrarentur." *De Nat. Deorum*, lib. ii. § 37.

From

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the relation between the effect and its cauſe, ſo as to infer by the powers of their own reaſon the exiſtence of the Creator from the preſence of his creatures. Such revelations, however, could be ſatisfactory only to thoſe who immediately received them. Whenever the Deity has been pleaſed by ſupernatural means to communicate any information to man, we may be ſure that he has taken effectual care to ſatisfy the perſon ſo highly favoured that his underſtanding was not under the influence of any illuſion; but ſuch a perſon could not communicate to another the knowledge which he had thus received by any other means than an addreſs to his rational faculties. No man can be required to believe, no man indeed can believe, without proof, that another, who has no more faculties either of ſenſation or intellect than himſelf, has obtained information from a ſource to which he has no poſſible acceſs. An appeal to miracles would in this caſe ſerve no purpoſe; for we muſt believe in the exiſtence, power, wiſdom, and juſtice, of God, before a miracle can be admitted as evidence of any thing but the power of him by whom it is performed. See MIRACLE.

9 And yet may be properly termed natural principles.

It is therefore undeniable that there are ſome principles of theology which may be called *natural*; for though it is in the higheſt degree probable that the parents of mankind received all their theological knowledge by *ſupernatural* means, it is yet obvious that ſome parts of that knowledge muſt have been capable of a proof purely rational, otherwiſe not a ſingle religious truth could have been conveyed through the ſucceeding generations of the human race but by the immediate inſpiration of each individual. We indeed admit many propoſitions as certainly true, upon the ſole authority of the Jewiſh and Chriſtian ſcriptures, and we receive theſe ſcriptures with gratitude as the lively oracles of God; but it is ſelf-evident that we could not do either the one or the other, were we not convinced by natural means that God exiſts, that he is a Being of goodneſs, juſtice, and power, and that he inſpired with divine wiſdom the penmen of theſe ſacred volumes. Now, though it is very poſſible that no man or body of men, left to themſelves from infancy in a deſert world, would ever have made a theological diſcovery; yet whatever propoſitions relating to the being and attributes of the firſt cauſe and the duty of man, can be demonſtrated by human reaſon, independent of written revelation, may be called *natural theology*, and are of the utmoſt importance, as being to us the firſt principles of all religion. Natural theology, in this ſenſe of the word, is the foundation of the Chriſtian revelation; for without a previous knowledge of it, we could have no evidence that the ſcriptures of the Old and New Teſtaments are indeed the word of God.

10 Natural theology to be ſtudied before the doctrines of revelation.

Our young divine, therefore, in the regular order of his ſtudies, ought to make himſelf maſter of *natural theology* before he enter upon the important taſk of ſearching the ſcriptures. On this ſubject many books have been publiſhed in our own and other languages; but perhaps there is none more worthy of attention than the Religion of Nature delineated by Mr Wollaſton (B). It is a work of great merit, and bears ample teſtimony to its author's learning and acuteneſs: yet we think it ought to be read with caution. Mr Wollaſton's theory of moral obligation is fanciful and groundleſs; and whilſt we readily acknowledge that he demonſtrates many truths with elegance and perſpicuity, we cannot deny that he attempts a proof of others, for which we believe no other evidence can be brought than the declarations of Chriſt and his apoſtles in the holy ſcriptures. To ſupply the defects of his theory of morals, we would recommend to the ſtudent an attentive peruſal of Cumberland on the Law of Nature, and Paley's Elements of Moral Philoſophy. A learned author * affirms of Cumberland, that "he excels all men in fixing the true grounds of moral obligation, out of which natural law and natural religion both ariſe;" and we have ourſelves never read a work in which the various duties which a man owes to his Maker, himſelf, and his fellow-creatures, are more accurately ſtated or placed on a ſurer baſis than in the moral treatiſe of the archdeacon of Carliſle.

11 Books recommended.

* Warburton.

As Wollaſton demonſtrates with great perſpicuity, and to the abſolute conviction of every man capable of feeling the force of argument, the being and many of the attributes of God, it may perhaps appear ſuperfluous to recommend any other book on that ſubject. The preſent age, however, having, among other wonderful phenomena, witneſſed a revival of the monſter *Atheiſm*, we would adviſe our ſtudent to read with much attention Cudworth's Intellectual Syſtem, and to read it rather in Moſheim's Latin tranſlation than in the author's original Engliſh. In the original, though many authors are quoted that are now but little known, there are very few references to the book, or chapter, or ſection, from which the quotations are taken. Theſe omiſſions are ſupplied by the tranſlator, who has likewiſe enriched his edition with many valuable and learned notes. It is well known that Cudworth wrote his incomparable work in confutation of Hobbes's philoſophy; but inſtead of confining himſelf to the whimſies of his antagoniſt, which were in a little time to ſink into oblivion, he took a much wider range, and traced atheiſm through all the mazes of antiquity, expoſing the weakneſs of every argument by which ſuch an abſurdity had ever been maintained. In exhauſting the metaphyſical queſtions agitated among the Greeks concerning the being and perfections of God, he has not only given us a complete hiſtory of ancient learning, as far as it relates to theſe inquiries, but has in fact anticipated moſt of the ſophiſms of our modern atheiſts, who are by no

From this paſſage it is evident, that the Stagyrite, though he conſidered the motions of the heavenly bodies, the ebbing and flowing of the ſea, and the other phenomena of nature, as affording a complete *proof* of the being and providence of God, did not however ſuppoſe that from theſe phenomena an untaught barbarian would *diſcover* this fundamental principle of religion. On the contrary, he expreſsly affirms, that before a man can feel the force of the evidence which they give of this important truth, he muſt have HEARD of the exiſtence and power of God.

(B) It may not be improper to inform the reader, that Mr Wollaſton, the author of the Religion of Nature, was a different man from Mr Woolſton, who blaſphemed the miracles of our Saviour. The former was a clergyman of great piety, and of ſuch moderate ambition as to refuſe one of the higheſt preferments in the church of England when it was offered to him; the latter was a layman remarkable for nothing but gloomy infidelity, and a perverſe deſire to deprive the wretched of every ſource of comfort. In the mind of the former, philoſophy and devotion were happily united; in the mind of the latter, there was neither devotion nor ſcience. Yet theſe writers have been frequently confounded; ſometimes through inadvertence from the ſimilarity of their names; and ſometimes, we are afraid, deſignedly, from a weak and bigotted abhorrence of every ſyſtem of religion that pretends to have its foundation in reaſon and in the nature of things.

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no means such discoverers as they are supposed to be by their deistical admirers.

12 How the scriptures are to be studied.

The student having made himself master of natural theology, and carefully endeavoured to ascertain its limits, is now prepared to enter upon the important task of searching the scriptures. In doing this, he ought to divest himself as much as possible of the prejudices of education in behalf of a particular system or sect, and to come to the study of the sacred volumes as of a work to which he is an entire stranger. He ought first to read it as a general history of nations and of men, beginning with the books of Moses, and proceeding through the rest, not in the order in which they are commonly printed, but in that in which there is reason to believe they were written (See SCRIPTURE). If he be master of the Hebrew and Greek languages, he will doubtless prefer the original text to any version; and in this perusal we would advise him to make no use of commentators, because his object at present is not to learn the doctrines contained in the bible, but merely to discover what are the subjects of which it treats. Many histories of the bible have been written; and were we acquainted with a good one, we should recommend it as a clue to direct the young divine's progress through the various books which compose the sacred volume. Stackhouse's history has been much applauded by some, and as much censured by others. It is not a work of which we can express any high degree of approbation; but if read with attention, it may no doubt be useful as a guide to the order of facts recorded in the scriptures. Between the Old and New Testaments there is a great chasm in the history of the Jewish nation; but it is supplied in a very able and satisfactory manner by Dr Prideaux, whose *Old and New Testament connected* is one of the most valuable historical works in our own or any other language. Shuckford's *Sacred and Profane History of the World connected* is likewise a work of merit, and may be read with advantage as throwing light upon many passages of the Old Testament; but the author is not intitled to the same confidence with Prideaux, as his learning was not so great, and his prejudices seem to have been greater.

In thus making himself master of the history of the Old and New Testaments, the student will unavoidably acquire some general notion of the various doctrines which they contain. These it will now be his business to study more particularly, to ascertain the precise meaning of each, and to distinguish such as relate to the whole human race, from those in which Abraham and his posterity were alone interested. He must therefore travel over the sacred volume a second time; and still we would advise him to travel without a guide. From Walton's *Polyglot bible*, and the large collection called *Critici sacri*, he may indeed derive much assistance in his endeavours to ascertain the sense of a difficult text; but we think he will do well to make little use of commentators and expositors, and still less of system-builders, till he has formed some opinions of his own respecting the leading doctrines of the Jewish and Christian religions.

"Impressed (says an able writer) with an awful sense of the importance of the sacred volume, the philosophical divine will shake off the bias of prejudices however formed, of opinions however sanctioned, and of passions however constitutional, and bring to the study of it the advantage of a pure and impartial mind. Instead of wasting all his labour upon a number of minute and less significant particulars, and of refining away plain and obvious sense by the subtleties of a narrow and corrosive mind, his first object will be to institute a theological inquiry into the general design of the written word; and from principles fully contained and fairly understood, to illustrate the true *nature* and *genius of the religious dispensation* in all its parts. He will mark the difference between the first and second covenants, and observe the connection that subsists between them. He will trace the temporary economy of the *Old Testament*, and weigh the nature and intent of the *partial covenant* with the Jews; observing with astonishment how it was made introductory of better things to come: and he will follow it through the *law* and the *prophets* in its wonderful evolutions, till he see this vast and preparatory machine of providence crowned and completed in the eternal gospel. The *New Testament*, the last and best part of the religious dispensation, he will peruse through the sacred pages of that gospel with redoubled attention; contemplating the divine foundation on which it claims to be built, the supernatural *means* by which it was executed, and the immortal end which it has in view.*"

In the course of this inquiry into the import of the sacred volume, the student will pay particular attention to the circumstances of the age and country in which the various writers respectively lived, and to the nature of the different *styles*, *idioms* and *turns of expression* in which it is written. He will likewise keep in mind that God, whom it claims for its author, is the parent of truth, and that all his actions and dispensations must be consistent with one another. He will therefore compare the different portions of the Old and New Testaments which relate to the same doctrine, or to the same event, unceasingly considering that the bible must be the best interpreter of itself: and though the opinions which he thus forms may often be erroneous, they will seldom be dangerous errors, and may easily be corrected by mature reflection, or by consulting approved authors who have treated before him of the various points which have been the subject of his studies. Of this mode of procedure one good consequence will be, that, having from the sacred scriptures formed a system of theology for himself, he will afterwards study the systems of other men without any violent prejudice for or against them; he will be so much attached to his own opinions as not to relinquish them in obedience to mere human authority, at the same time that he will be ready to give them up when convinced that they are not well founded; and if he have read the scriptures to any good purpose, he will have acquired such a love of truth as to embrace her wherever she may be found, whether among Papists or Protestants, in the school of Arminius or in that of Calvin.

13 Approved systems of divinity.

As we have supposed that every man, after having formed a theological system of his own, will consult the systems of others, it may perhaps be expected that we should here recommend those which, in our opinion, are most worthy of his attention. To do this, however, would, we apprehend, be a very ungracious interference with the rights of private judgment. It would be to arrogate to ourselves a kind of authority to which, when assumed by others, we have cautioned our readers not to submit. But lest we should be suspected of wishing to bias the mind of the young student toward the short system which we are obliged to give, we shall just observe, that by the divines of what is called the *Arminian school*, Episcopius's *Theologia Institutiones* (c), Limborch's *Theologia Christiana*, and Locke's *Reasonableness*

* [illegible]

(c) There is, however, one chapter of this work which the majority of Arminians loudly condemn. Episcopius acknowledges

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sonableness of Christianity, have long been held in the highest esteem; whilst the followers of Calvin have preferred the *Institutiones* of their master, Turretine's *Institutio Theologiae Elencticae*, and Gill's *Body of Divinity*. This last work, which was published in two vols 4to in 1769, has many merits and many defects. Its style is coarse, impure, and tedious; and the author, who was a zealous antipaedobaptist, and seems to have possessed very little science, embraces every opportunity of introducing the discriminating tenets of his sect: but his book is fraught with profound learning, breathes the spirit of piety, and may be read with advantage by every divine who has previously formed the outlines of a system for himself.

As the Jewish and Christian dispensations are closely linked together, being in truth but parts of one great whole, it is impossible to have an adequate notion of the latter without understanding the design of the former. Now, though the Mosaic religion is nowhere to be learned but in the Old Testament, it may be convenient for our student, after he has formed his own opinions of it from that sacred source, to know what has been written on the subject by others. For illustrating the ritual law, a learned prelate warmly recommends the *Ductor Dubitantium* of Maimonides, and Spencer's book entitled *De Legibus Hebraeorum Ritualibus*. Both works have undoubtedly great merit; but our young divine will do well to read along with them Lowman's *Hebrew Ritual explained*, and Dr Woodward's Discourse on the Worship of the ancient Egyptians, communicated to the London Society of Antiquaries in 1775, where some of Spencer's notions are shortly and ably refuted. On the other parts of this dispensation, such as the nature of its civil government; the rewards and punishments peculiar to it (D); its extraordinary administration by appointed agents, endowed with supernatural powers, and with the gifts of miracles and prophecy; the manner and time in which the latter is foretold to be abolished; and the important consequences to its nature and use — the reader will find much curious and ingenious matter displayed in the second part of Warburton's *Divine Legation of Moses demonstrated*. His Lordship indeed is supposed by many, and perhaps justly, to have advanced, together with a great deal of good sense, many paradoxes in his favourite work; but still that work is entitled to a frequent perusal, for it displays great learning and genius, and, we believe, the heaviest censures have fallen upon it from those by whom it was never read.

Having proceeded thus far in the course, the student's next business should be to inquire seriously what evidence there is that the doctrines which he has so carefully studied were indeed revealed in times past by God. He must already have perceived, in the nature and tendency of the doctrines themselves, strong marks of their origin being more than human; but he must likewise have met with many difficulties, and he must prepare himself to repel the attacks of unbelievers. Here he will find opportunities of exerting the utmost powers of his reasoning faculties, and of employing in the service of religion all the stores he may have amassed of human learning. The scriptures pretend to have been written by several men who lived in different ages of the world; but the latest of them in an age very remote from the present. His first business therefore must be to prove the authenticity of these books, by tracing them up by historical evidence to the several writers whose names they bear. But it is not enough to prove them authentic. They profess to have been written by men divinely assisted and inspired, and of course infallible in what they wrote. He must therefore inquire into the truth of this inspiration. "The Bible contains a number of truths doctrinal and moral, which are called *mysteries*, and asserted to be the immediate dictates of God himself. To evince this great point to men, a number of supernatural *tests* and *evidences* are inseparably connected with those mysteries; so that if the former be true, the latter must likewise be so. He must therefore examine these tests and evidences, to establish the divinity of the Holy Scriptures;" and in this part of his course he will find much assistance from many writers whose defences of the truth and divinity of the Christian religion do honour to human nature.

16 Books recommended on that subject.

The first step towards the embracing of any truth is, to get fairly rid of the objections which are made to it; and the general objections made by deistical writers to the Christian revelation are by no writer more completely removed than by bishop Butler, in his celebrated work entitled *The Analogy of Religion natural and revealed to the Constitution and Course of Nature*. This book therefore the student should read with attention, and meditate upon with patience; but as it does not furnish a *positive proof* of the divinity of our religion, he should pass from it to *Grotius de Veritate Religionis Christianae*, and Stillingfleet's *Origines Sacrae*. Both these works are excellent; and the latter, which may be considered as an improvement of the former, is perhaps the fullest and ablest defence of revelation in general that is to be found in any language. In this part of the united kingdom it is now indeed hardly mentioned, or mentioned with indifference; but half a century ago the English divines thought it a subject of triumph, and styled its author their *immortal Stillingfleet*. Other works, however, may be read with great advantage, and none with greater than Paley's *Evidences of the Christian Religion*, and Leslie's *Short Method with the Deists*; which last work, in the compass of a very few pages, contains proofs of the divinity of the Jewish and Christian revelations, to which the celebrated Dr Mid-

ledges (lib iv. sect. 2. cap. 33.) that it may be proved from scripture, that the person who was afterwards Jesus Christ was from eternity the only begotten of his Father, by whom all things were made, and that therefore he is really and truly God. He mentions five senses in which our Saviour is called the son of God; and shews that in this fifth and last sense the filiation is peculiar to him alone. Yet in cap. 34. he states the following question: "An quatenus iste modus filiationis Jesu Christi ad salutem scitu et creditu necessarius sit, adeo ut qui eum negant, anathema dicendam sit?" and gravely answers it in the negative. It is not to be wondered at that most Arminians differ from this celebrated remonstrant in their answers to this question; for nothing can be more absurd than to hold religious communion with those who deny the *divinity* of that person, whose divinity, it is *acknowledged*, may be clearly proved. Against this extravagant position many Arminian pens were drawn; but none to better purpose than that of bishop Bull, whose *Judicium Ecclesiae Catholicae trium primorum seculorum, &c. assertum contra M. Simonem Episcopium aliosque*, obtained for its author the thanks of the whole clergy of France assembled (1710) at *St Germains en Laye* in a national synod.

(D) On this subject the reader will find many excellent observations in bishop Bull's *Harmonia Apostolica*, with its several defences, and in a small book of Dr Wells's, entitled An Help for the right understanding of the several Divine Laws and Covenants, whereby man has been obliged through the several ages of the world to guide himself in order to salvation.

Prelimi-nary questions.

Middleton confessed (E), that for 20 years he had laboured in vain to fabricate a specious answer (F).

17 Jewish controversy, [illegible]

Having satisfied himself of the truth of revelation in general, it may be worth the young divine's while to provide a defence of the Christian religion against the objections of modern Judaism. In this part of his studies he will need no other instruction than what he may reap from Limborch's work entitled *De Veritate Religionis Christianæ amica collatio cum erudito Judæo*. "In that disputation which was held with Orobio, he will find all that the stretch of human parts on the one hand, or science on the other, can produce to varnish error or unravel sophistry. All the papers of Orobio in defence of Judaism, as opposed to Christianity, are printed at large, with Limborch's answers, section by section; and the subtilised sophistries of a very superior genius are ably and satisfactorily detected and exposed by the strong, profound, and clear reasoning, of this renowned remonstrant †." See OROBIO and LIMBORCH.

† *Warburton's Directions for the Study of Theology.*

18 And the various controversies among Christian denominations.

The various controversies subsisting between the several denominations of Christians, about points which separate them into different churches, ought next to be studied in the order of the course; for nothing is unimportant which divides the followers of that Master whose favourite precept was *Love*. It has indeed been long fashionable to decry polemical divinity as an useless, if not a pernicious, study; but it is not impossible that this fashion, like many others, has had its origin in ignorance, and that it tends to perpetuate those schisms which it professes to lament. We are, however, far, very far, from recommending to the young divine a perusal of the works of the several combatants on each side of a disputed question, till he has fitted himself for judging between them by a long course of preparatory study; and the only preparation which can fit him for this purpose is an impartial and comprehensive study of ecclesiastical history. He who has with accuracy traced the progress of our holy religion from the days of the apostles to the present time, and marked the introduction of new doctrines, and the rise of the various sects into which the Christian world is unhappily divided, is furnished with a criterion within himself by which to judge of the importance and truth of the many contested doctrines; whilst he who, without this preparation, shall read a multitude of books on any one religious controversy, will be in danger of becoming a convert to his last author, if that author possess any tolerable share of art and ingenuity. This we know was the case with Pope, who declares, that in studying the controversy between the churches of England and Rome, he found himself a Papist and Protestant by turns, according to the last book he read.

19 Importance of ecclesiastical history, and books recommended.

There are many histories of the Christian church which possess great merit, but we are acquainted with none which appears to us wholly impartial. Mosheim's is perhaps the most perfect compend (G); and one of its greatest excellencies is, that on every subject the best writers are referred to for fuller information. These indeed should often be consulted, not only to supply the defects necessarily resulting from the narrowness of the limits which the author, with great propriety, prescribed to himself; but also to correct his partial obliquities; for with all his merits, and they were many and great, he is certainly not free from the influence of prejudice. Indeed there is no coming at the true history of the primitive church, but by studying the works of the primitive writers; and the principal works of the four first centuries will amply reward the labour of perusing them (H). The rise and progress of the reformation in general, the most important period of church-history, may be best learned from Sleidan's book *De Statu Religionis et Reipublicæ Carolo V. Cæsare Commentarii*; the History of the Reformation of the Church of Scotland from Knox and Spotiswood; and that of the Church of England from the much applauded work of Bishop Burnet.

After this course of ecclesiastical history, the young divine may read with advantage the most important controversies which have agitated the Christian world; for he will now read them without danger of giving up his faith to the mere authority of great names. To enumerate these controversies, and to point out the ablest authors who have written on each, would be a very tedious, and perhaps not a very profitable, task. On one controversy, however, we are induced to recommend a very masterly work, because it is sufficient of itself to fix the principles of Protestants with respect to the church of Rome, and to put to shame the fashionable declaimers of *polemical divinity*. The work to which we allude is Chillingworth's book against Knott, entitled *The Religion of Protestants a safe way to Salvation*; in which the school jargon of that subtile Jesuit is incomparably exposed, and the long dispute between the Popish and Reformed churches placed on its proper ground, the Holy Scriptures.

One of the strongest and most plausible objections to the study of polemical divinity, is its tendency to give a rigid turn to the sentiments of those long engaged in it; whilst we know, from higher authority than that of the ablest disputant, that "the end of the commandment is charity." But for preserving charity in the minds of Christians, there are better means than absolute ignorance or indifference to truth. Charity is violated only when a church unreasonably restrains the inquiries of its own members, or exercises intolerance towards those who have renounced its jurisdiction. The injustice of the first species of ecclesiastical tyranny is exposed in a very masterly manner by Jeremy Taylor in his *Liberty of Prophecying*, and by Stillingfleet in his *Irenicum*; the injustice of the second, by Locke in his celebrated Letters on Toleration. The man who shall peruse

(E) This piece of information we had from the late Dr Berkeley, prebendary of Canterbury, who had it from Archbishop Secker, to whom the confession was made.

(F) To these defences of revelation we might have added the collection of sermons preached at Boyle's lecture from 1691 to 1732, published in three volumes folio, 1739; the works of Leland; Bishop Newton's Dissertations on Prophecy; and above all, Lardner's Credibility of the Gospel History, with the Supplement to it. But there would be no end of recommending eminent writers on this subject. We have mentioned such as we most approve among those with whom we are best acquainted; but we must, once for all, caution the reader against supposing that we approve of *every* thing to be found in any work except the sacred scriptures.

(G) The Bishop of Landaff, in the catalogue of books published at the end of his Theological Tracts, recommends several other ecclesiastical histories as works of great merit; such as, Dupin's, Echard's, Gregory's, and Formey's, together with *Pauli Ernesti Jablonski Institutiones Historiæ Christianæ*, published at Frankfort in three volumes, 1754-67.

(H) For a proof of this position, and for a just estimate of the value of the *Fathers*, as they are called, see the introduction to Warburton's Julian, and Kett's Sermons at Bampton's Lectures.

use these three works, and impartially weigh the force of their arguments, will be in no danger, unless his pride be very great, or his temper uncommonly irritable, of thinking uncharitably of those from whose principles the love of truth may compel him to dissent.

In these directions for the study of theology, we might have enumerated many more books on each branch of the subject well deserving of the most attentive perusal; but he who shall have gone through the course here recommended, will have laid a foundation on which, if he continue his diligence, he may raise such a superstructure as will entitle him to the character of an accomplished divine. His diligence must indeed be continued through life; for when a man ceases to make acquisitions in any department of learning, he soon begins to lose those which he has already made; and a more contemptible character is nowhere to be found than that of a clergyman unacquainted with the learning of his profession. This learning, however, is not to be acquired, and indeed is hardly to be preserved, by studying *bodies* or *institutes* of *theology*; and though we have mentioned a few generally approved by two rival sects of Christians, and must, in conformity with the plan of our work, give another ourselves, we do not hesitate to declare, that the man who has carefully gone through the course of study which we have recommended, though it be little more than the outlines on which he is to work, may, with no great loss to himself, neglect ours and all other systems. For as an excellent writer *, whom we have often quoted, well observes, "to judge of the *fact* whether such a revelation containing such a principle, with its mysteries and credentials, was actually sent from God and received by man, by examining the *evidences* and *circumstances* which accompanied it —the *time* when, the *place* where, the *manner* how, it was delivered—the *form* in which it descends to us—and in what it is *contained*—together with the particular *substance* and *burden* of it—and how every part is to be rightly *understood*: these are the various and extensive subjects which constitute the sublime office of THEOLOGIC REASONING and the PROPER STUDY OF DIVINITY." On this account we shall pass over slightly, and sometimes perhaps without any notice, many things which every clergyman ought thoroughly to understand, and confine ourselves, in the short compend which we are to give, to the prime articles of Christian theology. In doing this, we shall endeavour as much as possible to divest ourselves of party prejudices; but as we are far from thinking that this endeavour will be completely successful (for we believe there is no man totally free from prejudice), we cannot conclude this part of the article more properly than with the following solemn CHARGE, with which a very learned divine ‡ always prefaced his Theological Lectures.

Preliminary Directions.

‡ Dr Taylor of Norwich.

21 A charge to students of theology.

I. "I do solemnly charge you, in the name of the God of Truth, and of our Lord Jesus Christ, who is the Way, the Truth, and the Life, and before whose judgment seat you must in no long time appear, that in all your studies and inquiries of a religious nature, present or future, you do constantly, carefully, impartially, and conscientiously, attend to evidence, as it lies in the Holy Scriptures, or in the nature of things, and the dictates of reason; cautiously guarding against the sallies of imagination, and the fallacy of ill-grounded conjecture.

II. "That you admit, embrace, or assent, to no principle or sentiment by me taught or advanced, but only so far as it shall appear to you to be supported and justified by proper evidence from revelation or the reason of things.

III. "That if, at any time hereafter, any principle or sentiment by me taught or advanced, or by you admitted or embraced, shall, upon impartial and faithful examination, appear to you to be dubious or false, you either suspect or totally reject such principle or sentiment.

IV. "That you keep your mind always open to evidence: That you labour to banish from your breast all prejudice, prepossession, and party-zeal: That you study to live in peace and love with all your fellow Christians; and that you steadily assert for yourself, and freely allow to others, the unalienable rights of judgment and conscience."

PART I. OF NATURAL THEOLOGY.

SECT. I. *Of the Being and Attributes of* GOD.

HE who cometh to God, says an ancient divine *, deeply read in the philosophy of his age, must believe that he is, and that he is a rewarder of them who diligently seek him. This is a truth as undeniable as that a man cannot concern himself about a nonentity. The existence of God is indeed the foundation of all religion, and the first principle of the science which is the subject of this article. It is likewise a principle which must command the assent of every man who has any notion of the relation between effects and their causes, and whose curiosity has ever been excited by the phenomena of nature. This great and important truth we have elsewhere endeavoured to demonstrate (see METAPHYSICS, Part III. Chap. vi.); but it may be proved by arguments less abstracted from common apprehension than the nature of that article required us to use. Of these we shall give one or two, which we hope will be level to every ordinary capacity; whilst, at the same time, we earnestly recommend to the young divine a diligent study of those books on the subject which we have mentioned in the preceding directions.

We see that the human race, and every other species of animals, is at present propagated by the co-operation of two parents; but has this process continued from eternity? A moment's reflection will convince us that it has not. Let us take any one man alive, and, to avoid perplexity, let us suppose his father and mother dead, and himself the only person at present existing: how came he into the world? It will be said he was produced mechanically or chemically by the conjunction of his parents, and that his parents were produced in the same manner by theirs. Let this then be supposed; it must surely be granted, that when this man was born, an addition was made to the series of the human race. But a series which can be enlarged may likewise be diminished; and by tracing it backwards, we must at some period, however remote, reach its beginning. There must therefore have been a first pair of the human race, who were not propagated by the conjunction of parents. How did these come into the world?

Anaximander tells us *, that the first men and all animals were bred in warm moisture, inclosed in crustaceous skins like crab-fish or lobsters; and that when they arrived at a proper age, their shelly prisons growing dry, broke, and made way for their liberty. Empedocles informs us, that mother Earth at first brought forth vast numbers of legs, and arms, and heads, &c. which, approaching each other, arranging themselves properly, and being cemented together, started up at once full grown men. Another of these philosophers relates, that there first grew up a sort of wombs, which

* See Bentley's Boyle's Lectures.

which having their roots in the earth, attracted thence a kind of milk for the nourishment of the infant, which in process of time broke through the membranes and issued for milk; whilst the Egyptians, in their hypothesis of the original, contented themselves with simply affirming, that animals and vegetables sprung from the bosom of the earth.

Should these tales, or their followers, be called upon to tell us why the earth has not in any degree this power of bringing forth vegetables, men or the brutes at present. It is of no consequence to be told, we shall exclaim, it must be incapable of creating or the first earth then in any of its qualities; if it be not eternal, we shall be obliged to find a cause for its existence, or at least for its form and all its powers. But such a cause may have produced the first human pair, and undoubtedly did produce them, without making them spring as plants from the soil. Indeed the growth of plants themselves clearly evinces a cause superior to any vegetative power which can be supposed inherent in the earth. No plant, from the sturdy oak to the creeping ivy, can be propagated but from seed or slips from the parent stock; but when one contemplates the regular process of vegetation, the existence of every plant implies the prior existence of a parent seed, and the existence of every seed the prior existence of a parent plant. Which then of these, the oak or the acorn, was the first, and whence was its existence derived? Not from the earth; for we have the evidence of universal experience that the earth never produces a tree but from seed, nor seed but from a tree. There must therefore be some superior power which formed the first seed or the first tree, planted it in the earth, and gave to it those powers of vegetation by which the species has been propagated to this day.

25 Another from the laws of attraction and repulsion.

Thus clearly do the processes of generation and vegetation indicate a power superior to those which are usually called *the powers of nature*. The same thing appears no less evident from the laws of attraction and repulsion, which plainly prevail through the whole system of matter, and hold together the stupendous structure. Experiment shows that very few particles of the most solid body are in actual contact with each other (see Optics, n° 3—; Philosophy, n° 23.); and that there are considerable interstices between the particles of every elastic fluid, is obvious to the smallest reflection. Yet the particles of solid bodies strongly cohere, whilst those of elastic fluids repel each other. How are these phenomena accounted for? To say that the former is the effect of attraction and the latter of repulsion, is only to say that two individual phenomena are subject to those laws which prevail through the whole of the classes under which they are respectively arranged; whilst the question at issue is concerning THE ORIGIN OF THE LAWS THEMSELVES, the *power* which makes the particles of gold cohere, and those of air repel each other. Power without substance is inconceivable; and by a law of human thought, we cannot conceive a being to operate but where it is in some manner or other actually present: but the particles of gold adhere, and the particles of air keep at a distance from each other, by powers exerted where no matter is present. There must therefore be some substance endowed with power which is not material.

Of this substance or being the power is evidently immense. The earth and other planets are carried round the sun with a velocity which human imagination can hardly conceive. That this motion is not produced by the agency of these vast bodies on one another, or by the intervention of any material fluid, has been shown elsewhere (see Metaphysics, n° 1—2 and Optics, n° 67); and since it is a law of our best philosophy, *that we are not to multiply substances without necessity*, we must infer that the same Being which formed the first animals and vegetables, endowing them with powers to propagate their respective kinds, is likewise the cause of all the phenomena of nature, such as *cohesion*, *repulsion*, *gravitation*, and *motion*, even the motions of the heavenly bodies themselves.

If this powerful Being, who is the parent of vegetable and animal life, and the source of all corporeal motions, be self-existent, intelligent, and independent in his actions and volitions, he is an original or first cause, and that Being whom we denominate God. If he be not self-existent and independent, there must be a cause in the order of nature prior and superior to him, which is either itself the first cause, or a link in that series of causes and effects, which, however vast we suppose it, must be traced ultimately to some one Being, who is self-existent, and has in himself the power of beginning motion, independent of every thing but his own intelligence and volition. In vain have the Atheists alleged, that the series may ascend infinitely, and for that reason have no first mover or cause. An infinite series of successive beings involves an absurdity and contradiction (see Metaphysics, n° 2—8): but not to insist upon this at present, we shall only beg leave to consider such a series as a whole, and see what consequences will flow from the supposition. That we may with logical propriety consider it in this light, is incontrovertible; for the birth of every individual of the human race shows that it is made up of parts; but parts imply a whole as necessarily as an attribute implies its substance. As in this supposed series there is no cause which is not likewise an effect, nor any body moving another which was not itself moved by a third, the whole is undeniably equivalent to an infinite effect, or an infinite body moved: but as a finite effect must necessarily have proceeded from a cause, and a finite body in motion must have been put into that state by a mover, is there a human mind which can conceive an infinite effect to have proceeded from *no* cause, or an infinite body in motion to have been moved by *nothing*? No surely! An infinite effect, were such a thing possible, would compel us to admit an infinite cause, and an infinite body in motion a mover of infinite power.

This great cause is God, whose wisdom, power, and goodness, all nature loudly proclaims. That the phenomena which we daily see evince the existence of *one* such Being, has just been shown; and that we have no reason to infer the existence of more than one, a very few reflections will make abundantly evident. For, not to lay more stress than it will bear upon that rule of Newton's, which forbids us to multiply substances without necessity, such a harmony prevails through the whole visible universe, as plainly shows it to be under the government of one intelligence. That on this globe the several elements serve for nourishment to plants, plants to the inferior animals, and animals to man; that the other planets of our system are probably inhabited, and their inhabitants nourished in the same or a similar manner; that the sun is so placed as to give light and heat to all; and by the law of gravitation to bind the whole planets into one system with itself—are truths so obvious and so universally acknowledged, as to supersede the necessity of establishing them by proof. The fair inference therefore is, that the solar system and all its parts are under the government of *one* intelligence, which directs all its motions and all the changes which take place among its parts for some wise purposes. To suppose it under the government of two or more intelligences would be highly unreasonable; for if these intelligences had equal power, equal wisdom, and the same designs, one of them would evidently be superfluous; and if they had equal power and contrary designs, they could not be the parents of that harmony which we clearly perceive to prevail in the system.

ing and ributes f God.

But the Being capable of regulating the movements of so vast a machine, may well be supposed to possess infinite power, and to be capable of superintending the motions of the universe. That the widely extended system of nature is but one system, of which the several parts are united by many bonds of mutual connection, has been shown elsewhere (see PHYSICS), and appears daily more and more evident from our progress in physical discoveries; and therefore it is in the highest degree unreasonable to suppose that it has more than one author, or one supreme governor.

28 infinite wer, dom, d

As the unity of design apparent in the works of creation plainly prove the unity of their Author, so do the immensity of the whole, and the admirable adjustment of the several parts to one another, demonstrate His power and His wisdom. On this subject the following beautiful reflections by Mr Wollaston are deserving of the most serious attention.

Religion Nature, t. v. op. 14.

" In order (says that able writer ||) to prove to any one the grandness of this fabric of the world, one needs only to bid him consider the *sun*, with that insupportable glory and lustre that surrounds it; to demonstrate its vast distance, magnitude, and heat; to represent to him the chorus of planets moving periodically, by uniform laws, in their several orbits about it; guarded some of them by secondary planets, and as it were emulating the state of the sun, and probably all possessed by proper inhabitants; to remind him of those surprising visits which the *comets* make to us, and the large trains or uncommon splendor which attends them, the far country from which they come, and the curiosity and horror which they excite not only among us, but in the inhabitants of other planets, who may also be up to see the entry and progress of these ministers of fate: to direct his eye and contemplation through those azure fields and vast regions above him up to the *fixed stars*, that radiant numberless host of heaven; and to make him understand how unlikely a thing it is that they should be placed there only to adorn and bespangle a canopy over our heads; to convince him that they are rather so many *other suns*, with their several systems of planets about them; to show him by the help of glasses still more and more of these fixed lights, and to beget in him an apprehension of their inconceivable numbers, and those immense spaces that lie beyond our reach and even our imagination: One needs but to do this (continues our author), and explain to him such things as are now known almost to every body; and by it to show, that if the world be not infinite, it is *infinito similis*, and undoubtedly the work of an INFINITE ARCHITECT.

" But if we would take a view of all the *particulars* contained within that astonishing compass which we have thus hastily run over, how would wonders multiply upon us? Every corner, every part of the world, is as it were made up of *other* worlds. If we look upon this our earth, what scope does it furnish for admiration? The great variety of mountains, hills, valleys, plains, rivers, seas, trees, and plants! The many tribes of different animals with which it is stocked; the multifarious inventions and works of one of these, *i. e.* of us men; with the wonderful instincts of others, guiding them uniformly to what is best for themselves, in situations where neither sense nor reason could direct them. And yet when all these (heaven and earth) are surveyed as nicely as they can be by the help of our unassisted senses and of telescopes, we may discover by the assistance of good microscopes, in very small parts of matter, as many *new* wonders as those already discovered, new kingdoms of animals, with new and curious architecture. So that as our senses and even conception fainted before in the vast journeys we took in considering the expanse of the universe, they here again fail us in our researches into the principles and minute parts of which it is composed. Both the *beginnings* and the *ends* of things, the *least* and the *greatest*, all conspire to baffle us; and which way soever we prosecute our inquiries, we still meet with fresh subjects of amazement, and fresh reasons to believe that there are indefinitely more and more behind, that will forever escape our eagerest pursuits and deepest penetration.

Being and attributes of God.

" In this vast assemblage, and amidst all the multifarious motions by which the several processes of generation and corruption, and the other phenomena of nature, are carried on, we cannot but observe that there are stated methods, as so many forms of proceeding, to which things punctually and religiously adhere. The same *causes* circumstanced in the same manner produce always the same *effects*; all the *species* of animals among us are made according to one general *idea*; and so are those of *plants* also, and even of *minerals*. No new species are brought forth or have arisen anywhere; and the old are preserved and continued by the *old ways*.

" It appears, lastly, beyond dispute, that in the parts and model of the world there is a contrivance for accomplishing certain ends. The sun is placed near the centre of our system, for the more convenient dispensing of his benign influences to the planets moving about him; the place of the earth's *equator* intersects that of her *orbit*, and makes a proper angle with it, in order to diversify the *year*, and create an useful variety of *seasons*; and many other things of this kind will be always observed, and though a thousand times repeated, be meditated upon with pleasure by good men and true philosophers. Who can observe the vapours to ascend, especially from the sea, meet above in clouds, and fall again after condensation, without being convinced that this is a kind of *distillation*, in order to clear the water of its grosser salts, and then by rains and dews to supply the fountains and rivers with fresh and wholesome liquor; to nourish the vegetables below by showers, which descend in drops as from a *watering-pot* upon a garden? Who can view the *structure* of a plant or animal, the indefinite number of its fibres and fine vessels, the formation of larger vessels, and the several members out of them, with the apt disposition of all these; the means contrived for the reception and distribution of *nutriment*; the *effect* this nutriment has in extending the vessels, bringing the vegetable or animal to its full growth and expansion, continuing the *motion* of the several fluids, repairing the decays of the body, and preserving *life*? Who can take notice of the several *faculties* of animals, their arts of saving and providing for themselves, or the ways in which they are provided for; the uses of plants to animals, and of some animals to others, particularly to mankind; the care taken that the several species should be propagated, without confusion, from their proper seeds; the strong inclination planted in animals for that purpose, their love of their young and the like.—Who (says our author) can observe all this, and not see a *design* in such *regular* pieces, so nicely wrought and so admirably preserved? If there were but one animal in existence, and it could not be doubted but that his eyes were formed that he might see with them, his ears that he might hear with them, and his feet to be instruments by which he might remove himself from place to place; if *design* and *contrivance* can be much less doubted, when the same things are repeated in the individuals of all the tribes of animals; if the like observations may be made with respect to vegetables and other things; and if all these *classes* of things, and much more the *individuals* comprehended under them, be inconceivably numerous, as most unquestionably they are—one cannot but be convinced, from what so plainly runs through the nobler parts of the visible world, that not only *they*, but other things, even those that seem to be *useless*, have their ends likewise, though not always per-

[illegible] And fince we [illegible] parts of mat- [illegible] wonderful [illegible] respective [illegible] ends [illegible] there muft be [illegible] power are equal to [illegible] of the world [illegible] who modelled and [illegible] of things fo deep; pre- [illegible] laws; defines and [illegible] purpofes; and makes one thing to fit and [illegible] to produce one harmonious whole. Yes,

> [illegible] Parent of good!
> [illegible],
> [illegible] how wondrous then!
> [illegible] in power!"

29 Goodnefs. But the [illegible] of God is not lefs confpicuous in his works than His power or His wifdom. Contrivance proves [illegible] of the contrivances in-dicates the [illegible] of the defigner. "The world (fays an [illegible] writer†) abounds with contrivances, and all the contrivances in it with which we are acquainted are directed to beneficial purpofes. Evil no doubt exifts; but it is never that we can perceive the object of contrivance. Teeth are contrived to eat, not to ache; their aching now and then is incidental to the contrivance, perhaps infeparable from it; but it is not its object. This is a diftinction which well deferves to be attended to. In defcribing implements of huf-bandry, one would hardly fay of a fickle that it is made to cut the reaper's fingers, though from the conftruction of the inftrument, and the manner of ufing it, this mifchief often happens. But if he had occafion to defcribe inftruments of torture or execution, this, he would fay, is to extend the finews; this to diflocate the joints; this to break the bones; this to fcorch the foles of the feet. Here pain and mifery are the very objects of the contrivance. Now nothing of this fort is to be found in the works of nature. We never difcover a train of contrivance to bring about an evil purpofe. No anatomift ever difcovered a fyftem of organization calculated to produce pain and difeafe; or, in explaining the parts of the human body, ever faid, this is to irritate, this to inflame, this duct is to convey the gravel to the kidneys, this gland to fecrete the humour which forms the gout. If by chance he come to a part of which he knows not the ufe, the moft that he can fay is, that to him it appears to be ufelefs: no one ever fufpects that it is put there to incommode, to annoy, or to torment. If God had wifhed our mifery, he might have made fure of his purpofe, by forming our fenfes to be as many fores and pains to us as they are now inftruments of gratification and enjoyment; or, by placing us among objects fo ill fuited to our perceptions as to have continually offended us, inftead of miniftering to our refrefhment and delight. He might have made, for inftance, every thing we tafted bitter, every thing we faw loathfome, every thing we touched a fting, every fmell a ftench, and every found a difcord."

† Dr Paley.

Inftead of this, all our fenfations, except fuch as are excited by what is dangerous to our health, are pleafures to us: The view of a landfcape is pleafant; the tafte of nourifhing food is pleafant; founds not too loud are agreeable, while mufical founds are exquifite; and hardly any fmells, except fuch as are excited by effluvia obvioufly pernicious to the [illegible], are difagreeable: whilft fome of them, if not too long indulged, are delightful. Our lives are preferved and the fpecies is continued by obeying the impulfe of appetites; of which the gratification is exquifite when not repeated too frequently, to anfwer the purpofes of the Author of our being. Since, then, God has called forth his confummate wifdom to contrive and provide for our happinefs, and has made thofe things which are neceffary to our exiftence and the continuance of the race fources of our greateft fenfual pleafures, who can doubt but that benevolence is one of his attributes; and that, if it were not impious to draw a comparifon between them, it is the attribute in which he himfelf moft delighteth?

Being and attributes of God.

But it is not from fenfation only that we may infer the benevolence of the Deity: He has formed us with minds capable of intellectual improvement, and he has implanted in the breaft of every man a very ftrong defire of adding to his knowledge. This addition to be fure cannot be made without labour; and at firft the requifite labour is to moft people irkfome: but a very fhort progrefs in any ftudy converts what was irkfome into a pleafure of the moft exalted kind; and he who by ftudy, however intenfe, enlarges his ideas, and is confcious that he is daily rifing in the fcale of intelligence, experiences a complacency, which, though not fo poignant perhaps as the pleafures of the fenfualift, is fuch as endears him to himfelf, and is what he would not exchange for any thing elfe which this world has to beftow, except the ftill fweeter complacency arifing from the confcioufnefs of having difcharged his duty.

That the practice of virtue is attended with a peculiar pleafure of the pureft kind, is a fact which no man has ever queftioned, though the immediate fource of that pleafure has been the fubject of many difputes. He who attributes it to a moral fenfe, which inftinctively points out to every man his duty, and upon the performance of it rewards him with a fentiment of felf-approbation, muft of neceffity acknowledge benevolence to be one of the attributes of that Being who has fo conftituted the human mind. That to protect the innocent, relieve the diftreffed, and do to others as we would in like circumftances wifh to be done by, fills the breaft, previous to all reflection, with a holy joy, as the commiffion of any crime tears it with remorfe, cannot indeed be controverted. Many, however, contend, that this joy and this remorfe fpring not from any moral inftinct implanted in the mind, but are the confequence of early and deep-rooted affociations of the practice of virtue with the hope of future happinefs, and of vice with the dread of future mifery. On the refpective merits of thefe two theories we fhall not now decide. We have faid enough on the fubject in other articles (fee INSTINCT, MORAL PHILOSOPHY, and PASSION); and fhall here only obferve, that they both lead with equal certainty to the benevolence of the Deity, who made us capable of forming affociations, and fubjected thofe affociations to fixed laws. This being the cafe, the moral fenfe, with all its inftantaneous effects, affords not a clearer or more convincing proof of his goodnefs, than that principle in our nature by which remote circumftances become fo linked together, that, after the connecting ideas have efcaped from the mind, the one circumftance never occurs without bringing the other alfo into view. It is thus that the pleafing complacency, which was perhaps firft excited by the hopes of future happinefs, comes in time to be fo affociated with the confcioufnefs of virtuous conduct, the only thing entitled to reward, that a man never performs a meritorious action without experiencing the moft exquifite joy diffufed over his mind, though his attention at that inftant may not be directed either to heaven or futurity. Were we obliged, before we could experience this joy, to eftimate by reafon the merit of every individual action, and trace its connection to heaven and future happinefs through a long train of intermediate argu-

mentation,

Being and attributes of God.

mentation, we should be in a great measure deprived of the present reward of virtue; and therefore this associating principle contributes much to our happiness. But the benevolence of a Being, who seems as it were thus anxious to furnish us with both sensual and intellectual enjoyments, and who has made our duty our greatest pleasure cannot be questioned; and therefore we must infer, that the Author of Nature wishes the happiness of the whole sensible and intelligent creation.

30 Objections,

To such reasoning as this in support of the Divine Benevolence many objections have been made. Some of them appear at first sight plausible, and are apt to stagger the faith of him who has bestowed no time on the study of that branch of general science which is called *physics* (see Physics). To omit these altogether in such an article as this might be construed into neglect; whilst it is certain that there is in them nothing worthy of the attention of that man who is qualified either to estimate their force, or to understand the arguments by which they have often been repelled

It has been asked, Why, if the Author of Nature be a benevolent Being, are we necessarily subject to pain, diseases, and death? The scientific physiologist replies, Because from these evils Omnipotence itself could not in our present state

31 answered.

exempt us, but by a constant series of miracles. He who admits miracles, knows likewise that mankind were originally in a state in which they were not subject to death; and that they fell under its dominion through the fault of their common progenitors. But the fall and restoration of man is the great subject of revealed religion; and at present we are discussing the question like philosophers who have no other data on which to proceed than the phenomena of nature. Now we know, that as all matter is divisible, every system composed of it must necessarily be liable to decay and dissolution; and our material system would decay and be dissolved long before it could serve the purposes of nature, were there not methods contrived with admirable wisdom for repairing the waste occasioned by perpetual friction. The body is furnished with different fluids, which continually circulate through it in proper channels, and leave in their way what is necessary to repair the solids. These again are supplied by food *ab extra;* and to the whole processes of digestion, circulation, and nutrition, the air we breathe is absolutely necessary. (See Physiology, Sect. 1, 2, 3, 4, 5). But as the air is a very heterogeneous fluid, and subject to violent and sudden changes, it is obvious that these changes must affect the blood, and by consequence the whole frame of the human body. We see the air indeed in process of time consume even marble itself; and therefore cannot wonder, that as it is in one state the parent of health, it should in another be the source of disease to such creatures as man and other terrestrial animals. Nor could these consequences be avoided without introducing others much more deplorable. The world is governed by general laws, without which there could be among men neither arts nor sciences; and tho' laws different from those by which the system is at present governed might perhaps have been established, there is not the smallest reason to imagine that they could on the whole have been better, or attended with fewer inconveniencies. As long as we have material and solid bodies capable of motion, liable to resistance from other solid bodies, supported by food, subject to the agency of the air, and divisible, they must necessarily be liable to pain, disease, corruption, and death, and that too by the very influence of those laws which preserve the order and harmony of the universe. Thus gravitation is a general law so good and so necessary, that were it for a moment suspended, the world would instantly fall to pieces; and yet by means of this law the man must inevitably be crushed to death upon whom a tower shall chance to tumble. Again, the attraction of cohesion is a general law, without which it does not appear that any corporeal system could possibly exist: it is by this law too, or a modification of it, that the glands and lacteals of the human body extract from the blood such particles as are necessary to nourish the solids; and yet it is by means of the very same modification of the very same law that a man is liable to be poisoned. How are these effects to be prevented?

> Shall burning Ætna, if a sage requires,
> Forget to thunder, and recal her fires?
> On air or sea new motions be imprest,
> Oh blameless Bethel! to relieve thy breast:
> When the loose mountain trembles from on high
> Shall gravitation cease if you go by?
> Or some old temple nodding to its fall,
> For Charters' head reserve the hanging wall?

Such a perpetual miracle, such a frequent suspending of the laws of nature in particular instances, we cannot doubt to be within the compass of Almighty power: but were this suspension really to take place, mankind would be involved in ignorance greater than that of childhood; for not one of them could know, or have any means of discovering this moment, what was to happen the next; and the consequence would be, that, uncertain but the single motion of a single joint might bring on them sudden destruction, they would all perish in a state of absolute inactivity.

But though the human body could not have been preserved from dangers and dissolution but by introducing evils greater on the whole than those to which it is now liable, why, it has sometimes been asked, is every disorder to which it is subject attended with sickness or with pain? and why is such a horror of death implanted in our breasts, seeing that by the laws of nature death is inevitable? We answer, That sickness, pain, and the dread of death, serve the very best purposes. Could a man be put to death, or have his limbs broken without feeling pain, the human race had long ago been extinct. Felt we no uneasiness in a fever, we should be insensible of the disease, and die before we suspected our health to be impaired. The horror which generally accompanies our reflections on death tends to make us more careful of life, and prevents us from quitting this world rashly when our affairs prosper not according to our fond wishes. It is likewise an indication that our existence does not terminate in this world; for our dread is seldom excited by the prospect of the pain which we may suffer when dying, but by our anxiety concerning what we may be doomed to suffer or enjoy in the next stage of our existence; and this anxiety tends more perhaps than any thing else to make us live while we are here in such a manner as to ensure our happiness hereafter.

32 Sickness, pain, and the dread of death serve good purposes.

Thus from every view that we can take of the works and laws of God, and even from considering the objections which have sometimes been made to them, we are compelled to acknowledge the benevolence of their Author. We must not, however, suppose the Divine benevolence to be a fond and weak affection like that which is called benevolence among men. All human affections and passions originate in our dependence and wants; and it has been doubted whether any of them be at first disinterested (see Passion): but he to whom existence is essential cannot be dependent; he who is the Author of every thing can feel no want. The divine benevolence therefore must be wholly disinterested, and of course free from those partialities originating in self-love, which are alloys in the most sublime of human virtues. The most benevolent man on earth, though he wishes the happiness of

every fellow-creature, has still, from the ties of blood, the endearments of friendship, or, perhaps from a regard to his own interest, some particular favourites whom, on a competition with others, he would certainly prefer. But the
33 The divine benevolence coincident with justice.
equal Lord of all can have no particular favourites. His benevolence is therefore coincident with justice; or, to speak more properly, that which is called *divine justice*, is only benevolence exerting itself in a particular manner for the propagation of general felicity. When God prescribes laws for regulating the conduct of his intelligent creatures, it is not because he can reap any benefit from their obedience to those laws, but because such obedience is necessary to their own happiness; and when he punishes the transgressor, it is not because in his nature there is any disposition to which the prospect of such punishment can afford gratification, but because in the government of free agents punishment is necessary to reform the criminal, and to intimidate others from committing the like crimes. But on this subject we need not dwell. It has been shewn elsewhere (METAPHYSICS, n° 312.), that all the moral attributes of God, his HOLINESS, JUSTICE, MERCY, and TRUTH, should be conceived as the same divine BENEVOLENCE, acting in different ways according to different exigencies, but always for the same sublime end—the propagation of the utmost possible happiness.

34 God incomprehensible,
The substance or essence of this self-existent, all-powerful, infinitely wise, and perfectly good Being, is to us wholly incomprehensible. That it is not matter, is shewn by the process of argumentation by which we have proved it to exist; but what it is we know not, and it would be impious presumption to inquire. It is sufficient for all the purposes of religion to know that God is some how or other present to every part of his works; that existence and every possible perfection is essential to him; and that he wishes the happiness of all his creatures. From these truths we might proceed to prove and illustrate the perpetual superintendance of his providence, both general and particular, over every the minutest part of the universe: but that subject has been discussed in a separate article; to which, therefore, we refer the reader. (See PROVIDENCE). We shall only observe at present, that the manner in which animals are propagated affords as complete a proof of the constant superintendance of divine power and wisdom, as it does of the immediate exertion of these faculties in the formation of the parent pair of each species. For were this business of propagation carried on by *necessary* and mechanical laws, it is obvious, that in every age there would be generated, in each species of animals, the very same proportion of males to fe-
35 Present to every part of his works.
males that there was in the age preceding. On the other hand, did generation depend upon *fortuitous* mechanism, it is not conceivable but that, since the beginning of the world, or, according to this hypothesis, during the course of eternity, several species of animals should in *some* age have generated nothing but *males*, and others nothing but *females*; and that of course many species would have been long since extinct. As neither of these cases has ever happened, the preservation of the various species of animals, by keeping up constantly in the world a due, though not always the same, proportion between the sexes of male and female, is a complete proof of the superintendance of divine providence, and of that saying of the apostle, that it is "in God we live, move, and have our being."

SECT. II. *Of the Duties and Sanctions of Natural Religion.*

FROM the short and very inadequate view that we have taken of the divine perfections, it is evidently our duty to reverence in our minds the self-existent Being to whom they belong. This is indeed not only a duty, but a duty of which no man who contemplates their perfections, and believes them to be real, can possibly avoid the performance.
36 Reverence and gratitude due to God.
He who thinks irreverently of the Author of nature, can never have considered seriously the power, the wisdom, and the goodness, displayed in his works; for whoever has a tolerable notion of these must be convinced, that he who performed them has no imperfection; that his power can accomplish every thing, which involves not a contradiction; that his knowledge is intuitive, and free from the possibility of error; and that his goodness extends to all without partiality and without any alloy of selfish design. This conviction must make every man on whose mind it is impressed ready to prostrate himself in the dust before the Author of his being; who, though infinitely exalted above him, is the source of all his enjoyments, constantly watches over him with paternal care, and protects him from numberless dangers. The sense of so many benefits must excite in his mind a sentiment of the liveliest gratitude to him from whom they are received, and an ardent wish for their continuance.

37 Of whom we ought not to form images.
Whilst silent gratitude and devotion thus glow in the breast of the contemplative man, he will be careful not to form even a mental image of that all-perfect Being to whom they are directed. He knows that God is not material; that he exists in a manner altogether incomprehensible; that to frame an image of him would be to assign limits to what is infinite; and that to attempt to form a positive conception of him would be impiously to compare himself with his Maker.

38 How he ought to be spoke of; and
The man who has any tolerable notion of the perfections of the Supreme Being will never speak lightly of him, or make use of his name at all but on great and solemn occasions. He knows that the terms of all languages are inadequate and improper, when applied directly to him who has no equal, and to whom nothing can be compared; and therefore he will employ these terms with caution. When he speaks of his mercy and compassion, he will not consider them as feelings wringing the heart like the mercy and compassion experienced by man, but as rays of pure and disinterested benevolence. When he thinks of the stupendous system of nature, and hears it, perhaps, said that God formed it for his own glory, he will reflect that God is so infinitely exalted above all his creatures, and so perfect in himself, that he can neither take pleasure in their applause, as great men do in the applauses of their fellow-creatures, nor receive any accession of any kind from the existence of ten thousand worlds. The immense fabric of nature therefore only displays the glory or perfections of its Author to *us* and to other *creatures* who have not faculties to comprehend him in himself.

39 What is meant by serving him.
When the contemplative man talks of *serving* God, he does not dream that his services can increase the divine felicity; but means only that it is his duty to obey the divine laws. Even the pronoun *He*, when it refers to God, cannot be of the same import as when it refers to man; and by the philosophical divine it will seldom be used but with a mental allusion to this obvious distinction.

As the man who duly venerates the Author of his being will not speak of him on trivial occasions, so will he be still further from calling upon him to witness impertinences and falsehood, (see OATH). He will never mention his name but with a *pause*, that he may have time to reflect in silence on his numberless perfections, and on the immense distance between himself and the Being of whom he is speaking. The slightest reflection will convince him that the world with all that it contains depends every moment

upon that God who formed it; and this conviction will compel him to wish for the divine protection of himself and his friends from all dangers and misfortunes. Such a wish is in effect a prayer, and will always be accompanied with adoration, confession, and thanksgiving (see PRAYER). But adoration, confessions, application, and thanksgiving, constitute what is called *worship*, and therefore the worship of God is a natural duty. It is the addressing of ourselves as his dependants to him as the supreme cause and governor of the world, with acknowledgments of what we enjoy, and petitions for what we really want, or he knows to be convenient for us. As if, *ex. gr.* I should in some humble and composed manner (says Mr Wollaston) pray to that "almighty Being, upon whom depends the existence of the world, and by whose providence I have been preserved to this moment, and enjoyed many undeserved advantages, that he would graciously accept my grateful sense and acknowledgments of all his beneficence towards me; that he would deliver me from the evil consequences of all my transgressions and follies; that he would endue me with such dispositions and powers as may carry me innocently and safely through all future trials, and may enable me on all occasions to behave myself conformably to the laws of reason piously and wisely; that He would suffer no being to injure me, no misfortunes to befal me, nor me to hurt myself by any error or misconduct of my own; that he would vouchsafe me clear and distinct perceptions of things; with so much health and prosperity as may be good for me; that I may at least pass my time in peace, with contentment and tranquillity of mind; and that having faithfully discharged my duty to my family and friends, and endeavoured to improve myself in virtuous habits and useful knowledge, I may at last make a decent and happy exit, and find myself in some better state."

That an untaught savage would be prompted by *instinct* to address the Supreme Being in such terms as this, we are so far from thinking, that to us it appears not probable that such a savage, in a state of solitude, would be led by instinct to suppose the existence of that Being. But as soon as the being and attributes of God were, by whatever means, made known unto man, every sentiment expressed in this prayer must necessarily have been generated in his mind; for not to be sensible that we derive our existence and all our enjoyments from God, is in effect to deny his being or his providence; and not to feel a wish that he would give us what we want, is to deny either his goodness or his power.

41 Whether it is public worship a duty of natural religion? The worship of God therefore is a natural duty resulting from the contemplation of his attributes and a sense of our own dependence. But the reasoning which has led us to this conclusion respects only *private* devotion; for it is a question of much greater difficulty, and far enough from being yet determined, whether *public* worship be a duty of that religion which can with any propriety be termed *natural*. Mr Wollaston indeed positively affirms that it is, and endeavours to prove his position by the following arguments.

42 Arguments for it, "A man (says he) may be considered as a member of some society; and as *such* he ought to worship God if he has the opportunity of doing it, if there be proper prayers used publicly which he may resort to, and if his health, etc. permit. Or the society may be considered as one body, that has common interests and concerns, and as such is obliged to worship the Deity, and offer one prayer. Besides, there are many who know not of themselves how to pray; perhaps cannot so much as read. These must be taken *as they are*; and consequently some time and place *appointed* where they may have suitable prayers read to them, and be guided in their devotions. And further, towards the keeping mankind in order, it is *necessary* there should be some religion professed, and even established, which cannot be without public worship. And were it not for that sense of virtue which is *principally* preserved (so far as it is preserved) by national *forms* and *habits* of religion, men would soon lose it all, run wild, prey upon one another, and do what else the worst of savages do."

But not a duty of natural religion. These are in themselves just observations, and would come with great force and propriety from the tongue or pen of a Christian preacher, who is taught by revelation that the Master whom he serves has commanded his followers "not to forsake the assembling of themselves together," and has promised, "that if two of them shall agree on earth as touching any thing that they shall ask, it shall be done for them of his Father who is in heaven." As urged by such a man and on such grounds, they would serve to show the fitness of the divine command, and to point out the benefits which a religious obedience to it might give us reason to expect. But the author is here professing to treat of *natural* religion, and to state the duties which result from the mere relation which subsists between man as a creature and God as his creator and constant preserver. Now, though we readily admit the benefits of public worship as experienced under the Christian dispensation, we do not perceive any thing in this reasoning which could lead a pious theist to expect the same benefit previous to all experience. When the author thought of *national forms* and *establishments of religion*, he certainly lost sight of his proper subject, and, as such writers are too apt to do, comprehended under the religion of nature what belongs only to that which is revealed. Natural religion, in the proper sense of the words, admits of no particular *forms*, and of no *legal establishment*. Private devotion is obviously one of its duties, because sentiments of adoration, confession, supplication, and thanksgiving, necessarily spring up in the breast of every man who has just notions of God and of himself: but it is not so obvious that such notions would induce any body of men to meet at *stated times* for the purpose of expressing their devotional sentiments in public. Mankind are indeed social beings, and naturally communicate their sentiments to each other; but we cannot conceive what should at first have led them to think that public worship at stated times would be acceptable to the self-existent Author of the universe. In case of a famine, or any other calamity in which the whole tribe was equally involved, they might speak of it to each other, inquire into its cause, and in the extremity of their distress join perhaps in one fervent petition, that God would remove it. In the same manner they might be prompted to pour forth occasional ejaculations of public gratitude for public mercies; but it does not follow from these incidental occurrences that they would be led to institute times and places and forms of national worship, as if they believed the omniscient Deity more ready to hear them in public than in private. That the appointment of such times and forms and places is beneficial to society, experience teaches us; and that it is the duty, and has been the practice, of the supreme power in the state in every age and in every civilized country to provide for the maintenance of the national worship. But this practice has taken its rise, not from the deductions of reason, but either from direct revelation, as among the Jews and Christians; or from tradition, which had its origin in that early revelation, as among the more enlightened pagans of ancient and modern times.

43 Borrowed from revelation.

We hope that none of our readers will be so unjust as to suppose that by this disquisition we mean, in any degree, to

call in queſtion the fitneſs or the duty of public worſhip. So far are we from this intention, that we firmly believe with Mr Wollaſton, that what piety remains among us is to be attributed in a great meaſure to the practice of frequenting the church on Sundays; and that it is the neglect of this particular duty, which has rendered the preſent generation of men leſs pious, leſs humble, and more prone to vice than their forefathers were, who made it a point every Lord's day to meet with ſome congregation of Chriſtians in the public worſhip of their Creator and Redeemer. But while we are convinced of the importance and neceſſity of this too much neglected duty, and could wiſh to impreſs our conviction upon the minds of all our readers, we do not apprehend that we leſſen its dignity, or detract from the well-founded almoſt univerſal practice, by endeavouring to derive that practice from its true ſource, which appears to us to be not human reaſon, but divine revelation.

45 But whatever doubt may be entertained with reſpect to the origin of public worſhip, there can be none as to the foundation of moral virtue. Reaſon clearly perceives it to be the will of our Maker, that every individual of the human race ſhould treat every other individual as, in ſimilar circumſtances, he could juſtly expect to be treated himſelf. It is thus only that the greateſt ſum of human happineſs can be produced (ſee MORAL PHILOSOPHY, n° 17. and 135): for were all men temperate, ſober, juſt in their dealings, faithful to their promiſes, and charitable to the poor, &c. it is obvious that no miſery would be felt upon earth, but the few which, by the laws of corporeal nature, unavoidably reſult from the union of our minds with ſyſtems of matter. But it has been already ſhown, that the deſign of God in forming ſentient beings was to communicate to them ſome portion, or rather ſome reſemblance, of that felicity which is eſſential to himſelf; and therefore every action which in its natural tendency co-operates with this deſign muſt be agreeable to him, as every action of a contrary tendency muſt be diſagreeable.

46 From this reaſoning it follows undeniably, that we are obliged not only to be juſt and beneficent to one another, but alſo to abſtain from all unneceſſary cruelty to inferior animals. That we have a right to tame cattle, and employ them for the purpoſes of agriculture and other arts where ſtrength is required, is a poſition which we believe has never been controverted. But if it is the intention of God to communicate, in different degrees according to their different ranks, a portion of happineſs to all his creatures endowed with ſenſe, it is obvious that we ſin againſt him when we ſubject even the horſe or the aſs to greater labour than he is able to perform; and this ſin is aggravated when from avarice we give not the animal a ſufficient quantity of food to ſupport him under the exertions which we compel him to make. That it is our duty to defend ourſelves and our property from the ravages of beaſts of prey, and that we may even exterminate ſuch beaſts from the country in which we live, are truths which cannot be queſtioned; but it has been the opinion of men, eminent for wiſdom and learning, that we have no right to kill an ox or a ſheep for food, but in conſequence of the divine permiſſion to Noah recorded in the ninth chapter of the book of Geneſis. Whether this opinion be well or ill founded we ſhall not poſitively determine, though the arguments upon which it is made to reſt are of ſuch a nature as the philoſophic reaſoners of the preſent day would perhaps find it no eaſy taſk to anſwer; but it cannot admit of a doubt, that, in killing ſuch animals, we are, in duty to *their* Creator and *ours*, bound to put them to the leaſt poſſible pain. If this be granted, and we do not ſee how it can be denied by any man convinced of the benevolence of the Deity, it is ſtill more evident that we act contrary to the divine will when, for our mere amuſement, we torture and put to death ſuch animals as are confeſſedly not injurious to ourſelves, or to any thing upon which the comforts of life are known to depend. We are indeed far from being convinced with the poet, that inſects and reptiles "in mortal ſufferance feel as when a giant dies" (ſee PLEASURE and PHYSIOLOGY, Sect. viii.); but their feelings on that occaſion are certainly ſuch, as that, when we wantonly inflict them, we thwart as far as is in our power, the benevolent purpoſe of the Creator in giving them life and ſenſe. Let it be obſerved too, that the man who practiſes needleſs cruelty to the brute creation is training up his mind for exerciſing cruelty towards his fellow-creatures, to his ſlaves if he have any, and to his ſervants; and by a very quick progreſs to all who may be placed beneath him in the ſcale of ſociety.

Such are the plain duties of natural religion: and if they were univerſally practiſed, it is ſelf-evident that they would be productive of the greateſt happineſs which mankind could enjoy in this world, and that piety and virtue would be their own reward. They are however far from being univerſally practiſed; and the conſequence is, that men are frequently raiſed to affluence and power by vice, and ſometimes ſunk into poverty by a rigid adherence to the rules of virtue.

47 This being the caſe, there can be no queſtion of greater importance, while there are few more difficult to be anſwered, than "What are the ſanctions by which natural religion enforces obedience to her own laws?" It is not to be ſuppoſed that the great body of mankind ſhould, without the proſpect of an ample reward, practiſe virtue in thoſe inſtances in which ſuch practice would be obviouſly attended with injury to themſelves; nor does it appear reaſonable in any man to forego preſent enjoyment, without the well-grounded hope of thereby ſecuring to himſelf a greater or more permanent enjoyment in reverſion. Natural religion therefore, as a ſyſtem of doctrines influencing the conduct, is exceedingly defective, unleſs it affords ſufficient evidence, intelligible to every ordinary capacity, of the immortality of the ſoul, or at leaſt of a future ſtate of rewards and puniſhments. That it *does* afford this evidence, is ſtrenuouſly maintained by ſome deiſts, and by many philoſophers of a different deſcription, who, though they profeſs Chriſtianity, ſeem to have ſome unaccountable dread of being deceived by their bibles in every doctrine which cannot be propped by the additional buttreſs of philoſophical reaſoning.

48 One great argument made uſe of to prove that the immortality of the ſoul is among the doctrines of natural religion, is the univerſal belief of all ages and nations that men continue to live in ſome other ſtate after death has ſeparated their ſouls from their bodies. "Quod ſi omnium conſenſus naturæ vox eſt: omneſque, qui ubique ſunt, conſentiunt eſſe aliquid, quod ad eos pertineat, qui vita ceſſerint: nobis quoque idem exiſtimandum eſt: et ſi, quorum aut ingenio, aut virtute animus excellit, eos arbitramur, quia natura optima ſunt, cernere naturæ vim maxime: veriſimile eſt, *cum optimus quiſque maxime poſteritati ſerviat*, eſſe aliquid, cujus is poſt mortem ſenſum ſit, habiturus. Sed ut deos eſſe natura opinamur, qualeſque ſint, ratione cognoſcimus, ſic permanere animos arbitramur *conſenſu nationum omnium* *."

49 That this is a good argument for the truth of the doctrine, through whatever channel men may have received it, we readily acknowledge; but it appears not to us to be any proof of that doctrine's being the deduction of human reaſon. The popular belief of Paganiſm, both ancient and modern, is ſo fantaſtic and abſurd, that it could never have been

Margin notes: Duties of natural religion. — Natural religion defective in its evidence of a future ſtate. — The general expectation of a future ſtate, — Not the reſult of nature.

* Cicero Tuſc. lib. i. 16.

been rationally inferred from what nature teaches of God and the soul. In the Elysium of the Greek and Roman poets, departed spirits were visible to mortal eyes; and must therefore have been clothed with some material vehicle of sufficient density to reflect the rays of light, though not to resist the human touch. In the mythology of the northern nations, as deceased heroes are represented as eating and drinking, they could not be considered as entirely divested of matter; and in every popular creed of idolatry, future rewards were supposed to be conferred, not for private virtue, but for public violence, upon heroes and conquerors and the destroyers of nations. Surely no admirer of what is now called natural religion will pretend that these are part of its doctrines; they are evidently the remains of some primeval tradition obscured and corrupted in its long progress through ages and nations.

The philosophers of Greece and Rome, despising the popular mythology of their respective countries employed much time and great talents in disquisitions concerning the human soul and the probability of a future state; and if the genuine conclusions of natural religion on this subject are anywhere to be found, one would naturally look for them in the writings of those men whose genius and virtues did honour to human nature. Yet it is a fact which cannot be controverted, that the philosophers held such notions concerning the substance of the soul and its state after death as could afford no rational support to suffering virtue, (see METAPHYSICS, Part III. chap. 4). Socrates is indeed an exception. Confining himself to the study of ethics, and despising those metaphysical subtilties with which so many others had bewildered themselves, that excellent person inferred by the common moral arguments (see MORAL PHILOSOPHY, n. 232—246), that the reality of a future state of rewards and punishments is in the highest degree probable. He was not, however, at all times absolutely *convinced* of this important truth; for a little before his death he said to some who were about him, "I am now about to leave this world, and ye are still to continue in it; which of us have the better part allotted us, God only knows *." And again, at the end of his most admired discourse concerning the immortality of the soul, delivered at a time when he must have been serious, he said to his friends who came to pay their last visit, "I would have you to know that I have great hopes that I am now going into the company of good men; yet I would not be too peremptory and confident concerning it §."

Next to Socrates, Cicero was perhaps the most respectable of all the philosophers of antiquity; and he seems to have studied this great question with uncommon care: yet what were his conclusions? After retailing the opinions of various sages of Greece, and showing that some held the soul to be the *heart*; others, the *blood* in the heart; some, the *brain*; others, the *breath*; one, that it was *harmony*; another, that it was *number*; one, that it was *nothing* at all; and another, that it was a certain *quintessence* without a name, but which might properly be called ἐντελεχια—he gravely adds, "Harum sententiarum quæ vera sit, Deus aliquis viderit: quæ verisimillima, magna questio est §." He then proceeds to give his own opinion; which, as we have shown elsewhere, was, that the soul is part of God.

To us who know by other evidence that the soul is immortal, and that there will be a future state in which all the obliquities of the present shall be made straight, the argument drawn from the moral attributes of God, and the unequal distribution of the good things of this life, appears to have the force of demonstration. Yet none of us will surely pretend to say that his powers of reasoning are greater than were those of Socrates and Cicero: and therefore the probability is, that had we been like them destitute of the light of revelation, we should have been disturbed by the same doubts, and have said with the latter, upon reading the arguments of the former as detailed by Plato, "Nescio quomodo, dum lego, assentior: cum posui librum, et mecum ipse de immortalitate animorum cœpi cogitare, assensio illa elabitur ‡."

Doubts and fanctions of natural religion.

51
Without the light of revelation we should have doubted as they did.

‡ *Ibid.*

No one, we hope, will suspect us of an impious attempt to weaken the evidence of a future state, God forbid! The expectation of that state is the only support of virtue and religion; and we think the arguments which we have stated elsewhere, and referred to on the present occasion, make the reality of it so highly probable, that, though there were no other evidence, he would act a very foolish part who should confine his attention wholly to the present life. But we do not apprehend that we can injure the cause either of virtue or of religion, by confessing, that those arguments which left doubts in the minds of Socrates and Cicero appear not to us to have the force of *complete demonstration* of that life and immortality which our Saviour brought to light through the gospel.

52
Natural religion has no means of certainly reconciling the Deity to sinners.

Were the case, however, otherwise; were the arguments which the light of nature affords for the immortality of the human soul as absolutely convincing as any geometrical demonstration—natural religion would still be defective; because it points out no method by which such as have offended God may be certainly restored to his favour, and to the hopes of happiness which by their sin they had lost. That he who knows whereof we are made would show himself placable to sinners, and that he would find some way to be reconciled, might perhaps be reasonably inferred from the consideration of his benevolence displayed in his works. But when we come to inquire more particularly *how* we are to be reconciled, and whether a *propitiation* will be required, *nature* stops short, and expects with impatience the aid of some particular revelation. That God will receive returning sinners, and accept of repentance instead of perfect obedience, cannot be certainly known by those to whom he has not *declared* that he will. For though repentance be the most probable, and indeed the only means of reconciliation which nature suggests; yet whether he, who is of purer eyes than to behold iniquity, will not require something further before he restore sinners to the privileges which they have forfeited, mere human reason has no way of discovering. From nature therefore arises no sufficient comfort to sinners, but anxious and endless solicitude about the means of appeasing the Deity. Hence those divers ways of sacrificing, and those numberless superstitions which overspread the heathen world, but which were so little satisfactory to the wiser part of mankind, that, even in those days of darkness, the philosophers frequently declared that, in their opinion, those rites and oblations could avail nothing towards appeasing the wrath of an offended God, or making their prayers acceptable to him. Hence Socrates and one of his disciples are represented by Plato † as expecting a person divinely commissioned to inform them whether sacrifices be acceptable to the Deity, and as resolving to offer no more till that person's arrival, which they piously hoped might be at no great distance.

† *In Alcibi.*

53
This darkness of the pagan world, which the best of men who lived under it so pathetically deplored, is to us who live under the sunshine of the gospel happily removed by the various revelations contained in the scriptures of the Old and New Testaments. These taken together, and in the order in which they were given, exhibit such a display of providence, such a system of doctrines, and such precepts of

... removed by the scriptures.

practical wisdom, as the ingenuity of man could never have discovered. The Christian, with these scriptures in his hands, [illegible] by an infallible guide, and rest his hopes on the surest foundation. These scriptures it is now our business to examine.

Part II. Of REVEALED THEOLOGY.

In every nation and every country the popular system of theology is professedly founded on some supposed revelation. The Pagans of antiquity had their augurs and oracles; the Chinese have the writings of Confucius and Fohi; the Hindoos have their sacred books received from Brahma; the followers of Mahomet have their Koran dictated by an angel; and the Jews and Christians have the scriptures of the Old and New Testaments, which they believe to have been written by holy men of old, who spake and wrote as they were moved by the Holy Ghost.

That the claims of ancient Paganism to a theology derived from heaven, as well as the similar claims of the Chinese, Hindoos, and Mahometans, are ill founded, has been shown in various articles of this work, (see CHINA, HINDOSTAN, MAHOMETANISM, MYTHOLOGY, and POLYTHEISM; whilst, under the words RELIGION, REVELATION, and SCRIPTURE,
55 we have sufficiently proved the divine inspiration of the Jewish and Christian scriptures, and of course the divine origin of Jewish and Christian theology. These indeed are not two systems of theology, but parts of one system which was gradually revealed as men were able to receive it; and therefore both scriptures must be studied by the Christian divine.

There is nothing in the sacred volume which it is not of importance that he should understand whose office it is to be a teacher of religion; for the whole proceeds from the fountain of truth: but some of its doctrines are much more important than others, as relating immediately to man's everlasting happiness; and these it has been customary to arrange and digest into regular systems, called *bodies* or *institutes* of *Christian theology*. Could these artificial systems be formed with perfect impartiality, they would undoubtedly be useful, for the bible contains many historical details, but remotely related to human salvation; and even of its most important truths, it requires more time and attention than the majority of Christans have to bestow, to discover the mutual connection and dependence.

Artificial systems of theology are commonly divided into two great parts, the *theoretic* and the *practical*; and these again are subdivided into many inferior branches. Under the theoretic part are sometimes classed,

1. *Dogmatic* theology; which comprehends an entire system of all the dogmas or tenets which a Christian is bound to believe and profess. The truth of these the divine must clearly perceive, and be able to enforce upon his audience: and hence the necessity of studying what is called,

2. The *exegesis*, or the art of attaining the true sense of the holy scriptures; and,

3. *Hermeneutic* theology, or the art of interpreting and explaining the scriptures to others; an art of which no man can be competent who knows how to attain the true sense of them himself.

4. *Polemic* theology, or controversy; and,

5. *Moral* theology, which is distinguished from moral philosophy, or the simple doctrine of ethics, by teaching a much higher degree of moral perfection than the mere light of reason could ever have discovered, and adding new motives to the practice of virtue.

The practical sciences of the divine are,

1. *Homiletic*, or *pastoral* theology; which teaches him to adapt his discourses from the pulpit to the capacity of his hearers, and to pursue the best methods of guiding them by his doctrine and example in the way of salvation.

2. *Catechetic* theology, or the art of teaching youth and ignorant persons the principal points of evangelical doctrine, as well with regard to belief as to practice.

3. *Casuistic* theology, or the science which decides on doubtful cases of moral theology, and that calms the scruples of conscience which arise in the Christian's soul during his journey through the present world

We have mentioned these divisions and subdivisions of the science of theology, not because we think them important, but merely that our readers may be at no loss to understand the terms when they meet with them in other works. Of such terms we shall ourselves make no use, for the greater part of them indicate distinctions where there is no difference, and tend only to perplex the student. As the truths of Christianity are all contained in the scriptures of the Old and New Testaments, it is obvious that dogmatic theology must comprehend the speculative part of that which is called moral, as well as every doctrine about which controversy can be of importance. But no man can extract a single dogma from the bible but by the practice of what is here called the *exegesis*; so that all the subdivisions of this arrangement of theoretical theology must be studied together as they necessarily coalesce into one. The same thing is true of the three branches into which practical theology is here divided. He who has acquired the art of adapting his homilies to the various capacities of a mixed audience, will need no new study to fit him for instructing children, and the most ignorant persons who are capable of instruction; and the complete master of moral theology will find it no very difficult task to resolve all the cases of conscience which he can have reason to suppose will ever be submitted to his judgment. For these reasons we shall not, in the short summary which our limits permit us to give, trouble either ourselves or our readers with the various divisions and subdivisions of theology. Our preliminary directions will show them how we think the science should be studied; and all that we have to do as system-*builders*, a title of which we are far from being ambitious, is to lay before them the view which the scriptures present to us of the being and perfections of God, his various dispensations to man, and the duties thence incumbent upon Christians. In doing this, we shall follow the order of the divine dispensations as we find them recorded in the Old and New Testaments, dwelling longest upon those which appear to us of most general importance. But as we take it for granted that every reader of this article will have previously read the whole sacred volume, we shall not scruple to illustrate dogmas contained in the Old Testament by texts taken from the New, or to confirm doctrines peculiar to the Christian religion by the testimony of Jewish prophets.

Sect. I. *Of God and his Attributes.*

In every system of theology the first truths to be believed are those which relate to the being and attributes of God. The Jewish lawgiver, therefore, who records the earliest revelations that were made to man, begins his history with a display of the power and wisdom of God in the creation of the world. He does not inform his country-

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men, and expect them to believe, upon the authority of his divine commission, that God *exists*; for he well knew that the being of God must be admitted, and tolerably just notions entertained of his attributes, before man can be required to pay any regard to miracles which afford the only evidence of a primary revelation. "In the beginning (says he) God created the heavens and the earth." Here the being of God is assumed as a truth universally received; but the sentence, short as it is, reveals another which, as we shall afterwards shew, human reason could never have discovered.

It will however be proper, before we consider the creation of the world, and compare what the scriptures say of it with the opinions of the most enlightened ancients on the same subject, to attend to the appellation which is here given to God; and inquire what light is thrown upon it by subsequent revelations. The passage in the original is בראשית ברא אלהים, where it is remarkable that the Creator is denominated by a noun in the plural number, signifying literally "persons under the obligation of an oath to perform certain conditions." This is certainly a very extraordinary denomination for the one supreme and self-existent Being; and what adds to the strangeness of the phraseology is, that the verb with which this plural noun is made to agree is put in the singular number. What now could be the sacred historian's motive for expressing himself in this manner? His style is in general remarkable for its plainness and grammatical accuracy; and we believe it would be difficult to find in all his five books a single phrase not relating to the Supreme Being in which there appears such a violation of concord.

59 Extraordinary denomination of the Supreme Being in the book of Genesis

In answer to this question, it has been said, that Moses uses the plural noun to express in a magnificent way the majesty of God, just as it is customary for kings and earthly potentates, when publishing edicts and laws, to call themselves *we* and *us*. But there is no evidence on record that such a mode of speaking was introduced among kings at a period so early as the era of Moses. Pharaoh was probably as mighty a potentate as any who then reigned upon the earth; but though he is often mentioned by the same sacred historian as issuing edicts with regal authority, he is nowhere represented as speaking of himself in the plural number. Let it be observed, too, that whenever this phraseology was introduced among men, the plural noun was in every grammatical tongue joined to a plural verb; whereas Moses not only puts the noun and the verb in different numbers in the verse under consideration, but afterwards represents the אלהים as saying, "let *us* make man in *our* image;" and, "behold the man is become as *one of us*." Such phrases as these last were never used by a single man, and therefore cannot have been borrowed from human idioms.

Do they then denote a plurality of gods? No; there is nothing which the scriptures more frequently or more earnestly inculcate than the unity of the divine nature. The texts asserting this great and fundamental truth are almost numberless. "Unto thee (says Moses to his countrymen †) it was shewed, that thou mightest know that the Lord is God; there is *none else besides him*. Know therefore that the Lord *he is God* in *heaven above* and upon the *earth beneath*: there is *none else*. And again, "Hear, O Israel, the Lord our God is *one Lord*," or, as it is expressed in the original, "Jehovah our God is one Jehovah;" one Being to whom existence is essential, who could not have a beginning and cannot have an end. In the prophecies of Isaiah, God is introduced as repeatedly declaring ‡, "I am Jehovah, and there is *none else*; there is *no God besides me*; that they may know from the rising of the sun and from the west, that there is *none besides me*: I am *Jehovah*, and there is *none else*: Is there a God besides me? Yea there is *no God*; I know not any." In perfect harmony with these declarations of Moses and the prophets, our Saviour, addressing himself to his Father, says §, "This is life eternal, that they might know *Thee, the only true God*, and Jesus Christ whom Thou hast sent;" and St Paul, who derived his doctrine from his divine Master, affirms ‖, that "an idol is nothing in the world; and that there is *none other God but one*."

† Deut. iv. 35. and 39. vi. 4.

‡ Isaiah xlv. 5, 6, 18, 21. xliv. 8.

§ John xvii. 3.

‖ 1 Cor. viii. 4.

The unity of the divine nature, which, from the order and harmony of the world, appears probable to human reason, these texts of revelation put beyond a doubt. Hence the first precept of the Jewish law, and, according to their own writers, the foundation of their whole religion, was, "Thou shalt have none other gods before Me." Hence, too, the reason of that strict command to Jews and Christians to give divine worship to none but God: "Thou shalt worship the Lord thy God, and him only shalt thou serve;" because he is *God alone*. Him only must we fear, because he alone hath infinite power; in him alone must we trust, because "he only is our rock and our salvation;" and to him alone must we direct our devotions, because "he only knoweth the hearts of the children of men."

60 Denotes a plurality of persons in the Godhead.

It is past dispute, then, that the word אלהים does not indicate a plurality of gods. In the opinion, however, of many eminent divines, it denotes, by its junction with the singular verb, a plurality of persons in the one Godhead; and some few have contended, that by means of this peculiar construction, the Christian doctrine of the Trinity may be proved from the first chapter of the book of Genesis. To this latter opinion we can by no means give our assent. That there are three distinct persons in the one divine nature may be inferred with sufficient evidence from a multitude of passages in the Old and New Testaments diligently compared together; but it would perhaps be rash to rest the proof of so sublime a mystery upon any single text of holy scripture, and would certainly be so to rest it upon the text in question. That Moses was acquainted with this doctrine, we, to whom it has been explicitly revealed, may reasonably conclude from his so frequently making a plural name of God to agree with a verb in the singular number; but had we not possessed the brighter light of the New Testament to guide us, we should never have thought of drawing such an inference. For supposing the word אלהים to denote clearly a plurality of persons, and that it cannot possibly signify any thing else, how could we have known that the number is neither more nor less than three, had it not been ascertained to us by subsequent revelations?

There are indeed various passages in the Old Testament, of the phraseology of which no rational account can be given, but that they indicate more than one person in the Godhead. Such are those texts already noticed; "and the Lord God said, let us make man in OUR image, after OUR likeness;" and "the Lord God said, behold the man is become like ONE OF US." To these may be added the following, which are to us perfectly unintelligible upon any other supposition; "and the Lord God said, let us go down, and there confound their language †." "If I be a *Master* (in the Hebrew *adonim*, MASTERS), where is my fear ‡?" "The fear of the Lord (JEHOVAH) is the beginning of wisdom, and the knowledge of the Holy (in the Hebrew HOLY ONES) is understanding §." "Remember thy Creator (Hebrew, thy CREATORS) in the days of thy youth *." "And now the LORD GOD and his SPIRIT hath sent me §." "Seek ye out of the book of the LORD and read; for MY mouth it hath commanded, and his SPIRIT it hath gathered them ¶."

† Gen. xi.

‡ Mal. i. 6.

§ Prov. ix. 10.

* Eccl. xii. 1.

§ Isaiah xlviii. 16.

¶ Isaiah xxxiv. 16.

That these texts imply a plurality of divine persons, seems to us incontrovertible. It has been already observed, that when Moses represents God as saying, let us

make

[illegible] make man, the ma[illegible] of the plural number had not been [illegible]; [illegible] that the [illegible] Being [illegible], as has been [illegible] supposed, [illegible] to make man, [illegible] plural [illegible] [illegible] the plural number, though [illegible] [illegible]. In the passage [illegible] quoted [illegible] there [illegible] made between the [illegible] and the [illegible], and [illegible] the other, three divine perfons are introduced, *viz.* the *Speaker*, the [illegible] Lord. It does not, however, appear evident from thefe paffages, or from any other [illegible] Teftament, that the perfons in [illegible]; but no [illegible] Chriftian will [illegible] a doubt but that the precife number was by fome means [illegible] made known to the ancient Hebrews; for inquiries leading to it would be naturally fuggefted by the form in which the high prieft was commanded to blefs the people. "The L[illegible] blefs thee and keep thee. The Lord make his face to fhine upon thee, and be gracious unto thee. The Lord lift up his countenance upon thee, and give thee peace †."

† Numb. vi. 24, 25, 26. Of this benediction it has been well obferved, that if its three articles be attentively confidered, they will be found to agree refpectively to the three perfons taken in the ufual order of the Father, the Son, and the Holy Ghost. The Father is the author of [illegible] and *pr*[illegible]. [illegible] and *illumination* are from the Son, by whom we have "the light of the knowledge of the glory of God, in the face of Jefus Chrift." *Peace* is the gift of the Spirit, whofe name is the C[illegible], and whofe firft and beft fruit is the work of *peace* [illegible].

61
A Trinity in unity the doctrine of fcripture.

Similar to this benediction, but much more explicit, is the form of Chriftian baptifm; which, to us who live under the funfhine of the gofpel, eftablifhes the truth of the doctrine of the Trinity beyond all reafonable ground of difpute. "Go (fays our bleffed Saviour) and teach all nations, baptizing them in the name of the Father, and of the Son, and of the Holy Ghoft." What was it the apoftles, in obedience to this command, were to teach all nations? Was it not to turn from their vanities to the living God; to renounce their [illegible] gods, and to be baptized in the name of the Father, and of the Son, and of the Holy Ghoft? What now muft occur to the Gentile nations upon this occafion, but that, inftead of all their deities, to whom they had before bowed down, they were in future to ferve, worfhip, and adore, Father, Son, and Holy Ghoft, as the only true and living God. To fuppofe that God and two creatures are here joined together in the folemn rite by which men were to be admitted into a new religion, which [illegible] *creature-worfhip*, would be fo extravagantly [illegible], that we are perfuaded fuch a fuppofition never was made by any converted Polytheift of antiquity. The nations were to be baptized in the name of three perfons in the *fame manner*, and therefore, doubtlefs, in the *fame fenfe*. It is not faid in the name of God and his two faithful *fervants*; nor in the name of God, and Christ, and the Holy Ghost, which might have fuggefted a thought that *one* only of the three is God; but in the name of the Father, and of the Son, and of the Holy Ghost. Whatever honour, reverence, or regard, is paid to the firft perfon in this folemn rite, the fame we cannot but fuppofe paid to all three. Is he acknowledged as the object of worfhip? So are the other two likewife. Is he God and Lord over us? So are they. Are we enrolled as fubjects, fervants, and foldiers, under him? So are we equally under all. Are we hereby regenerated and made the temple of the Father? So are we likewife of the Son and Holy Ghoft. "We will come (fays our Saviour ‡) and make our abode with him." ‡ John xiv. 23.

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If thofe who believe the infpiration of the fcriptures could require any further proof that the Godhead comprehends a Trinity of perfons in one nature, we might urge upon them the apoftolical form of benediction; "The grace of our Lord Jesus Christ, and the love of God, and the communion of the Holy Ghost, be with you all *." * 2 Cor. xiii. 14. Would St Paul, or any other man of common fenfe, have in the fame fentence, and in the moft folemn manner, recommended his Corinthian converts to the love of God, and to the grace and communion of two creatures? We fhould think it very abfurd to recommend a man at once to the favour of a king and a beggar; but how infinitely fmall is the diftance between the greateft earthly potentate and the meaneft beggar when compared with that which muft for ever fubfift between the Almighty Creator of heaven and earth and the moft elevated creature?

62
Difficulties in this doctrine.

But how, it will be afked, can three divine perfons be but one and the fame God? This is a queftion which has been often put, but which, we believe, no created being can fully anfwer. The divine nature and its manner of exiftence is, to us, wholly incomprehenfible; and we might with greater reafon attempt to weigh the mountains in a pair of fcales, than by our limited faculties to fathom the depths of infinity. The Supreme Being is prefent in power to every portion of fpace, and yet it is demonftrable, that in his [illegible] he is not [illegible] (fee [illegible] 3[illegible]). Both thefe truths, his inextenfion and omniprefence, are fundamental principles in what is called *natural religion*; and when taken together they form, in the opinion of moft people, a myftery as incomprehenfible as that of the Trinity in unity. Indeed there is nothing of which it is more difficult for us to form a [illegible] notion than [illegible], and [illegible]; and we are perfuaded that fuch of our readers as have been accuftomed to turn their thoughts [illegible], and reflect upon the operations of their own minds, will acknowledge the difficulty is not much lefs to them. Though the Trinity in unity, therefore, were no Chriftian doctrine, myfteries muft ftill be believed; for they are as infeparable from the religion of nature as from that of revelation; and atheifm involves the moft incomprehenfible of all myfteries, even the beginning of exiftence without a caufe. We muft indeed form the beft notions that we can of this and of all other myfteries; for if we have no notions whatever of a Trinity in unity, we can neither believe nor

[illegible] Petrus Alphonfus, an eminent Jew, converted in the beginning of the 12th century, and prefented to the font by Alphonfus a king of Spain, wrote a learned treatife againft the Jews, wherein he preffes them with this fcripture, as a [illegible] argument that there are three perfons, to whom the great and incommunicable name of Jehovah is applied. And [illegible] Jews, according to Bechai, one of their Rabbies, have a tradition, that when the high-prieft [illegible] the people—*Attollens manuum [illegible] digitis [illegible], ut Trinitatem exprimeret*, "he lifted up his [illegible] into fuch a form as to exprefs a *Trinity*." All the foundation there is for this in the fcripture, is Lev. ix. 22. As for the reft, be it a matter of fact or not, yet if we confider whence it comes, there is fomething very remarkable in it. See [illegible] *de verf.* in *Pug. Fid.* p. 400, 556, 557.

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nor disbelieve that doctrine. It is however to be remembered, that all our notions of God are more or less analogical; that they must be expressed in words which, literally interpreted, are applicable only to man; and that propositions understood in this literal sense may involve an apparent contradiction, from which the truth meant to be expressed by them would be seen to be free, had we direct and adequate conceptions of the divine nature. On this account it is to be wished that men treating of the mystery of the holy Trinity, had always expressed themselves in scripture language, and never aimed at being wise beyond what is written; but since they have acted otherwise, we must, in justice to our readers, animadvert upon one or two statements of this doctrine, which we have reason to believe are earnestly contended for by some who consider themselves as the only orthodox.

In the scriptures, the three persons are denominated by the terms FATHER, SON, and HOLY GHOST, or by GOD, the WORD, who is also declared to be God, and the SPIRIT OF GOD. If each be truly God, it is obvious that they must all have the same divine nature, just as every man has the same human nature with every other man; and if there be but ONE GOD, it is equally obvious that they must be of the same individual substance or essence, which no three men can possibly be. In this there is a difficulty; but, as will be seen by and by, there is no contradiction. The very terms FATHER and SON imply such a relation between the two persons so denominated, as that though they are of the same substance, possessed of the same attributes, and equally

63 Subordination of the second and third persons.

God, just as a human father and his son are equally men, yet the second must be personally subordinate to the first. In like manner, the HOLY GHOST, who is called the Spirit of God, and is said to *proceed from* the *Father*, and to be *sent* by the *Son*, must be conceived as subordinate to both, much in the same way as a son is subordinate to his parents, tho' possessed of equal or even of superior powers. That this is the true doctrine, appears to us undeniable from the words of our Saviour himself, who, in a prayer addressed to his Father, styles‖ him by way of pre-eminence, "the only true God," as being the fountain or origin of the Godhead from which the Son and the Holy Ghost derive their true divinity. In like manner, St Paul, when opposing the polytheism of the Greeks, says expressly ‡, that "to us there is but one God, THE FATHER, OF whom are all things, and we in, or for, him; and one LORD JESUS CHRIST, BY whom are all things, and we by him."

‖ John xvii. 3.

‡ 1 Cor. viii. 6.

That the primitive fathers of the Christian church maintained this subordination of the second and third persons of the blessed Trinity to the first, has been evinced with such complete evidence by bishop Bull, that we do not perceive how any man can read his works and entertain a doubt on the subject. We shall transcribe two quotations from him, and refer the reader for fuller satisfaction to *sect.* 4. of his *Defensio fidei Nicenæ*. The first shall be a passage cited from *Novatian*, or whoever is the author of the book on the Trinity published among the works of Tertullian, in which the learned prelate assures us the sense of all the ancients is expressed. "Quia quid est Filius, non ex se est, quia nec innatus est; sed ex patre est, quia genitus est: sive dum verbum est, sive dum virtus est, sive dum sapientia est, sive dum lux est, sive dum Filius est, et quicquid horum est, non aliunde est quam ex Patre, Patri suo originem suam debens." The next is from Athanasius, who has never been accused of holding low opinions respecting the second person of the holy Trinity. This father, in his fifth discourse against the Arians, says, [illegible Greek] *according to John, the word was in this first principle, and the word was God. For God is the principle; and because the word is from the principle, therefore the word is God.* Agreeably to this doctrine, the Nicene fathers, in the creed which they published for the use of the universal church, style the only begotten Son, GOD OF GOD [illegible].

64 Regardless however of antiquity, and, as we think, of the plain sense of scripture, some modern divines of great learning contend, that the three persons in Deity are all *consubstantial, co-eternal, co-ordinate*, without *derivation, subordination*, or *dependence*, of *any sort*, as to nature or essence; whilst others affirm, that the second and third persons derive from the first their personality, but not their nature. We shall consider these opinions as different, though, from the obscurity of the language in which we have always seen them expressed, we cannot be certain but they may be one and the same. The maintainers of the former opinion hold, that the three persons called *Elohim* in the Old Testament, naturally independent on each other, entered into an agreement before the creation of the world, that one of them should in the fulness of time assume human nature, for the purpose of redeeming mankind from that misery into which it was foreseen that they would fall. This antemundane agreement, they add, constitutes the whole of that paternal and filial relation which subsists between the first and second persons whom we denominate Father and Son; and they hold, that the Son is said to be begotten before all worlds, to indicate that *He* who was before all worlds was *begotten*, or to *be* begotten, into the office of redeemer; or, more decisively, to signify that he undertook that office before the creation, and *assumed* to himself some appearance or figure of the reality in which he was to execute it; and he is called μονογενης or the only begotten, because he *alone* was begotten into the office of redeemer *.

God and his attributes. Some modern divines, but

* See Ridgeley's *Body of Divinity*.

65 The express doctrine of scripture.

To many of our readers we doubt not but this will appear a very extraordinary doctrine, and not easy to be reconciled with the unity of God. It is however sufficiently overturned by two sentences of holy scripture, about the meaning of which there can be no dispute. "In this (says St John †) was manifested the love of God towards us, because that God sent his only begotten Son into the world, that we might live through him." Taking the word *son* in its usual acceptation, this was certainly a wonderful degree of love in the Father of mercies to send into the world on our account a person so nearly related to him as an only son; but if we substitute this novel interpretation of the words *only begotten son* in their stead, the apostle's reasoning will lose all its force. St John will then be made to say, "In this was manifested the love of God toward us, because that God sent a divine person equal to himself, and no way related to him, but who had before the creation covenanted to come into the world, that we might live through him." Is this a proof of the love of the person here called God? Again, the inspired author of the epistle to the Hebrews, treating of our Saviour's priesthood, says, among other things expressive of his humiliation, that "though he was a SON, yet learned he obedience (or, as others would render the words εμαθεν υ'πακοην, he taught obedience) by the things which he suffered ‡." If the word *son* be here understood in its proper sense, this verse displays in a very striking manner the condescension of our divine Redeemer, who, though he was no less a person than the proper Son of God by nature, yet vouchsafed to learn or teach us obedience by the things which he suffered; but if we substitute this metaphorical sonship in place of the natural, the reasoning of the author (for that he is reasoning cannot be denied) will be very extraordinary. "Though this divine personage agreed before all worlds to suffer death for the redemption of man, yet learned he obedience, or yet taught

† John iv. 9.

‡ Heb. v. 8.

God and his attributes.

he us obedience, by the things which he suffered." What sense is there in this argument? Is it a proof of condescension to fulfil one's engagement? Surely, if the meaning of the word ὢν, when applied to the second person of the blessed Trinity, were what is here supposed, the inspired writer's argument would have been more to the purpose for which it is brought, had it run thus; "Though he was *not* a son, *i. e.* though he had made no previous agreement, yet condescended he to learn or teach," &c.

The other opinion, which supposes the Son and the Holy Ghost to derive from the Father their personality, but not their nature, is to us wholly unintelligible; for personality cannot exist, or be conceived in a state of separation from all natures, any more than a quality can exist in a state of separation from all substances. The former of these opinions we are unable to reconcile with the unity of God; the latter is clothed in words that have no meaning. Both, as far we can understand them, are palpable polytheism; more palpable indeed than that of the Grecian philosophers, who though they worshipped gods many, and lords many, yet all held one God supreme over the rest. See POLYTHEISM, n° 32.

56
The second and third persons not posterior to the first.

But if the Son and the Holy Ghost derive their nature as well their personality from the Father, will it not follow that they must be posterior to him in time, since every effect is posterior to its cause? No; this consequence seems to follow only by reasoning too closely from one nature to another, when there is between the two but a very distant analogy. It is indeed true, that among men, every father must be prior in time as well as in the order of nature to his son; but were it essential to a man to be a father, so as that he could not exist otherwise than in that relation, it is obvious that his son would be coeval with himself, though still as proceeding from him, he would be posterior in the order of nature. This is the case with all necessary causes and effects. The visible sun is the immediate and necessary cause of light and heat, either as emitting the rays from his own substance, or as exciting the agency of a fluid diffused for that purpose through the whole system. Light and heat therefore must be as old as the sun; and had he existed from all eternity, they would have existed from eternity with him, though still, as his effects, they would have been behind him in the order of nature. Hence it is, that as we must speak analogically of the Divine nature, and when treating of mind, even the Supreme mind, make use of words literally applicable only to the modifications of matter, the Nicene fathers illustrate the eternal generation of the second person of the blessed Trinity by this procession of light from the corporeal sun, calling him *God of God, light of light*.

Another comparison has been made use of to enable us to form some notion, however inadequate, how three Divine persons can subsist in the same substance, and thereby constitute but one God. Moses informs us, that man was made after the image of God. That this relates to the soul more than to the body of man, has been granted by all but a few gross anthropomorphites; but it has been well observed, that the soul, though in itself one indivisible and unextended substance, is conceived as consisting of three principal faculties, the *understanding*, the *memory*, and the *will*. Of these, though they are all coeval in time, and equally essential to a rational soul, the understanding is in the order of nature obviously the first, and the memory the second; for things must be perceived before they can be remembered; and they must be remembered and compared together before they can excite volitions, from being, some agreeable, and others disagreeable. The memory therefore may be said to spring from the understanding, and the will from both; and as these three faculties are conceived to constitute one soul, so may three Divine persons partaking of the same individual nature or essence constitute one God.

67
No contradiction in the Catholic doctrine of the Trinity.

These parallels or analogies are by no means brought forward as proofs of the Trinity, of which the evidence is to be gathered wholly from the word of God; but they serve perhaps to help our labouring minds to form the justest notions of that adorable mystery which it is possible for us to form in the present state of our existence; and they seem to rescue the doctrine sufficiently from the charge of contradiction, which has been so often urged against it by Unitarian writers. To the last analogy we are aware it has often been objected, that the soul may as well be said to consist of ten or twenty faculties as of three, since the passions are equally essential to it with the understanding, the memory, and the will, and are as different from one another as these three faculties are. This, however, is probably a mistake; for the best philosophy seems to teach us, that the passions are not innate; that a man might exist through a long life a stranger to many of them; and that there are probably no two minds in which are generated *all* the passions (see PASSION); but understanding, memory, and will, are absolutely and equally necessary to every rational being. But whatever be in this, if the human mind can be *conceived* to be one indivisible substance, consisting of different faculties, whether many or few, why should it be thought an impossibility for the infinite and eternal nature of God to be communicated to three persons acting different parts in the creation and government of the world, and in the great scheme of man's redemption.

68
Objections.

To the doctrine of the Trinity many objections have been made, as it implies the divinity of the Son and the Holy Ghost; of whom the former assumed our nature, and in it died for the redemption of man. These we shall notice when we come to examine the revelations more peculiarly Christian; but there is one objection which, as it respects the doctrine in general, may be properly noticed here. It is said that the first Christians borrowed the notion of a Tri-une God from the later Platonists; and that we hear not of a Trinity in the church till converts were made from the school of Alexandria. But if this be the case, we may properly ask, whence had those Platonists the doctrine themselves? It is not surely so simple or so obvious as to be likely to have occurred to the reasoning mind of a Pagan philosopher; or if it be, why do Unitarians suppose it to involve a contradiction? Plato indeed taught a doctrine in some respects similar to that of the Christian Trinity, and so did Pythagoras, with many other philosophers of Greece and the East (see PLATONISM, POLYTHEISM, and PYTHAGORAS); but tho' these sages appear to have been on some occasions extremely credulous, and on others to have indulged themselves in the most mysterious speculations, there is no room to suppose that they were *naturally weaker men* than ourselves, or that they were capable of inculcating as truths what they *perceived* to involve a *contradiction*. The Platonic and Pythagorean Trinities never could have occurred to the mind of him who merely from the works of creation endeavoured to discover the being and attributes of the Creator; and therefore as those philosophers travelled into Egypt and the East in quest of knowledge, it appears to us in the highest degree probable, that they picked up this mysterious and sublime doctrine in those regions where it had been handed down as a dogma from the remotest ages, and where we know that science was not taught systematically, but detailed in collections of sententious maxims and traditionary opinions. If this be so, we cannot doubt but that the Pagan Trinities had their origin in some primæval reve-

69
Answered.

revelation. Nothing else indeed can account for the general prevalence of a doctrine so remote from human imagination, and of which we find vestiges in the sacred books of almost every civilized people of antiquity. The corrupt state in which it is viewed in the writings of Plato and others, is the natural consequence of its descent through a long course of oral tradition; and then falling into the hands of men who bent every opinion as much as possible to a conformity with their own speculations. The Trinity of Platonism therefore, instead of being an objection, lends, in our opinion, no feeble support to the Christian doctrine, since it affords almost a complete proof of that doctrine's having made part of the first revelations communicated to man.

Having thus discovered that the one God, to whom Moses gives the plural name *Elohim*, comprehends three persons: let us now inquire what power this Triune God exerted, when, as the same sacred writer informs us, he created the heaven and the earth. That by the heaven and the earth is here meant the whole universe, visible and invisible, is known to every person acquainted with the phraseology of Scripture; and we need inform no man conversant with English writers, that by *creation*, in its proper sense, is meant bringing into *being*, or making that to *exist* which existed not *before*. It must, however, be acknowledged, that the Hebrew word ברא does not always imply the production of substance, but very often the forming of particular organized bodies out of pre-existing matter. Thus when it is said * that "God *created* great whales, and every living creature that moveth, which the waters brought forth abundantly after their kind," and again that "he *created* man male and female;" though the word ברא is used on both occasions, we are not to conceive that the bodies of the first human pair, and of these animals, were brought into being from nonentity, but only that they were formed by a proper organization being given to pre-existent matter. But when Moses says, "In the beginning God *created* the heaven and the earth," he cannot be supposed to mean that "in the beginning God only gave form to matter already existing of itself;" for in the very next verse we are assured that after this act of creation was over, "the earth was still *without form* and void," or, in other words, in a chaotic state.

That the Jews, before the coming of our Saviour, understood their lawgiver to teach a proper creation, is plain from that passage in the second book of the Maccabees, in which a mother, to persuade her son to suffer the cruellest tortures rather than forsake the law of his God, uses the following argument: "I beseech thee, my son, look upon the heaven and the earth, and all that is therein, and consider that God made them of things that were not." To the same purpose the inspired author of the epistle to the Hebrews, when magnifying the excellence of faith, says, "Through faith we understand that the worlds were framed by the word of God, so that things which are seen were not made of things which do appear;" where, as bishop Pearson has ably proved, the phrase [illegible] is equivalent to [illegible], in the quotation from the Maccabees.

The very first verse, therefore, of the book of Genesis informs us of a most important truth, which all the uninspired wisdom of antiquity could not discover. It assures us, that as nothing exists by chance, so nothing is necessarily existing but the three divine persons in the one Godhead. Every thing else, whether material or immaterial, derives its substance, as well as its form or qualities, from the fiat of that self-existent Being, "who was, and is, and is to come."

It does not, however, follow from this verse, or from any other passage in the sacred Scriptures, that the whole universe was called into existence at the same instant; neither is it by any means evident that the chaos of our world was brought into being on the first of those six days during which it was gradually reduced into form. From a passage ‡ in the book of Job, in which we are told by God himself, that when the "foundation of the earth was laid the morning stars sang together, and all the sons of God shouted for joy," it appears extremely probable that worlds had been created, formed, and inhabited, long before our earth had any existence. Nor is this opinion at all contrary to what Moses says of the creation of the stars; for though they are mentioned in the same verse with the sun and moon, yet the manner in which, according to the original, they are introduced, by no means indicates that all the stars were formed at the same time with the luminaries of our system. Most of them may have been created long before, and some of them since, our world was brought into being; for that clause (verse 16.) "he made the stars also," is in the Hebrew no more than "and the stars," the words *he made* being inserted by the translators. The whole verse therefore ought to be rendered thus, "and God made two great lights; the greater light to rule the day, and the lesser light with the stars to rule the night;" where nothing is intimated with respect to the *time* when the stars were formed, any more than in that verse of the Psalms ||, which exhorts us to give thanks to God who made the moon and stars to rule by night; for his mercy endureth "for ever." The first verse of the book of Genesis informs us, that all things spiritual and corporeal derive their existence from God; but it is nowhere said that all matter was created at the same time; and the generations of men afford sufficient evidence of a successive and continual creation of spirits.

That the whole corporeal universe *may have been* created at once must be granted; but if so, we have reason to believe that this earth, with the sun and all the planets of the system, were suffered to remain for ages in a state of chaos, "without form and void;" because it appears from other scriptures, that worlds of intelligent creatures existed, and even that some angels had fallen from a state of happiness prior to the era of the Mosaic cosmogony. That the sun and the other planets revolving round him were formed at the same time with the earth, cannot indeed be questioned; for it is not only extremely probable in itself from the known laws of nature, but is expressly affirmed by the sacred historian, who relates the formation of the sun and moon in the order in which it took place. Into the particulars of his narrative we have no occasion to enter, as it is sufficiently explained and vindicated in other articles of this work (see CREATION and EARTH); but there is one difficulty which, though we have given the common solutions of it elsewhere, we may again notice in this place, because it has furnished infidel ignorance with something like an objection to the divine legation of the Hebrew lawgiver.

Moses informs us, that on the *first day* after the production of the chaos, the *element of light* was created; and yet within a few sentences he declares that the sun, the fountain of light, was not made till the *fourth day*. How are these two passages to be reconciled? We answer, That they may be reconciled many ways. Moses wrote for the use of a whole people, and not for the amusement or instruction of a few astronomers; and in this view his language is sufficiently proper, even though we suppose the formation of the sun and the other planets to have been carried on at the same time, and in the same progressive manner, with the formation of this earth. The voice which called light into existence would separate the fiery and luminous particles of

God and his attributes.

71 The whole universe not created at once.

‡ Job xxxviii. 4–7.

|| Psalm cxxxvi. 9.

72 The solar system created at once.

73 A difficulty solved.

the chaos from those which were opake, and, on this hypothesis, [illegible] them as one globe, diffusing an [illegible] light through the planetary system; but if the earth's atmosphere continued till the fourth day loaded with vapours, as from the narrative of Moses it appears to have done, the sun could not till *that day* have been *seen* from the earth, and may therefore, in popular language, be said with sufficient propriety to have been *formed* on the fourth day, as it was then first made to *appear*. (See CREATION, n° 13. and LIGHT, n° 1[illegible], 174, 175). But though this solution of the difficulty serves to remove the infidel objection, and to secure the credit of the sacred historian, candour compels us to confess that it appears not to be the true solution.

The difficulty itself arises entirely from supposing the sun to be the sole fountain of light; but the truth of this opinion is not self-evident, nor has it ever been established by satisfactory proof. It is indeed to a mind divested of undue deference to great names, and considering the matter with impartiality, an opinion extremely improbable. The light of a candle placed upon an eminence may in a dark night be seen in every direction at the distance of at least three miles. But if this small body be rendered visible by means of rays emitted from itself, the flame of a candle, which cannot be supposed more than an inch in diameter, must, during every instant that it continues to burn, throw from its own substance luminous matter sufficient to fill a spherical space of six miles in diameter. This phenomenon, if real, is certainly surprising; but if we pursue the reflection a little farther, our wonder will be greatly increased. The matter which, when convertd into flame, is an inch in diameter, is not, when of the consistence of cotton and tallow, of the dimensions of the 20th part of an inch; and therefore, upon the common hypothesis, the 20th part of an inch of tallow may be so rarefied as to fill a space of 113,0976 cubic miles! a rarefaction which to us appears altogether incredible. We have indeed heard much of the divisibility of matter *ad infinitum*, and think we understand what are usually called *demonstrations* of the truth of that proposition; but these demonstrations prove not the actual divisibility of real solid substances, but only that upon trial we shall find no end of the ideal process of dividing and subdividing imaginary extension.

Upon the whole, therefore, we are much more inclined to believe that the matter of light is an extremely subtile fluid, diffused through the corporeal universe, and only excited to agency by the sun and other fiery bodies, than that it consists of streams continually issuing from the substance of these bodies. It is indeed an opinion pretty generally received, and certainly not improbable in itself, that light and electricity are one and the same substance (see *Electricity-Index*); but we know that the electrical fluid, though pervading the whole of corporeal nature, and, as experiments show, capable of acting with great violence, yet lies dormant and unperceived till its agency be excited by some foreign cause. Just so it may be with the matter of light. That substance may be "diffused from one end of the creation to the other, it may traverse the whole universe, form a communication between the most remote spheres, penetrate into the inmost recesses of the earth, and only wait to be put in a proper motion to communicate visible sensations to the eye. Light is to the organ of sight what the air is to the organ of hearing. Air is the medium which, vibrating on the ear, causes the sensation of sound; but it equally exists round us at all times, though there be no sonorous body to put it in motion. In like manner, light may be equally extended at all times, by night as well as by day, from the most distant fixed stars to this earth, tho' it then only strikes our eyes so as to excite visible sensations when impelled by the sun or some other mass of fire." Nor let any one imagine that this hypothesis interferes with any of the known laws of optics; for if the rays of light be impelled in straight lines, and in the same direction in which they are supposed to be emitted, the phenomena of vision must necessarily be the same.

Moses therefore was probably a more accurate philosopher than he is sometimes supposed to be. The element of light was doubtless created, as he informs us, on the first day; but whether it was then put in that state in which it is the medium of vision, we cannot know, and we need not inquire, since there was neither man nor inferior animal with organs fitted to receive its impressions. For the first three days it may have been used only as a powerful instrument to reduce into order the jarring chaos. Or if it was from the beginning capable of communicating visible sensations, and dividing the day from the night, its agency must have been immediately excited by the Divine power till the fourth day, when the sun was formed, and endowed with proper qualities for instrumentally discharging that office. This was indeed miraculous, as being contrary to the present laws of nature: but the whole creation was miraculous; and we surely need not hesitate to admit a less miracle where we are under the necessity of admitting a greater. The power which called light and all other things into existence, could give them their proper motions by ten thousand different means; and to attempt to solve the difficulties of creation by philosophic theories respecting the laws of nature, is to trifle with the common sense as well as the piety of mankind: it is to consider as subservient to a law that very power by whose continued exertion the law is established.

Having thus proved that the universe derives its being, as well as the form and adjustment of its several parts, from the one supreme and self-existent God, let us here pause, and reflect on the sublime conceptions which such astonishing works are fitted to give us of the Divine perfections.

And, in the first place, how strongly do the works of creation impress upon our minds a conviction of the infinite power of their Author? He spoke, and the universe started into being; he commanded, and it stood fast. How mighty is the arm which "stretched out the heavens and laid the foundations of the earth; which removeth the mountains, and they know it not; which overturneth them in his anger; which shaketh the earth out of her place, and the pillars thereof tremble! How powerful the word which commandeth the sun, and it riseth not; and which sealeth up the stars;" which sustaineth numberless worlds of amazing bulk suspended in the regions of empty space, and directs their various and inconceivably rapid motions with the utmost regularity! "Lift up your eyes on high, and behold, who hath created all these things? By the word of the Lord were the heavens made, and all the host of them by the breath of his mouth. Hell is naked before him, and destruction hath no covering. He stretcheth out the North over the empty place, and hangeth the earth upon nothing. He has measured the waters in the hollow of his hand, and meted out the heavens with a span; and comprehended the dust of the earth in a measure; and weighed the mountains in scales, and the hills in a balance. Behold! the nations are as a drop of the bucket, and are counted as the small dust of the balance; behold, he taketh up the isles as a very little thing. All nations before him are as nothing, and they are counted to him less than nothing, and vanity. To whom then will ye liken God, or what likeness will ye compare unto him ǁ?"

As the works of creation are the effects of God's power, they likewise in the most eminent manner display his wisdom. This was so apparent to Cicero, even from the partial

partial and very imperfect knowledge in astronomy which his time afforded, that he declared § those who could assert the contrary void of all understanding. But if that great master of reason had been acquainted with the modern discoveries in astronomy, which exhibit numberless worlds scattered through space, and each of immense magnitude; had he known that the sun is placed in the centre of our system, and that to diversify the seasons the planets move round him with exquisite regularity; could he have conceived that the distinction between light and darkness is produced by the diurnal rotation of the earth on its own axis, instead of that disproportionate whirling of the whole heavens which the ancient astronomers were forced to suppose; had he known of the wonderful motions of the comets, and considered how such eccentric bodies have been preserved from falling upon some of the planets in the same system, and the several systems from falling upon each other; had he taken into the account that there are yet greater things than these, and "that we have seen but a few of God's works;"—that virtuous Pagan would have been ready to exclaim in the words of the Psalmist, "O Lord, how manifold are thy works! In wisdom hast thou made them all; the earth is full of thy riches."

That creation is the offspring of unmixed goodness, has been already shown with sufficient evidence (see METAPHYSICS, n° 312. and n° 29. of this article); and from the vast number of creatures on our earth endowed with life and sense, and a capability of happiness, and the infinitely greater number which probably inhabit the planets of this and other systems, we may infer that the goodness of God is as boundless as his power, and that "as is his majesty, so is his mercy." Out of his own fulness hath he brought into being numberless worlds, replenished with myriads of myriads of creatures, furnished with various powers and organs, capacities and instincts; and out of his own fulness he continually and plentifully supplies them all with every thing necessary to make their existence comfortable. "The eyes of all wait upon him, and he giveth them their meat in due season. He openeth his hand and satisfies the desires of every living thing: he loveth righteousness and judgment; the earth is full of the goodness of the Lord. He watereth the ridges thereof abundantly; he settleth the furrows thereof; he maketh it soft with showers, and blesseth the springing thereof. He crowneth the year with his goodness; and his paths drop fatness. They drop upon the pastures of the wilderness; and the little hills rejoice on every side. The pastures are clothed with flocks; the valleys also are covered with corn; they shout with joy, they also sing *". Survey the whole of what may be seen on and about this terraqueous globe, and say, if our Maker hath a sparing and a niggardly hand. Surely the Author of so much happiness must be essential goodness; and we must conclude with St John, that "God is love."

These attributes of power, wisdom, and goodness, so conspicuously displayed in the works of creation, belong in the same supreme degree to each person in the blessed Trinity; for Moses declares that the heaven and the earth were created, not by *one* person, but by the *Elohim*. The λογος indeed, or second person, appears to have been the *immediate* Creator; for St John assures us ‖, that "all things were made by him, and that without him was not any thing made that was made." Some Arian writers of great learning (and we believe the late Dr Price was of the number) have asserted, that a being who was created himself may be endowed by the Omnipotent God with the power of creating other beings; and as they hold the λογος or *word* to be a creature, they contend that he was employed by the Supreme Deity to create, not the whole universe, but only this earth, or at the utmost the solar system. "The old argument (says one of them), that no being inferior to the great Omnipotent can create a world, is so childish as to deserve no answer. Why may not God communicate the power of making worlds to any being whom he may choose to honour with so glorious a prerogative? I have no doubt but such a power may be communicated to many good men during the progress of their existence; and to say that it may *not*, is not only to limit the power of God, but to contradict acknowledged analogies."

72 We are far from being inclined to limit the power of God. He can certainly do whatever involves not a direct contradiction; and therefore, though we know nothing *analogous* to the power of *creating worlds*, yet as we perceive not any contradiction implied in the notion of that power being communicated, we shall admit that such a communication may be *possible*, though we think it in the highest degree *improbable*. But surely no man will contend that the *whole universe* was brought into existence by *a creature*; because that creature himself, however highly exalted, is necessarily comprehended in the notion of the universe. Now St Paul expressly affirms *, that, by the second person in the blessed Trinity, "were ALL *things* created that are in heaven, and that are in earth, *visible* and *invisible*, whether they be THRONES, or DOMINIONS, or PRINCIPALITIES, or POWERS; all things were created by him and for him; and he is before all things, and by him all things consist." Indeed the Hebrew scriptures in more places than one † expressly declare that this earth, and of course the whole solar system, was *formed* as well as *created*, not by any inferior being, but by the *true* God, even *Jehovah* alone; and in the New Testament ‡, the Gentiles are said to be without excuse for not glorifying him as God, "because his eternal power and Godhead are clearly seen from the creation of the world." But if it were natural to suppose that the power of creating worlds has been, or ever will be, communicated to beings inferior to the great Omnipotent, this reasoning of the apostle's would be founded on false principles, and the sentence which he passed on the Heathen would be contrary to justice.

God and his attributes.

Creation peculiar to God.

* Colof. iv. 17.

† Isa. xl. 12. xliv. 24. Jerem. x. 10—13.

‡ Rom. i. 18—22.

But though it be thus evident that the λογος was the immediate Creator of the universe, we are not to suppose that it was without the concurrence of the other two persons. The Father, who may be said to be the fountain of the Divinity itself, was certainly concerned in the creation of the world, and is therefore in the apostle's creed denominated the "Father Almighty, Maker of heaven and earth;" and that the Holy Ghost or third person is likewise a Creator, we have the express testimony of two inspired writers: "By the word of the Lord (says the Psalmist) were the heavens made, and all the host of them by the breath (Hebrew, SPIRIT) of his mouth." And Job declares, that the "SPIRIT of God made him, and that the breath of the Almighty gave him life." Indeed these three divine persons are so intimately united, that what is done by one must be done by all, as they have but one and the same will. This is the reason assigned by Origen * for our paying divine worship to each; [illegible], "we worship the Father of truth, and the Son the truth itself, being two things as to Hypostasis, but one in agreement, consent, and sameness of will." Nor is their union a mere agreement in will only; it is a physical or essential union: so that what is done by one must necessarily be done by the others also, according to that of our Saviour, "I am in the Father and the Father in me: The Father who dwelleth in me, he doth the works."

Th[e]

Original state of man.

Thus we see, that to the several persons in the ever blessed Trinity is equal praise due for the creation of the world. Their all-powerful word commanded into being every thing that exists, and by the same Divine power is every thing continued in existence. Well therefore might the Psalmist call upon the heavens and the earth to praise the name of the Lord; "for he commanded, and they were created. He hath also established them for ever and ever; he hath made a decree which shall not pass. Let all things praise the name of the Lord; for his name יהוה אלהים, Father, Son, and Holy Ghost, alone is excellent, and his glory above the earth and heaven."

SECT. II. *Of the Original State of Man, and the first Covenant of Eternal Life which God vouchsafed to make with him.*

80 Peculiarity of the expression in which God is said to make man.

In the Mosaic account of the creation, every attentive reader must be struck with the manner in which the supreme Being is represented as making man: "And God said, let us make man in our image, after our likeness; and let *them* have dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth. So God created man in his own image; in the image of God created he him; male and female created he THEM. And God blessed them; and God said unto them, be fruitful, and multiply, and replenish the earth, and subdue it; and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth. And God said, behold, I have given you every herb bearing seed, which is upon the face of all the earth; and every tree, in the which is the fruit of a tree yielding seed: to you it shall be for meat. And God saw every thing that he had made, and, behold, it was very good. And the evening and the morning were the sixth day. Thus the heavens and the earth were finished, and all the host of them. And on the seventh day God ended his work which he had made; and he rested on the seventh day from all his works which he had made. And God blessed the seventh day, and sanctified it: because that in it he had rested from all his work which God created and made ‡."

‡ Gen. i. 26, &c. ii. 1, 2, 3.

This is a very remarkable passage, and contains much important information. It indicates a plurality of persons in the Godhead, describes the nature of man as he came at first from the hands of his Creator, and furnishes data from which we may infer what were the duties required of him in that primeval state, and what were the rewards to which obedience would entitle him.

81 In his own image.

Of the plurality of Divine persons, and their essential union, we have treated in the preceding section, and proceed now to inquire into the specific nature of the first man. This must be implied in the *image of God*, in which he is said to have been created; for it is by that phrase alone that he is characterized, and his pre-eminence marked over the other animals. Now this image or likeness must have been found either in his body alone, his soul alone, or in both united. That it could not be in his body alone, is obvious; for the infinite and omnipotent God is allowed by all men to be without body, parts, or passions, and therefore to be such as nothing corporeal can possibly resemble.

82 Different opinions of the image of God.

If this likeness is to be found in the human soul, it comes to be a question in what faculty or power of the soul it consists. Some have contended, that man is the only creature on this earth who is animated by a principle essentially different from matter; and hence they have inferred, that he is said to have been formed in the Divine image, on account of the immateriality of that vital principle which was infused into his body when the "Lord God breathed into his nostrils the breath of life, and man became a living soul §." That this account of the animation of the body of man indicates a superiority of the human soul to the vital principle of all other animals, cannot, we think, be questioned; but it does not therefore follow, that the human soul is the only immaterial principle of life which animates any terrestrial creature. It has been shown elsewhere (see METAPHYSICS, n° 235.), that the power of sensation, attended with individual consciousness, as it appears to be in all the higher species of animals, cannot result from any organical structure, or be the quality of a compound extended being. The vital principle in such animals therefore must be immaterial as well as the human soul; but as the word *immaterial* denotes only a negative notion, the souls of men and brutes, though both immaterial, may yet be substances essentially different. This being the case, it is plain that the Divine image in which man was formed, and by which he is distinguished from the brute creation, cannot consist in the mere circumstance of his mind being a substance different from matter, but in some positive quality which distinguishes him from every other creature on this globe.

§ Gen. ii. 7.

About this characteristic quality very various opinions have been formed. Some have supposed † "that the image of God in Adam appeared in that rectitude, righteousness, and holiness, in which he was made; for God made man upright (Eccles. vii. 2.), a holy and righteous creature; which holiness and righteousness were in their kind perfect; his understanding was free from all error and mistakes; his will biassed to that which is good; his affections flowed in a right channel towards their proper objects; there were no sinful motions and evil thoughts in his heart, nor any propensity or inclination to that which is evil; and the whole of his conduct and behaviour was according to the will of God. And this righteousness (say they) was *natural*, and not personal and acquired. It was not obtained by the exercise of his free-will, but was created with him, and belonged to his mind, as a natural faculty or instinct." They therefore call it *original righteousness*, and suppose that it was lost in the fall.

To this doctrine many objections have been made. It has been said that righteousness consisting in right actions proceeding from proper principles, could not be created with Adam and make a part of his nature; because nothing which is produced in a man without his knowledge and consent can be in him either virtue or vice. Adam, it is added, was unquestionably placed in a state of trial, which proves that he had righteous habits to *acquire*; whereas the doctrine under consideration, affirming his original righteousness to have been perfect, and therefore incapable of improvement, is inconsistent with a state of trial. That his understanding was free from all errors and mistakes, has been thought a blasphemous position, as it attributes to man one of the incommunicable perfections of the Deity. It is likewise believed to be contrary to fact; for either his understanding was bewildered in error, or his affections flowed towards an improper object, when he suffered himself at the persuasion of his wife to transgress the express law of his Creator. The objector expresses his wonder at its having ever been supposed that the *whole* of Adam's conduct and behaviour was according to the will of God, when it is so notorious that he yielded to the first temptation with which, as far as we know, he was assailed in paradise.

Convinced by these and other arguments, that the image of God in which man was created could not consist in original righteousness, or in exemption from all possibility of error, many learned men, and Bishop Bull * among others, have

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have supposed, that by the image of God is to be understood certain gifts and powers supernaturally infused by the Holy Spirit into the minds of our first parents, to guide them in the ways of piety and virtue. This opinion they rest chiefly upon the authority of Tatian, Irenæus, Tertullian, Cyprian, Athanasius, and other fathers of the primitive church; but they think, at the same time, that it is countenanced by several passages in the New Testament. Thus when St Paul says §, "and so it is written, The first man Adam was made a living soul, the last Adam was made a quickening Spirit;" they understand the whole passage as relating to the creation of man, and not as drawing a comparison between Adam and Christ, to show the great superiority of the latter over the former. In support of this interpretation they observe, that the apostle immediately adds, "howbeit, that was not first which is spiritual, but that which is natural, and afterwards that which is spiritual;" an addition which they think was altogether needless, if by the quickening Spirit he had referred to the incarnation of Christ, which had happened in the very age in which he was writing. They are therefore of opinion, that the body of Adam, after being formed of the dust of the ground, was first animated by a vital principle endowed with the faculties of reason and sensation, which entitled the whole man to the appellation of a living soul. After this they suppose certain graces of the Holy Spirit to have been infused into him, by which he was made a quickening spirit, or formed in the image of God; and that it was in consequence of this succession of powers communicated to the same person, that the apostle said, "Howbeit, that was not first which is spiritual, but that which is natural."

85 Opinion of Bishop Bull some e an- fa-

§ 1 Cor. xv. 45, 46.

We need hardly observe, that with respect to a question of this kind the authority of *Tatian* and the other fathers quoted is nothing. Those men had no better means of discovering the true sense of the scriptures of the Old Testament than we have; and their ignorance of the language in which these scriptures are written, added to some metaphysical notions respecting the soul, which too many of them had derived from the school of Plato, rendered them very ill qualified to interpret the writings of Moses. Were authority to be admitted, we should consider that of bishop Bull and his modern followers as of greater weight than the authority of all the ancients to whom they appeal. But authority cannot be admitted; and the reasoning of this learned and excellent man from the text of St Paul is surely very inconclusive. It makes two persons of Adam; a first, when he was a natural man composed of a body and a reasonable soul; a second, when he was endowed with the gifts of the Holy Spirit and by them formed in the image of God! In the verse following too, the apostle expressly calls the second man, of whom he had been speaking, "the Lord from heaven;" but this appellation we apprehend to be too high for Adam in the state of greatest perfection in which he ever existed. That our first parents were endowed with the gifts of the Holy Ghost, we are strongly inclined to believe for reasons which shall be given by and by; but as these gifts were adventitious to their nature, they could not be that image in which God made man.

86 …ounded.

87 …r opinion.

Since man was *made* in the image of God, that phrase, whatever be its precise import, must denote something *peculiar* and at the same time essential to human nature; but the only two qualities at once natural and peculiar to man are his shape and his reason. As none but an anthropomorphite will say that it was Adam's shape which reflected this image of his Creator, it has been concluded that it was the faculty of reason which made the resemblance. To give strength to this argument it is observed ‡, that when God says, "let us make man in our image," he immediately adds, "and let them have dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth;" but as many of the cattle have much greater bodily strength than man, this dominion could not be maintained but by the faculty of reason bestowed upon him and withheld from them.

‡ Warburton's Div. Leg. book ix.

If the image of God was impressed only on the mind of man, this reasoning seems to be conclusive; but it has been well observed ‡ that it was the whole man, and not the *soul alone*, or the *body* alone, that is said to have been formed in the divine image; even as the whole man, soul and body, is the seat of the new and spiritual image of God in regeneration and sanctification. "The very God of peace (says the apostle) sanctify you wholly; and may your whole *spirit*, *soul* and *body*, be preserved blameless to the coming of our Lord Jesus Christ." It is worthy of notice too, that the reason assigned for the prohibition of murder to Noah and his sons after the deluge, is, that man was made in the image of God. "Whoso sheddeth man's blood, by man shall his blood be shed; for in the image of God made he man." These texts seem to indicate, that whatever be meant by the image of God, it was stamped equally on the soul and on the body. In vain is it said that man cannot resemble God in shape. This is true, but it is little to the purpose; for man does not resemble God in his reasoning faculty more than in his form. It would be idolatry to suppose the supreme majesty of heaven and earth to have a body or a shape; and it would be little short of idolatry to imagine that he is obliged to compare ideas and notions together; to advance from particular truths to general propositions; and to acquire knowledge, as we do, by the tedious processes of inductive and syllogistic reasoning. There can therefore be no direct image of God either in the soul or in the body of man; and the phrase really seems to import nothing more than those powers or qualities by which man was fitted to exercise dominion over the inferior creation; as if it had been said, "Let us make man in our image, after our likeness, that *they may have* dominion, &c." But the erect form of man contributes in some degree, as well as his rational powers, to enable him to maintain his authority over the brute creation; for it has been observed by travellers, that the fiercest beast of prey, unless ready to perish by hunger, shrinks back from a steady look of the human face divine.

‡ *Gill's Body of Divinity*, book iii. chap 3.

88 True import of the phrase.

By some *, however, who have admitted the probability of this interpretation, another, and in their opinion a still better reason, has been devised for its being said that man was formed in the image of God. All the members of Christ's body, say they, were written and delineated in the book of God's purposes and decrees, and had an ideal existence from eternity in the divine mind; and therefore the body of Adam might be said to be formed after the image of God, because it was made according to that idea. But to this reasoning objections may be urged, which we know not how to answer. All things that ever were or ever shall be, the bodies of us who live at present as well as the bodies of those who lived 5000 years ago, have from all eternity had an ideal existence in the Divine mind; nor in this sense can one be said to be prior to another. It could not therefore be after the idea of the identical body of Christ that the body of Adam was formed; for in the Divine mind ideas of both bodies were present together from all eternity, and each body was undoubtedly formed after the ideal archetype of itself. It may be added likewise, that the body of Christ was not God, nor the idea of that body the idea of God. Adam therefore could not with propriety, or even with truth, be said to have been formed in the image of God, if by that phrase nothing more were intended than the resemblance between his body and the body of Christ.

* Gill, &c.

The

[illegible] These objections to this interpretation appear to us unanswerable; but we mean not to dictate to our readers. Every man will adopt that opinion which he thinks supported by the best arguments; but it is obvious, that whatever else may be meant by the image of God in which man was made, the phrase undoubtedly comprehends all those powers and qualities by which he is enabled to maintain his authority over the inferior creation. Among these the faculty of reason is confessedly the most important; for it is by it that man is capable of being made acquainted with the Author of his being, the relation which subsists between them, and the duties imposed in that relation upon the creature to the Creator.

89 Religion [illegible] communicated to Adam. That the first man, however, was not left to discover these things by the mere efforts of his own unassisted reason, we have endeavoured to show in another place; (See RELIGION, n° 5—14.); and the conclusion to which we were there led, is confirmed by the portion of revelation before us. The inspired historian says, that "God blessed the seventh day and sanctified it, because that in it he had rested from all his works, which he created and made:" but Adam could not have understood what was meant by the *sanctification* of a particular day, or of any thing else, unless he had previously received some religious instruction. There cannot therefore be a doubt, but that as soon as man was made, his Creator communicated to him the truths of what is called natural religion, which we have endeavoured to explain and establish in Part I. of this article; and to these were added the precept to keep holy the Sabbath-day, and set it apart for the purposes of contemplation and worship.

90 Institution of the Sabbath. This was a very wise institution, as all the divine institutions must be. "The great end for which we are brought into life, is to attain the knowledge and be confirmed in the love of God. This includes obedience to his will in thought, word, and deed, or that course of conduct which can alone make us happy here, and fit us for everlasting glory hereafter. But of these things we cannot retain a proper sense without close and repeated application of thought; and the unavoidable cares and concerns of the present life occupying much of our attention, it is, in the nature of things, necessary that some certain portion of time should be appropriated to the purposes of religious instruction and the public adoration of our Creator, in whom we all live, and move, and have our being." Hence a very learned divine † has inferred, that though the particular time is a matter of positive appointment, the observation of a sabbath in general is a duty of natural religion, as having its foundation in the reason of things. See SABBATH.

† *Dr Taylor of Norwich.*

91 Duties of man in his original state, Man therefore in his *natural* and original state was a rational and religious being, bound to do "justice, to love mercy, to walk humbly with his God, and to keep holy the Sabbath-day." These seem to be all the duties which in that state were required of him; for as soon as he was introduced into the terrestrial paradise and admitted into covenant with his Maker, he was placed in a *supernatural* state, when other duties were of course enjoined.

That our first parents were both made on the sixth day, Moses expresly affirms when he says ‖, that "God created them male and female, and blessed them, and called *their* name *Adam* (K), in the day when they were created:" but that they were introduced into the garden of Eden on that day, is an opinion which, however generally it may be received, seems not to be reconcileable with the plain narrative of the sacred penman. After telling us that on the sixth day God finished all his works, which he saw to be very good, and rested on the seventh day, he briefly recapitulates the history of the generations of the heavens and of the earth, gives us a more particular account of the formation of the first man, informing us that the "Lord God formed him out of the dust of the ground, and breathed into his nostrils the breath of life, when man became a living soul;" and then proceeds to say ‡, that the "Lord God planted a garden eastward in Eden, where he put the man whom he had *formed*." From this short history of the first pair it appears beyond dispute evident, that neither the man nor the woman was formed *in* the garden; and that from their creation some time elapsed before the garden was prepared for their reception, is likewise evident from a comparison of Gen. i. 29. with Gen. ii. 16, 17. In the first of these passages God gives to man, immediately after his creation, "every herb bearing seed which was upon the face of all the earth, and *every tree*, without exception, in which was the fruit of a tree bearing seed: to him he said it should be for meat." In the second, "he commanded the man, saying, of every tree of the garden thou mayest freely eat; but of the tree of knowledge of good and evil, thou shalt not eat of it; for in the day thou eatest thereof thou shalt surely die." When the first grant of food was given, Adam and his wife must have been where no tree of knowledge grew, and they must have been intended to live at least so long in that state as that they should have occasion for food, otherwise the formal grant of it would have been not only superfluous, but apt to mislead them with respect to the subsequent restriction.

‖ Gen. i. 27. v. 2.

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‡ Gen. ii. 7, 8, and 15.

92 Before he was placed in the garden of Eden,

In this original state man was under the discipline of what we have called *natural religion*, entitled to happiness while he should perform the duties required of him, and liable to punishment when he should neglect those duties, or transgress the law of his nature as a rational and moral agent. This being the case, it is a matter of some importance, and what will enable us to perceive more clearly the prerogatives of Christianity, to ascertain, if we can, what the rewards and punishments are which natural religion holds out to her votaries.

That under every dispensation of religion the pious and virtuous man shall, during the whole of his existence, enjoy more happiness than misery; and that the incorrigibly wicked, if there be any such, shall have a greater portion of misery than happiness, are truths which cannot be controverted by any one who admits, that the Almighty governor of the universe is a Being of wisdom, goodness, and justice. But respecting the rewards of virtue and the punishment of vice, more than these general truths seems not to be taught by natural religion. Many divines, however, of great learning and worth, have thought otherwise, and have contended, that from the nature of things the rewards bestowed by an infinite God upon piety and virtue must be eternal like their author. These men indeed appear willing enough to allow that the punishments with which natural religion is armed against vice must be only of a temporary duration, because reason, say they, is ready to revolt at the thought of *everlasting* punishment.

93 Did not, when performed, entitle him to eternal life.

This opinion, which confounds natural with revealed religion, giving to the former an important truth which belongs exclusively

(K) The woman was some time afterwards distinguished by the name of Eve חוה, because she was to be the mother of all living, and particularly of that blessed seed which was to bruise the head of the serpent. See *Parkhurst's Lexicon* on the word.

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exclusively to the latter, has been so ably confuted by a learned writer, who was never averse from allowing to human reason all the discoveries which it can justly claim, that we shall submit his arguments to our readers in preference to any thing which we can give ourselves.

"If reason doth, on the one hand, seem to revolt at *everlasting punishment*, we must confess that FANCY, on the other, (even when full plumed by *vanity*), hath scarce force enough to rise to the idea of *infinite rewards*. How the heart of man came to consider this as no more than an adequate retribution for his right conduct during the short trial of his virtue here, would be hard to tell, did we not know what monsters PRIDE begot of old upon *Pagan philosophy*; and how much
94 greater still these latter ages have disclosed, *by the long* incubation of *school-divinity* upon *folly*. What hath been urged from natural reason, in support of this extravagant presumption, is so very slender, that it recoils as you enforce it. First, you say, 'that the soul, the subject of these eternal rewards, being *immaterial*, and so therefore unaffected by the causes which bring material things to an end, is, by its nature, fitted for eternal rewards.—This is an argument *ad ignorantiam*, and holds no farther. Because an *immaterial* being is not subject to that mode of dissolution which affects *material* substances, you conclude it to be eternal. This is going too fast. There may be, and probably are, many natural causes (unknown indeed to us), whereby immaterial beings come to an end. But if the nature of things cannot, yet God certainly can, put a final period to such a being when it hath served the purpose of its creation. Doth ANNIHILATION impeach that wisdom and goodness which was displayed when God brought it *out of nothing?* Other immaterial beings there are, *viz.* the souls of brutes, which have the same natural security with man for their existence, of whose *eternity* we never dream. But pride, as the poet observes, *calls God unjust*.

> If man alone engross not heaven's high care;
> Alone made *perfect* here, IMMORTAL there.

However, let us (for argument's sake) allow the human soul to be unperishable by nature, and secured in its existence by the unchangeable will of God, and see what will follow from thence—An *infinite* reward for virtue, during one moment of its existence, because reason discovers that, by the law of nature, *some* reward is due? By no means. When God hath amply repaid us for the performance of our duty, will he be at a loss how to dispose of us for the long remainder of *eternity?* May he not find new and endless employment for reasonable creatures, to which, when properly discharged, new rewards and in endless succession will be assigned? Modest reason seems to dictate this to the followers of the *law of nature*. The flattering expedient of ETERNAL REWARDS for virtue here was invented in the simplicity of early speculation, after it had fairly brought men to conclude that the soul is immaterial.

"Another argument urged for the eternity of the rewards held out by natural religion to the practice of piety and virtue is partly physical and partly moral. The merit of service (say the admirers of that religion) increases in proportion to the excellence of that Being to whom our service is directed and becomes acceptable. An infinite being, therefore, can dispense no rewards but what are infinite. And thus the virtuous man becomes intitled to immortality.

"The misfortune is, that this reasoning holds equally on the side of the unmerciful doctors, as they are called, who doom the wicked to EVERLASTING PUNISHMENT. Indeed were this the only discredit under which it labours, the merciless doctors would hold themselves little concerned. But the truth is, that the argument from *infinity* proves just nothing. To make it of any force, both the parties should be *infinite*. This inferior emanation of God's *image*, MAN, should either be supremely good or supremely bad, a kind of deity or a kind of devil. But these reasoners, in their attention to the *divinity*, overlook the *humanity* which makes the decrease keep pace with the accumulation, till the rule of logic, that *the conclusion follows the weaker* part, comes in to end the dispute‡.

‡ Warburton's Divine Legation, book ix.

These arguments seem to prove unanswerably that immortality is not essential to any part of the compound being man, and that it cannot be claimed as a reward due to his virtue. It is not indeed essential to any created being, for what has not existence of itself, cannot of itself have perpetuity of existence (see METAPHYSICS, n° 272, &c.); and as neither man nor angel can be profitable to God, they cannot claim from him any thing as a debt. Both, indeed, as moral agents have duties prescribed them; and while they faithfully perform these duties, they have all the security which can arise from the perfect benevolence of him who brought them into existence, that they shall enjoy a sufficient portion of happiness to make that existence preferable to non-existence; but reason and philosophy furnish no data from which it can be inferred that they shall exist for ever. Man is composed in part of perishable materials. However perfect Adam may be thought to have been when he came first from the hands of his Creator, his body, as formed of the dust of the ground, must have been naturally liable to decay and dissolution. His soul, indeed, was of a more durable substance; but as it was formed to animate his body, and had no prior conscious existence, it is not easy to conceive what should have led him, under an equal providence, where rewards and punishments were exactly distributed, to suppose that one part of him should survive the other. In his natural and original state, before the covenant made with him in paradise, he was unquestionably a mortal creature. How long he continued in that state, it seems not possible to form a plausible conjecture. Bishop Warburton supposes him to have lived several years under no other dispensation than that of natural religion; during which he was as liable to death as his fallen posterity are at present.

95 Adam before his introduction into paradise liable to death.

"We must needs conclude (says this learned writer*), that God having tried Adam in *the state of nature*, and approved of the good use he made of his free will under the direction of that light, advanced him to a superior station in *Paradise*. How long, before this remove, man had continued subject to *natural religion* alone, we can only guess: but of this we may be assured, that it was some considerable time before the garden of Eden could naturally be made fit for his reception. Since Moses, when he had concluded his history of the creation, and of God's *rest* on, and *sanctification* of, the seventh day proceeds to speak of the condition of this new world in the following terms: "*And God made every plant of the field before it was in the earth, and every herb of the field before it grew; for the Lord God had not caused it to rain upon the earth*‡." Which seems plainly to intimate, that when the seeds of vegetables had been created on the third day, they were left to nature, in its ordinary operations, to mature by sun and showers. So that when in course of time Paradise was become capable of accommodating its inhabitants, they were transplanted thither."

* Divine Legation, book ix. chap. i.

96 How long he continued in that state

‡ Gen. ii. 4, 5.

This reasoning is not without a portion of that ingenuity which was apparent in every thing that fell from the pen of Warburton; but it was completely confuted almost as soon as it was given to the public, and shown to be deduced from premises which could be employed against the author's system. If only the *seeds* of vegetables were created on the third day, and then left to nature, in its ordinary operations, to

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to mature by sun and showers, the first pair must have perished before a single vegetable could be fit to furnish them with food; and we may suppose that it was to prevent this disaster that the garden of Eden was miraculously stored at once with full grown trees and fruit in perfect maturity, whilst the rest of the earth was left under the ordinary laws of vegetation. There is, however, no evidence that they were only the *seeds* of vegetables that God created. On the contrary, Moses says expressly †, that God made the earth on the third day bring forth the herb *yielding* seed after his kind, and the tree *yielding fruit* whose seed was in itself after his kind;" and when he recapitulates the history of the creation, he says, that God made, not every seed, but every *plant* of the field *before* it was in the earth, and every *herb* of the field *before* it grew. From the process of vegetation, therefore, nothing can be inferred with respect to the time of Adam's introduction into Paradise, or to ascertain the duration of his original state of nature. If angels were created during the six days of which the Hebrew lawgiver writes the history, an hypothesis very generally received (see ANGEL), though in the opinion of the present writer not very probable, there can be no doubt but our first parents lived a considerable time under the law of nature before they were raised to a superior station in the garden of Eden; for it seems very evident that the period of their continuance *in* that station was not long. Of this, however, nothing can be said with certainty. They may have lived for years or only a few days in their original state; but it is very necessary to distinguish between that state in which they were under no other dispensation than what is commonly called *natural religion*, entitled, upon their obedience, to the indefinite rewards of piety and virtue, and their state in Paradise when they were put under a new law, and by the free grace of God promised, if they should be obedient, a supernatural and eternal reward. Into that state we must now attend them, and ascertain, if we can, the precise terms of the first covenant.

* Gen i. 12.

97 Impossible to be known.

Moses, who in this investigation is our only guide, tells us, that the Lord God, after he had formed the first pair, "planted a garden eastward in Eden, and took the man and put him into the garden to dress it and to keep it. And the Lord God (continues he) commanded the man, saying, of every tree of the garden thou mayest freely eat; but of the tree of the knowledge of good and evil thou shalt not eat of it; for in the day that thou eatest thereof, thou shalt surely die ‡." Here is no mention made of the laws of piety and moral virtue resulting from the relation in which the various individuals of the human race stand to each other, and in which all as creatures stand to God their Almighty and beneficient Creator. With these laws Adam was already well acquainted; and he must have been sensible, that as they were founded in his nature no subsequent law could dispense with their obligation. They have been equally binding upon all men in every state and under every dispensation; and they will continue to be so as long as the general practice of justice, mercy, and piety, shall contribute to the sum of human happiness. The new law peculiar to his paradisaical state was the command not to eat of the fruit of the tree of the knowledge of good and evil. This was a positive precept, not founded in the nature of man, but very proper to be the test of his obedience to the will of his Creator. The laws of piety and virtue are sanctioned by nature, or by that general system of rules according to which God governs the physical and moral worlds, and by which he has secured, in some state or other, happiness to the pious and virtuous man, and misery to such as shall prove incorrigibly wicked. The law respecting the forbidden fruit was sanctioned by the penalty of *death* denounced against disobedience; and by the subjects of that law the nature of this penalty must have been perfectly understood: but Christian divines, as we shall afterwards see, have differed widely in opinion respecting the full import of the Hebrew words which our translators have rendered by the phrase *thou shalt surely die*. All, however, agree that they threatened death, in the common acceptation of the word, or the separation of the soul and body as one part of the punishment to be incurred by eating the forbidden fruit; and hence we must infer, that had the forbidden fruit not been eaten, our first parents would never have died, because the penalty of death was denounced against no other transgression. What therefore is said respecting the fruit of the tree of knowledge, implies not only a law but also a covenant (L), promising to man, upon the observance of one positive precept, immortality or eternal life; which is not essential to the nature of any created being, and cannot be claimed as the merited reward of the greatest virtue or the most fervent piety.

‡ Gen. ii. 8, 15, 16, 17.

98 The covenant of eternal life made with Adam in paradise.

This obvious truth will enable us to dispose of the objections which have been sometimes brought by free-thinking divines against the wisdom and justice of punishing so severely as by death the breach of a mere positive precept; which, considered in itself, or as connected with the general principles of moral obligation, appears to be a precept of very little importance. We have only to reply, that as an exemption from death is not due either to the nature or to the virtue of man, it was wise and just to make it depend upon the observance of a positive precept, to impress upon the minds of our first parents a constant conviction that they were to be preserved immortal, not in the ordinary course of divine providence, but by the special grace and favour of God. The same consideration will show us the folly of those men who, because the terms of the first covenant, as stated in some systems of theology, agree not with certain philosophical maxims which they have adopted, are for turning all that is said of the trees of knowledge and of life into figure and allegory. But the other trees which Adam and Eve were permitted to eat were certainly real trees, or they must have perished for want of food. And what rules of interpretation will authorise us to interpret *eating* and *trees* literally in one part of the sentence and figuratively in the other? A garden in

(L) It does not appear that any transaction between God and mankind in general was denominated by a word equivalent to the English word *covenant* till the end of the fourth century, when such phraseology was introduced into the church by the celebrated Augustine, bishop of Hippo. That the phraseology is strictly proper, no man can suppose who reflects on the infinite distance between the contracting parties, and the absolute dominion of the one over the other. To be capable of entering into a *covenant*, in the proper sense of the word, both parties must have a right either to agree to the terms proposed or to reject them; but surely Adam had no right to bargain with his Maker, or to refuse the gift of immortality on the terms on which it was offered to him. The word *dispensation* would more accurately denote what is here meant by the word *covenant;* but as this last is in general use, we have retained it as sufficient, when thus explained, to distinguish what man received from God upon certain positive conditions, from what he had a claim to by the constitution of his nature.

in a delightful climate is the very habitation, and the fruits produced in that garden the very food, which we should naturally suppose to have been prepared for the progenitors of the human race; and though in the garden actually fitted up for this purpose two trees were remarkably distinguished from the rest, perhaps in situation and appearance as well as in use, the distinction was calculated to serve the best of purposes. The one called the *tree of life*, of which, while they continued innocent, they were permitted to eat, served as a sacramental pledge or assurance on the part of God, that as long as they should observe the terms of the covenant their life should be preserved; the other, of which it was death to taste, was admirably adapted to impress upon their minds the necessity of implicit obedience to the Divine will, in whatever manner it might be made known to them.

A question has been started, and it is of some importance, What would have finally become of men if the first covenant had not been violated? That they would have been all immortal is certain; but it is by no means certain that they would have lived for ever upon this earth. On the contrary, it has been an article of very general belief in all ages of the church *, that the garden of Eden was an emblem or type of heaven, and therefore called *Paradise* (see PARADISE); and that under the first covenant, mankind, after a sufficient probation here, were to be translated into heaven without tasting death. This doctrine is not indeed explicitly taught in scripture; but many things conspire to make it highly probable. The frequent communications between God and man before the fall (M), seem to indicate that Adam was training up for some higher state than the terrestrial paradise. Had he been intended for nothing but to cultivate the ground and propagate his species, he might have been left like other animals to the guidance of his own reason and instincts; which, after the rudiments of knowledge were communicated to him, must surely have been sufficient to direct him to every thing necessary to the comforts of a life merely sensual and rational, otherwise he would have been an imperfect animal. It is obvious too, that this earth, however fertile it may have originally been, could not have afforded the means of subsistence to a race of immortal beings multiplying to infinity. For these reasons, and others which will readily occur to the reader, it seems incontrovertible, that, under the first covenant, either mankind would have been successively translated to some superior state, or would have ceased to propagate their kind as soon as the earth should have been replenished with inhabitants. He who reflects on the promise, that, after the general resurrection, there is to be a new heaven and a new earth, will probably embrace the latter part of the alternative; but that part in its consequences differs not from the former. In the new earth promised in the Christian revelation, nothing is to dwell but righteousness. It will therefore be precisely the same with what we conceive to be expressed by the word heaven; and if under the first covenant this earth was to be converted into a similar place, where, after a certain period, men should neither marry nor be given in marriage, but enjoy what divines have called the *beatific vision*, we may confidently affirm, that, had the first covenant been faithfully observed, Adam and his posterity, after a sufficient
100 probation, would all have been translated to some superior state or heaven.

To fit them for that state, the gifts of divine grace seem to have been absolutely necessary. To them it was a state certainly supernatural, otherwise a God of infinite wisdom and perfect goodness would not, for a moment, have placed them in an inferior state. But to enable any creature, especially such a creature as man, whom an ancient philosopher has justly styled ζῶον μεθόριον, to rise above its *nature*, foreign and divine aid is unquestionably requisite: and therefore, though we cannot persuade ourselves that the gifts of the Holy Ghost constituted that image of God in which man was originally made, we agree with bishop Bull, that these gifts were bestowed upon our first parents to enable them to fulfil the terms of the covenant under which they were placed.

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Upon the whole, we think it apparent from the portions of scripture which we have examined, that Adam and Eve were endued with such powers of body and mind as fitted them to exercise dominion over the other animals; that those powers constituted that image of God in which they are said to have been formed; that they received by immediate revelation the first principles of all useful knowledge, and especially of that system which is usually called *natural religion*; that they lived for some time with no other religion, entitled to the natural rewards of piety and virtue, but all the while liable to death; that they were afterwards translated into paradise, where they were placed under a new law, with the penalty of death threatened to the breach of it, and the promise of endless life if they should faithfully observe it; and that they were endued with the gifts of the Holy Ghost, to enable them, if not wanting to themselves, to fulfil the terms of that covenant, which has been improperly termed the *covenant of works*, since it flowed from the mere grace of God, and conferred privileges on man to which the most perfect human virtue could lay no just claim.

101 It is therefore improperly called the covenant of works.

SECT. III. *Of the Fall of Adam, and its Consequences.*

FROM the preceding account of the primeval state of man, it is evident that his continuance in the terrestrial paradise, together with all the privileges which he there enjoyed, were made to depend upon his observance of one positive precept. Every other duty incumbent on him, whether as resulting from what is called the law of his nature, or from the express command of his God, was as much his duty before as after he was introduced into the garden of Eden; and though the transgression of any law would undoubtedly have been punished, or have been forgiven only in consequence of sincere repentance and amendment, it does not appear that a breach of the *moral* law, or of the command directing respecting the sanctification of the *Sabbath-day*, would have been punished with death, whatever may be the import of that word in the place where it is first threatened. The punishment was denounced only against eating the fruit of the tree of the knowledge of good and evil: For "the Lord God commanded the man, saying, of every tree of the garden thou mayest freely eat, but of the tree of the knowledge of good and evil thou shalt not eat of it; for in the day that thou eatest thereof thou shalt surely die." To the word *death* in this passage divines have affixed many and different meanings. By some it is supposed to import a separation of the soul and body, while the latter was to continue in a state of conscious existence; by others, it is taken to imply annihilation or a state without consciousness; by some, it is imagined to signify eternal life in torments; and by others a spiritual and moral death, or a state necessarily subject to sin.

102 As it could be violated only by disobedience to one positive command.

(M) That there were such frequent communications, has been shown to be in the highest degree probable by the late Dr Law bishop of Carlisle. See his *Discourse on the several Dispensations of revealed Religion*.

In any one of these acceptations it denoted something new to Adam, which he could not understand without an explanation of the term; and therefore, as it was threatened as the punishment of only one transgression, it would not be the divine intention to inflict it upon any other.

The abstaining from a particular fruit in the midst of a garden abounding with fruits of all kinds, was a precept which at first view appears of easy observation; and the penalty threatened against the breach of it was, in every sense, awful. The precept, however, was broken notwithstanding that penalty; and though we may thence infer that our first parents were not beings of such absolute perfection as by system-building divines they have sometimes been represented, we shall yet find, upon due consideration, that the temptation by which they were seduced, when taken with all its circumstances, was such as no wise and modest man will think himself able to have resisted. The short history of this important transaction, as we have it in the third chapter of the book of Genesis, is as follows.

"Now the serpent was more subtile than any beast of the field which the Lord God had made; and he said unto the woman, Yea, hath God said, ye shall not eat of every tree of the garden? And the woman said unto the serpent, We may eat of the fruit of the trees of the garden; but of the fruit of the tree which is in the midst of the garden, God hath said ye shall not eat of it, neither shall ye touch it, lest ye die. And the serpent said unto the woman, ye shall not surely die: For God doth know, that on the day ye eat thereof, then your eyes shall be opened, and ye shall be as gods, knowing good and evil. And when the woman *saw* that the tree was good for food, and that it was pleasant to the eyes, and a tree to be desired to make one wise, she took of the fruit thereof, and did eat, and gave also unto her husband with her, and he did eat."

104 In consequence of a most artful temptation,

To the less attentive reader this conversation between the serpent and the woman must appear to begin abruptly; and indeed it is not possible to reconcile it with the natural order of a dialogue, or even with the common rules of grammar, but by supposing the tempter's question, "Yea, hath God said, ye shall not eat of every tree of the garden?" to have been suggested by something immediately preceding either in words or in significant signs. Eve had undoubtedly by some means or other informed the serpent that she was forbidden to eat of the fruit upon which he was probably feasting; and that information, whether given in words or in actions, must have produced the question with which the sacred historian begins his relation of this fatal dialogue. We are told that the woman *saw* that the tree was *good for food*; that it was pleasant to the eyes, and a tree to be *desired to make one wise*; but all this she could not have *seen*, had not the serpent eaten of its fruit in her presence. In her walks through the garden, it might have often appeared pleasant to her eyes; but previous to experience she could not know but that its fruit was the most deadly poison, far less could she conceive it capable of conferring wisdom. But if the serpent eat of it before her, and then extolled its virtues in rapturous and intelligible language, she would at once see that it was not destructive of animal life, and naturally infer that it had very singular qualities. At the moment she was drawing this inference, it is probable that he invited her to partake of the delicious fruit, and that her refusal produced the conference before us. That she yielded to the temptation need excite no wonder; for she knew that the serpent was by nature a mute animal, and if he attributed his speech to the virtues of the tree, she might infer, with some plausibility, that what had power to raise the brute mind to human, might raise the human to divine, and make her and her husband, according to the promise of the tempter, become as gods, knowing good and evil. Milton, who was an eminent divine as well as the prince of poets, makes her reason thus with herself.

> Great are thy virtues, doubtless, best of fruits,
> Tho' kept from man, and worthy to be admir'd;
> Whose taste, too long forborne, at first essay
> Gave elocution to the mute, and taught
> The tongue not made for speech to speak thy praise.
> * * * * *
> ——— For us alone
> Was death invented? or to us denied
> This intellectual food, for beasts reserved?
> For beasts it seems: yet that one beast which first
> Hath tasted, envies not, but brings with joy
> The good befallen him, author unsuspect,
> Friendly to man, far from deceit or guile.
> What fear I then, rather what know to fear
> Under this ignorance of good and evil,
> Of God or death, of law or penalty?
> Here grows the cure of all, this fruit divine,
> Fair to the eye, inviting to the taste,
> Of virtue to make wise: what hinders then
> To reach, and feed at once both body and mind?
>
> *Paradise Lost*, book ix.

Full of these hopes of raising herself to divinity, and not, as has sometimes been supposed, led headlong by a sensual appetite, she took of the fruit and did eat, and gave to her husband with her, and he did eat. The great poet makes Adam delude himself with the same sophistry that had deluded Eve, and infer, that as the serpent had attained the language and reasoning powers of man, they should attain

> Proportional ascent, which could not be
> But to be gods, or angels, demi-gods.

105 Adam and Eve turned out of paradise.

Thus was the covenant, which, on the introduction of our first parents into paradise, their Creator was graciously pleased to make with them, broken by their violation of the condition on which they were advanced to that supernatural state; and therefore the historian tells us, that "lest they should put forth their hand and take also of the tree of life and eat, and live for ever, the Lord God sent them forth from the garden of Eden to till the ground from whence they were taken (N)." Had they been so sent forth without any farther intimation respecting their present condition or their future prospects, and if the death under which they had fallen was only a loss of consciousness, they would have been in precisely the same state in which they lived before they were placed in the garden of Eden; only their minds must now have been burdened with the inward sense of guilt, and they must have *known* themselves to be subject to death; of which, though not exempted from it by nature, they had probably *no apprehension* till it was revealed to them in the covenant of life which they had so wantonly broken.

God, however, did not send them forth thus hopeless and forlorn from the paradise of delights which they had so recently

(N) The ideas which this language conveys are indeed *allegorical*; but they inform us of this, and nothing but this, that *immortal life was a thing extraneous to our nature*, and not put into our paste or composition when first fashioned by the forming hand of the Creator." *Warburton's Divine Legation*, book ix. Chap. 1.

cently forfeited. He determined to puniſh them for their tranſgreſſion, and at the ſame time to give them an opportunity of recovering more than their loſt inheritance. Calling therefore the various offenders before him, and inquiring into their different degrees of guilt, he began with pronouncing judgment on the ſerpent in terms which implied that there was mercy for man. "And the Lord God ſaid unto the ſerpent, Becauſe thou haſt done this, thou art curſed above all cattle, and above every beaſt of the field: upon thy belly ſhalt thou go, and duſt ſhalt thou eat all the days of thy life; and I will put enmity between thee and the woman, and between thy ſeed and her ſeed: it ſhall bruiſe thy head, and thou ſhalt bruiſe his heel."

That this ſentence has been fully inflicted on the ſerpent, no reaſoning can be neceſſary to evince. Every ſpecies of that reptile is more hateful to man than any other terreſtrial creature; and there is literally a perpetual war between them and the human race. It is remarkable too that the *head* of this animal is the only part which it is ſafe to bruiſe. His tail may be bruiſed, or even cut off, and he will turn with fury and death on his adverſary: but the ſlighteſt ſtroke on the head infallibly kills him. That the ſerpent, or at leaſt the greater part of ſerpents, go on their belly, every one knows; though it is ſaid *, that in ſome parts of the eaſt ſerpents have been ſeen with wings, and others with feet, and that theſe ſpecies are highly beautiful. If there be any truth in this ſtory, we may ſuppoſe that theſe walking and flying ſerpents have been ſuffered to retain their original elegance, that mankind might ſee what the whole genus was before the curſe was denounced on the tempter of Eve: but it is certain that moſt of the ſpecies have neither wings nor feet, and that many of the moſt poiſonous of them live in burning deſerts, where they have nothing to eat but the duſt among which they crawl ‖.

To this degradation of the ſerpent, infidels have objected, that it implies the puniſhment of an animal which was incapable of guilt; but this objection is founded in thoughtleſſneſs and ignorance. The elegant form of any ſpecies of inferior animals adds nothing to the happineſs of the animals themſelves: the aſs is probably as happy as the horſe, and the ſerpent that crawls as he that flies. Fine proportions attract indeed the notice of man, and tend to impreſs upon his mind juſt notions of the wiſdom and goodneſs of the Creator; but ſurely the ſymmetry of the horſe or the beauty of the peacock is more properly diſplayed for this purpoſe than the elegance of the inſtrument employed by the enemy of mankind. The degradation of the ſerpent in the preſence of our firſt parents muſt have ſerved the beſt of purpoſes. If they had ſo little reflection as not yet to have diſcovered that he was only the inſtrument with which a more powerful Being had wrought their ruin, they would be convinced, by the execution of this ſentence, that the forbidden fruit had no power in itſelf to improve the nature either of man or of beaſt. But it is impoſſible that they could be ſo ſtupid as this objection ſuppoſes them. They doubtleſs knew by this time that ſome great and wicked ſpirit had actuated the organs of the ſerpent; and that when enmity was promiſed to be put between its ſeed and the ſeed of the woman, that promiſe was not meant to be fulfilled by ſerpents occaſionally biting the heels of men, and by men in return bruiſing the heads of ſerpents! If ſuch enmity, though it has literally taken place, was all that was meant by this prediction, why was not Adam directed to bruiſe the head of the identical ſerpent which had ſeduced his wife? If he could derive any conſolation from the exerciſe of revenge, ſurely it would be greater from his revenging himſelf on his own enemy, than from the knowledge that there ſhould be a perpetual warfare between his deſcendants and the breed of ſerpents through all generations.

Fall of Adam, and its conſequences.

We are told, that when the foundations of the earth were laid, the morning ſtars ſang together, and all the ſons of God ſhouted for joy; and it is at leaſt probable that there would be ſimilar rejoicing when the ſix days work of creation was finiſhed. If ſo, Adam and Eve, who were but a little lower than the angels, might be admitted into the chorus, and thus be made acquainted with the exiſtence of good and evil ſpirits. At all events, we cannot doubt but their gracious and merciful Creator would inform them that they had a powerful enemy; that he was a rebellious angel capable of deceiving them in many ways; and that they ought therefore to be conſtantly on their guard againſt his wiles. They muſt have known too that they were themſelves animated by ſomething different from matter; and when they found they were deceived by the ſerpent, they might ſurely, without any remarkable ſtretch of ſagacity, infer that their malignant enemy had actuated the organs of that creature in a manner ſomewhat ſimilar to that in which their own ſouls actuated their own bodies. If this be admitted, the degradation of the ſerpent would convince them of the weakneſs of the tempter when compared with their Creator; and confirm their hopes, that ſince he was not able to preſerve unhurt his own inſtrument of miſchief, he ſhould not be able finally to prevail againſt them; but that though he had bruiſed their heels, the promiſed ſeed of the woman ſhould at laſt bruiſe his head, and recover the inheritance which they had loſt. See PROPHECY, n° 9, 10.

107
Sentence paſſed on Adam and Eve.

Having thus puniſhed the original inſtigator to evil, the Almighty Judge turned to the fallen pair, and ſaid to the woman, "I will greatly multiply thy ſorrow and thy conception: in ſorrow ſhalt thou bring forth children; and thy deſire ſhall be to thy huſband, and he ſhall rule over thee. And unto Adam he ſaid, Becauſe thou haſt hearkened unto the voice of thy wife, and haſt eaten of the tree of which I commanded thee, ſaying, Thou ſhalt not eat of it; curſed is the ground for thy ſake; in ſorrow ſhalt thou eat of it all the days of thy life. Thorns alſo and thiſtles ſhall it bring forth unto thee, and thou ſhalt eat the herb of the field. In the ſweat of thy face ſhalt thou eat bread till thou return unto the ground; for out of it waſt thou taken: for duſt thou art, and unto duſt ſhalt thou return."

Here is a terrible denunciation of toil and miſery and death upon two creatures; who, being inured to nothing, and formed for nothing but happineſs, muſt have felt infinitely more horror from ſuch a ſentence, than we, who are familiar with death, intimate with miſery, and "born to ſorrow as the ſparks fly upward," can form any adequate conception of. The hardſhip of it, too, ſeems to be aggravated by its being ſeverer than what was originally threatened againſt the breach of the covenant of life. It was indeed ſaid, "In the day thou eateſt thereof, thou ſhalt ſurely die:" but no mention was made of the woman's incurring ſorrow in conception, and in the bringing forth of children; of the curſe to be inflicted on the ground; of its bringing forth thorns and thiſtles inſtead of food for the uſe of man; and of Adam's eating bread in ſorrow and the ſweat of his face till he ſhould return to the duſt from which he was taken.

109
An obſcure intimation given them of deliverance from it.

Theſe ſeeming aggravations, however, are in reality inſtances of divine benevolence. Adam and Eve were now ſubjected to death; but in the ſentence paſſed on the ſerpent, an obſcure intimation had been given them that they were not to remain for ever under its power. It was therefore their intereſt, as well as their duty, to reconcile themſelves as much as poſſible to their fate; to wean their affections from this world, in which they were to live only for a

4 time;

Fall of Adam and its conſequences.

time; and to hope, with humble confidence, in the promiſe of their God, that, upon their departure from it, they ſhould be received into ſome better ſtate. To enable them to wean their affections from earth, nothing could more contribute than to combine ſenſual enjoyment with ſorrow, and lay them under the neceſſity of procuring their means of ſubſiſtence by labour, hard and often fruitleſs. This would daily and hourly impreſs upon their minds a full conviction that the preſent world is not a place fit to be an everlaſting habitation; and they would look forward, with pious reſignation, to death, as putting a period to all their woes. Had they indeed been furniſhed with no ground of hope beyond the grave, we cannot believe that the Righteous Judge of all the earth would have added to the penalty originally threatened. That penalty they would doubtleſs have incurred the very day on which they fell; but as they were promiſed a deliverance from the conſequences of their fall, it was proper to train them up by ſevere diſcipline for the happineſs reſerved for them in a future ſtate.

After the paſſing of their ſentence, the man and woman were turned out into the world, where they had formerly lived before they were placed in the garden of Eden; and all future acceſs to the garden was for ever denied them. They were not, however, in the ſame ſtate in which they were originally before their introduction into Paradiſe: They were now conſcious of guilt; doomed to ſevere labour; liable to ſorrow and ſickneſs, diſeaſe and death: and all theſe miſeries they had brought, not only upon themſelves, but alſo, as we learn from different paſſages of the New Teſtament, upon their unborn poſterity to the end of time. It may ſeem indeed to militate againſt the moral attributes of God, to inflict miſery upon children for the ſins of their parents; but before any thing can be pronounced concerning the Divine goodneſs and juſtice in the preſent caſe, we muſt know preciſely how much we ſuffer in conſequence of Adam's tranſgreſſion, and whether we have ourſelves any ſhare in that guilt which is the cauſe of our ſufferings.

109
Doubtful whether men would have been exempted from pain under the firſt covenant,

That women would have had leſs ſorrow in conception and in the bringing forth of children; that we ſhould have been ſubjected to leſs toil and exempted from death, had our firſt parents not fallen from their paradiſaical ſtate—are truths incontrovertible by him who believes the inſpiration of the Holy Scriptures; but that mankind would in that ſtate have been wholly free from pain and every bodily diſtreſs, is a propoſition which is not to be found in the Bible, and which therefore no man is bound to believe. The bodies of Adam and Eve conſiſted of fleſh, blood, and bones, as ours do; they were ſurrounded by material objects as we are; and their limbs were unqueſtionably capable of being fractured. That their ſouls ſhould never be ſeparated from their bodies while they abſtained from the forbidden fruit, they knew from the infallible promiſe of him who formed them, and breathed into their noſtrils the breath of life; but that not a bone of themſelves or of their numerous poſterity ſhould ever be broken by the fall of a ſtone or of a tree, they were not told, and had no reaſon to expect. Of ſuch fractures, pain would ſurely have been the conſequence; though we have reaſon to believe that it would have been quickly removed by ſome infallible remedy, probably by the fruit of the tree of life.

Perhaps it may be ſaid, that if we ſuppoſe our firſt parents or their children to have been liable to accidents of this kind in the garden of Eden, it will be difficult to conceive how they could have been preſerved from death, as a ſtone might have fallen on their heads as well as on their feet, and have at once deſtroyed the principle of vitality. But this can be ſaid only by him who knows little of the phyſical world, and ſtill leſs of the power of God. There are many animals which are ſuſceptible of pain, and yet not eaſily killed; and man in paradiſe might have reſembled theſe. At any rate, we are ſure that the Omnipotent Creator could and would have preſerved him from death; but we have no reaſon to believe that, by a conſtant miracle, he would have preſerved him from every kind of pain. Indeed, if, under the firſt covenant, mankind were in a ſtate of probation, it is certainly conceivable that ſome one individual of the numerous race might have fallen into ſin, without actually breaking the covenant by eating the fruit of the tree of knowledge; and ſuch a ſinner would undoubtedly have been puniſhed by that God who is of purer eyes than to behold iniquity: but how puniſhment could have been inflicted on a being exempted from all poſſibility of pain as well as of death we confeſs ourſelves unable to imagine. Remorſe, which is the inſeparable conſequence of guilt, and conſtitutes in our preſent ſtate great part of its puniſhment, flows from the fearful looking for of judgment, which the ſinner knows ſhall, in a future ſtate, devour the adverſaries of the goſpel of Chriſt; but he, who could neither ſuffer pain nor death, had no cauſe to be afraid of future judgement, and was therefore not liable to the tortures of remorſe. We conclude, therefore, that it is a miſtake to ſuppoſe pain to have been introduced into the world by the fall of our firſt parents, or at leaſt that the opinion contrary to ours has no foundation in the word of God.

110
Though they were from death.

Death, however, was certainly introduced by their fall; for the inſpired apoſtle aſſures us, that in *Adam all die* *; and again, that *through the offence of* ONE *many are dead* †. But concerning the full import of the word *death* in this place, and in the ſentence pronounced upon our firſt parents, divines hold opinions extremely different. Many contend, that it includes death *corporal*, *ſpiritual*, or *moral* and *eternal*; and that all mankind are ſubjected to theſe three kinds of death, on account of their ſhare in the guilt of the original tranſgreſſion, which is uſually denominated *original ſin*, and conſidered as the ſource of all moral evil.

* 1 Cor. xv. 22.
† Rom. v. 15.

That all men are ſubjected to death corporal in conſequence of Adam's tranſgreſſion, is univerſally admitted; but that they are in any ſenſe partakers of his guilt, and on that account ſubjected to death ſpiritual and eternal, has been very ſtrenuouſly denied. To diſcover the truth is of great importance; for it is intimately connected with the Chriſtian doctrine of redemption. We ſhall therefore ſtate, with as much impartiality as we can, the arguments commonly urged on each ſide of this much agitated queſtion: but ſhould the reader perceive, as very probably he may, that we lean more to the one ſide than to the other, he will do well to ſhut our book, and, diſregarding all artificial ſyſtems, ſtudy, with an unbiaſſed mind, the writings only of the prophets and apoſtles.

111
Doctrine of original ſin ſtated.

Thoſe who maintain that all men ſinned in Adam, generally ſtate their doctrine thus: "The covenant being made with Adam as a public perſon, not for himſelf only but for his poſterity, all mankind deſcending from him by ordinary generation *ſinned* in him and fell with him in that firſt tranſgreſſion; whereby they are deprived of that original righteouſneſs in which he was created, and are utterly indiſpoſed, diſabled, and made oppoſite to all that is ſpiritually good, and wholly inclined to all evil, and that continually; which is commonly called *original ſin*, and from which do proceed all actual tranſgreſſions, ſo as we are by nature children of wrath, bond-ſlaves to Satan, and juſtly liable to all puniſhments in this world and in that which is to come, even to everlaſting ſeparation from the comfortable preſence of God, and to moſt grievous torments in ſoul and body, without intermiſſion, in hell fire for ever."

That which in this paſſage we are firſt to examine is the ſentence

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sentence which affirms all mankind descending from Adam by ordinary generation to have *sinned* in him and fallen with him in his first transgression; the truth of which is attempted to be proved by various texts of Holy Scripture. Thus St Paul says expressly, that "by one man sin entered into the world, and death by sin; and so death passed upon all men, for that *all have sinned*. But not as the offence,

112 Arguments for it

so also is the free gift. For if, through the *offence* of *one*, *many* be *dead*; much more the grace of God, and the gift by grace, which is by one man, Jesus Christ, hath abounded unto many; and not as it was by one that sinned, so is the gift (for the *judgment* was by *one* unto *condemnation*); but the free gift is of many offences unto justification. For if, by one man's offence, death reigned by one; much more they, who receive the abundance of grace and of the gift of righteousness, shall reign in life by one, Jesus Christ. Therefore as, by the *offence of one*, *judgment* came upon *all men* to *condemnation*; even so, by the righteousness of One, the free gift came upon all men unto justification of life. For as by one man's disobedience *many were made sinners*; so by the obedience of one shall many be made righteous ‡." (Rom. v. 12, 15—20.) In this passage the apostle assures us, that all upon whom death hath passed have *sinned*; but death hath passed upon infants, who could not commit actual sin. Infants therefore must have sinned in Adam, since death hath passed upon them; for death "is the wages only of sin." He tells us likewise, that by the offence of one, judgment came upon all men to condemnation; and therefore, since the Righteous Judge of heaven and earth never condemns the innocent with the wicked, we must conclude, that all men partake of the guilt of that offence for which judgment came upon them to condemnation. These conclusions are confirmed by his saying expressly, that "by one man's disobedience many (*i. e.* all mankind) were *made sinners*;" and elsewhere*, that "there is none righteous, no *not one*;" and that his Ephesian converts "were dead in trespasses and sins, and were by *nature* children of wrath even as *others*." (Rom. iii. 10. and Eph. ii. 1. and 3.) The same doctrine, it is said, we are taught by the inspired writers of the Old Testament. Thus Job, expostulating with God for bringing into judgment with him such a creature as man, says, "Who can bring a clean thing out of an unclean? Not one." And Eliphaz, reproving the patient patriarch for what he deemed presumption, asks ‡, "What is man that he should be clean, or he who is born of a woman that he should be righteous?" (Job xiv. 4. and xv. 14.) From these two passages it is plain, that Job and his unfeeling friend, though they agreed in little else, admitted as a truth unquestionable, that man inherits from his parents a sinful nature, and that it is impossible for any thing born of a woman by ordinary generation to be righteous. The Psalmist talks the very same language; when acknowledging his transgressions, he says §, "Behold I was shapen in iniquity, and in sin did my mother conceive me." (Psalm li. 5.)

113 Adam's guilt imputed to his posterity.

Having thus proved the fact, that all men are made sinners by Adam's disobedience, the divines, who embrace this side of the question, proceed to inquire how they can be partakers in guilt which was incurred so many ages before they were born. It cannot be by imitation; for infants, according to them, are involved in this guilt before they be capable of imitating any thing. Neither do they admit that sin is by the apostle put for the consequences of sin, and many said to be made sinners by one man's disobedience, because by that disobedience they were subjected to death, which is the wages of sin. This, which they call the doctrine of the Arminians, they affirm to be contrary to the whole scope and design of the context; as it confounds together sin and death, which are there represented, the one as the cause, and the other as the effect. It likewise exhibits the apostle reasoning in such a manner as would, in their opinion, disgrace any man of common sense, and much more an inspired writer; for then the sense of these words, "Death hath passed upon all men, for that all have sinned," must be, death hath passed upon all men, because it hath passed upon all men; or, all men are obnoxious to death, because they are obnoxious to it. The only way therefore, continue they, in which Adam's posterity can be made sinners through his disobedience, is by the IMPUTATION of his disobedience to them; and this imputation is not to be considered in a *moral* sense, as the action of a man committed by himself, whether good or bad, is reckoned unto him as his own; but in a *forensic* sense, as when one man's debts are in a legal way placed to the account of another. Of this we have an instance in the apostle Paul, who said to Philemon concerning Onesimus, "If he hath wronged thee, or oweth thee any thing (ἐλλόγει), let it be imputed to me," or placed to and put on my account. And thus the posterity of Adam are made sinners by his disobedience; that being imputed to them and put to their account, as if it had been committed by them personally, though it was not.

Some few divines of this school are indeed of opinion, that the phrase, "By one man's disobedience many were made sinners," means nothing more than that the posterity of Adam, through his sin, derive from him a corrupt nature. But though this be admitted as an undoubted truth, the more zealous abettors of the system contend, that it is not the whole truth. "It is true (say they) that all men are made of one man's blood, and that blood tainted with sin; and so a clean thing cannot be brought out of an unclean. What is born of the flesh is flesh, carnal and corrupt: every man is conceived in sin and shapen in iniquity; but then there is a difference between being *made sinners* and *becoming* sinful. The one respects the *guilt*, the other the *pollution* of nature; the one is previous to the other, and the foundation of it. Men receive a corrupt nature from their immediate parents; but they are made sinners, not by any act of their disobedience, but only by the imputation of the sin of Adam."

To confirm and illustrate this doctrine of imputed sin, they observe, that the word κατεστάθησαν, used by the apostle, signifies *constituted* in a judicial way, ordained and appointed in the dispensation of things that so it should be, just as Christ was made sin or a sinner by imputation, or by that constitution of God which laid upon him the sins of all his people, and dealt with him as if he had been the guilty person. That this is the sense of the passage, they argue further from the punishment inflicted on men for the sin of Adam. The punishment threatened to that sin was death;

114 The punishment of imputed guilt.

which includes death corporal, moral, and eternal. Corporal death, say they, is allowed by all to be suffered on account of the sin of Adam; and if so, there must be guilt, and that guilt made over to the sufferer, which can be done only by *imputation*. A moral death is no other than the loss of the image of God in man, which consisted in righteousness and holiness; and particularly it is the loss of original righteousness, to which succeeded unrighteousness and unholiness. It is both a sin and a punishment for sin; and since it comes upon all men as a punishment, it must suppose a preceding sin, which can be nothing but Adam's disobedience; the guilt of which is made over to his posterity by *imputation*. This appears still more evident from the posterity of Adam being made liable to eternal death in consequence of his transgression; for the wages of sin, we are assured, is death, even death eternal, which never can be inflicted on guiltless persons. But from the passage before us we learn, that "by the offence of one judgment came upon all

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all men to condemnation ;" and therefore the guilt of that offence must be reckoned to all men, or they could not be justly condemned for it. That Adam's sin is imputed to his posterity, appears not only from the words, "by one man's disobedience many were made sinners ;" but likewise from the opposite clause, "so by the obedience of One shall many be made righteous ;" for the many ordained to eternal life, for whom Christ died, are made righteous, or justified, only through the imputation of his righteousness to them; and therefore it follows, that all men are made sinners only through the imputation of Adam's disobedience.

To this doctrine it is said to be no objection that Adam's posterity were not in being when his sin was committed ; for though they had not then actual being, they had yet a virtual and representative one. They were in him both *seminally* and *federally*, and sinned in him * ; just as Levi was in the loins of Abraham, and paid in him tithes to Melchizedeck †. From Adam, as their common parent, they derive a corrupt nature ; but it is only from him, as their federal head, that they derive a share of his guilt, and are subjected to his punishment. That he was a federal head to all his posterity, the divines of this school think evident from his being called a figure of Christ ‡ ; and the first Adam described as natural and earthly, in contradistinction to Christ the second Adam described as spiritual and the Lord from heaven ; and from the punishment threatened against his sin being inflicted not on himself only, but on all his succeeding offspring. He could not be a figure of Christ, say they, merely as a man ; for all the sons of Adam have been men as well as he, and in that sense were as much figures of Christ as he ; yet Adam and Christ are constantly contrasted, as though they had been the only two men that ever existed, because they were the only two heads of their respective offspring. He could not be a figure of Christ on account of his extraordinary production ; for though both were produced in ways uncommon, yet each was brought into the world in a way peculiar to himself. The first Adam was formed of the dust of the ground ; the second, though not begotten by a man, was born of a woman. They did not therefore resemble each other in the manner of their formation, but in their office as covenant-heads ; and in that alone the comparison between them is exact.

115 Adam a federal head to his posterity.

* Rom. v. 12.

† Heb. vii. 9, 10.

‡ Rom. v. 14.

116 No cause of complaint in this constitution of things.

Nor have any of the posterity of Adam, it is said, reason to complain of such a procedure. Had he stood in his integrity, they would have been, by his standing, partakers of all his happiness ; and therefore should not murmur at receiving evil through his fall. If this do not satisfy, let it be considered, that since God, in his infinite wisdom, thought proper that men should have a head and representative, in whose hands their good and happiness should be placed, none could be so fit for this high station as the common parent, made after the image of God, so wise, so holy, just, and good. Lastly, to silence all objections, let it be remembered, that what God gave to Adam as a federal head, relating to himself and his posterity, he gave as the Sovereign of the universe, to whom no created being has a right to ask, "What dost thou * ?"

* See Gill's Body of Divinity.

117 St Augustine the author of this doctrine.

Such are the consequences of Adam's fall, and such the doctrine of original sin, as maintained by the more rigid followers of Calvin. That great reformer, however, was not the author of this doctrine. It had been taught, so early as in the beginning of the fifth century, by St Augustine, the celebrated bishop of Hippo (see AUGUSTINE); and the authority of that father had made it more or less prevalent in both the Greek and Roman churches long before the Reformation. Calvin was indeed the most eminent modern divine by whom it has been held in all its rigour ; and it constitutes one great part of that theological system which, from being taught by him, is now known by the name of *Calvinism*. Those by whom it is embraced maintain it with zeal, as, in their opinion, forming, together with the other tenets of their master, the only pure system of evangelical truths ; but it hath met with much opposition in some of the Lutheran churches, as well as from private divines in the church of England, and from the great body of Dutch remonstrants (see CALVINISM, ARMINIANS, and SYNOD OF DORT) ; and of their objections it is now our duty to give a candid view, as well as of the doctrine which they substitute in its stead.

118 Objections to it.

They begin then with alleging, that if it was as sovereign of the universe that God gave to Adam what he received in paradise relating to himself and his posterity, Adam could in no sense of the words be a federal head ; because, upon this supposition, there was no covenant. The Sovereign of the Universe may unquestionably dispense his benefits, or withhold them, as seems expedient to his infinite wisdom ; and none of his subjects or creatures can have a right to say to him, What dost thou ? But the dispensing or withholding of benefits is a transaction very different from the entering into covenants ; and a judgment is to be formed of it upon very different principles. Every thing around us proclaims that the Sovereign of the Universe is a being of perfect benevolence ; but, say the disciples of the school now under consideration, the dispensation given to Adam in paradise was so far from being the offspring of benevolence, that, as it is understood by the followers of Calvin, it cannot possibly be reconciled with the eternal laws of equity. The self-existent and all-sufficient God might or might not have created such a being as man ; and in either case there would have been no reason for the question "What dost thou ?" But as soon as he determined to create him capable of happiness or misery, he would not have been either benevolent or just, if he had not placed him in a state where, by his own exertions, he might, if he chose, have a greater share of happiness than of misery, and find his existence, upon the whole, a blessing. They readily acknowledge, that the existence of any created being may be of longer or shorter duration, according to the good pleasure of the Creator ; and therefore they have no objection to the apostolic doctrine, that "in Adam all die :" for immortality being not a debt, but a *free gift*, may be bestowed upon any terms whatever, and with perfect justice withdrawn when these terms are not complied with. Between death, however, as it implies a loss of consciousness, and the extreme misery of eternal life in torments, there is an immense difference. To death all mankind might justly be subjected through the offence of one ; because they had originally no claim of right to be exempted from it, though that one and they too had remained for ever innocent : but eternal life in torments is a punishment which a God of justice and benevolence can never inflict but upon personal guilt of the deepest die. That we can personally have incurred guilt from a crime committed some thousands of years before we were born, is impossible. It is indeed a notion, if such a notion can be formed, as contrary to Scripture as to reason and common sense : for the apostle expressly informs us *, "that sin is the transgression of some law ;" and the sin of Adam was the transgression of a law which it was never in our power either to observe or to break. Another apostle † assures us, that "where no law is, there is no transgression ;" but there is now no law, nor has been any these 5000 years, forbidding mankind to eat of a particular fruit; for, according to the Calvinists themselves ‡, Adam had no sooner committed his first sin, by which the covenant with him was broken, than he ceased to be a covenant-head. The law given

119 As inconsistent with the justice of God.

* 1 John iii. 4.

† Rom. iv. 15.

‡ Gill's Body of Divinity, book iii. ch. 10.

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given him was no more; the promise of life by it ceased; and its sanction, death, took place. But if this be so, how is it possible that his unborn posterity should be under a law which had no existence, or that they should be in a worse state in consequence of the covenant being broken, and its promise having ceased, than he himself was before the covenant was first made? He was originally a mortal being, and was promised the supernatural gift of immortality on the single condition of his abstaining from the fruit of the tree of knowledge of good and evil. From that fruit he did not abstain; but by eating it fell back into his natural state of mortality. Thus far it is admitted that his posterity fell with him; for they have no claim to a supernatural gift which he had forfeited by his transgression. But we cannot admit, say the divines of this school, that they fell into his guilt; for to render it possible for a man to incur guilt by the transgression of a law, it is necessary not only that he have it in his power to keep the law, but also that he be capable of transgressing it by a *voluntary* deed. But surely no man could be capable of voluntarily eating the forbidden fruit 5000 years before he himself or his volitions existed. The followers of Calvin think it a sufficient objection to the doctrine of transubstantiation, that the same numerical body cannot be in different places at the same instant of time. But this ubiquity of body, say the remonstrants, is not more palpably absurd, than the supposition that a man could exert volitions before he or his will had any existence. If indeed there be any difference between the two cases, it is in favour of the Catholic doctrine of the real presence; for we are by no means so intimately acquainted with the internal substance of body, and what can be predicated of it, as we are with the nature of guilt and the exercise of volition. These we know thoroughly as they really are in themselves; the former only relatively as it is seen in its qualities.

120
The scripture, and the nature of things.

121
The word IMPUTATION removes no difficulties.

Nor will the introduction of the word *imputation* into this important question remove a single difficulty. For what is it that we mean by saying that the sin of Adam is imputed to his posterity? Is the guilt of that sin transferred from him to them? So surely thought Dr Gill, when he said that it *is made over to them*. But this is the same absurdity as the making over of the sensible qualities of bread and wine to the internal substance of our Saviour's body and blood! This imputation either found the posterity of Adam guilty of his sin, or it made them so. It could not find them guilty for the reason already assigned; as well as because the apostle says expresly, that for the offence of *one* judgment came upon *all* men, which would not be true had *all* offended. It could not make them guilty; for this reason, that if there be in physics or metaphysics a single truth self-evident, it is, that the numerical powers, actions, or qualities, of one being cannot possibly be transferred to another, and be made its powers, actions, or qualities Different beings may in distant ages have qualities of the same kind; but as easily may 4 and 3 be made equal to 9, as two beings be made to have the same identical quality. In Scripture we nowhere read of the actions of one man being imputed to another. "Abraham (we are told) believed in God, and it was counted to him for righteousness;" but it was his *own* faith, and not the faith of another man, that was so counted. "To him that worketh not, but believeth, his faith (not another's) is imputed for righteousness." And of our faith in him that raised Christ from the dead, it is said, that "it shall be imputed, not to our fathers or our children, but to us for righteousness."

122
Meaning of that word in scripture

When this phrase is used with a negative, not only is the man's own personal sin spoken of, but the non-imputation of that sin means nothing more but that it brings not upon the sinner condign punishment. Thus when Shemei "said unto David, Let not my lord *impute* iniquity unto me," it could not be his meaning that the king should not think that he had offended; for with the same breath he added, "Neither do thou remember that which thy servant *did perversely*, the day that my lord the king went out of Jerusalem, that the king should take it to his *heart*. For thy servant doth *know* that *I have sinned*." Here he plainly confesses his sin, and declares, that by intreating the king not to *impute it to him*, he wished only that it should not be so remembered as that the king should take it to heart, and punish him as his perverseness deserved. When therefore it is said *, that "God was in Christ reconciling the world to himself, not imputing to them their iniquities, the meaning is only that for Christ's sake he was pleased to exempt them from the punishment due to their sins. In like manner, when the prophet, foretelling the sufferings of the Messiah, says, that "the Lord laid on him the iniquity of us all," his meaning cannot be, that the Lord by *imputation* made his immaculate Son guilty of all the sins that men have ever committed; for in that case it would not be true that the "just suffered for the unjust," as the apostle expresly teaches §: but the sense of the verse must be as Bishop Coverdale translated it, "through him the Lord pardoneth all our sins." This interpretation is countenanced by the ancient version of the Seventy, καὶ Κύριος παρέδωκεν αὐτὸν ταῖς ἁμαρτίαις ἡμῶν; words which express a notion very different from that of imputed guilt. The Messiah was, without a breach of justice, delivered for sins of which he had voluntarily offered to pay the penalty; and St Paul might have been justly charged by Philemon with the debts of Onesimus, which he had desired might be placed to his account. Had the apostle, however, expressed no such desire, surely Philemon could by no deed of his have made him liable for debts contracted by another; far less could he by *imputation*, whatever that word may mean, have made him virtually concur in the contracting of those debts. Just so it seems to be with respect to the sufferings of Christ for the sins of men: He could not have been justly subjected to suffering without his own consent; and he could not possibly have been made guilty of the sins of those for whom he suffered.

[illegible]

* 2 Cor v. 19.

§ 1 Peter iii. 18.

The doctrine of imputed guilt therefore, as understood by the Calvinists, is, in the opinion of their opponents, without foundation in Scripture, and contrary to the nature of things. It is an impious absurdity (say they), to which the mind can never be reconciled by the hypothesis, that all men were in Adam both seminally and federally, and sinned in him, as Levi paid tithes to Melchizedeck in the loins of Abraham. The apostle, when he employs that argument to lessen in the minds of his countrymen the pride of birth and the lofty opinions entertained of their priesthood, plainly intimates, that he was using a bold figure, and that Levi's paying tithes is not to be understood in a strict and literal sense. "Now consider (says he) how great this man was, unto whom even the patriarch Abraham gave the tenth of the spoils. And, *as I may so say*, Levi also, who receiveth tithes, paid tithes in Abraham: for he was yet in the loins of his father when Melchizedeck met him." This is a very good argument to prove that the Levitical priesthood was inferior in dignity to that of Melchizedeck; and by the apostle it is employed for no other purpose. Levi could not be greater than Abraham, and yet Abraham was inferior to Melchizedeck. This is the whole of St Paul's reasoning, which lends no support to the doctrine of original sin, unless it can be shown that Levi and all his descendants contracted from this circumstance such a strong propensity to the *paying* of tithes, as made it a matter of extreme difficulty for them, in every subsequent generation, to

123
Moral guilt [illegible]

to

Fall of Adam and its consequences.

to comply with that part of the divine law which constituted them *masters* of itself. That all men were seminally in Adam, is granted; and it is likewise granted that they may have derived from him, by ordinary generation, diseased and enfeebling bodies: but it is as impossible to believe that moral guilt can be transmitted from father to son by the physical act of generation, as to conceive a scarlet colour to be a scene of music, or the sound of a trumpet a cannon ball. That Adam was as fit a person as any other to be entrusted with the good and happiness of his posterity, may be true; but there is no fitness whatever, according to the Arminians, in making the everlasting happiness or misery of a whole race depend upon the conduct of any fallible individual. "That any man should so represent me (says Dr Taylor *), that when he is guilty, I am to be reputed guilty; when he transgresses, I shall be accountable and punishable for his transgression; and this before I am born, and consequently before I am in any capacity of knowing, helping, or hindering, what he doth: all this every one who useth his understanding must clearly see to be false, unreasonable, and altogether inconsistent with the truth and goodness of God." And that no such appointment ever had place, he endeavours to prove, by showing that the texts of Scripture upon which is built the doctrine of the Calvinists respecting original sin, will each admit of a very different interpretation.

* Doctrine of original Sin, part iii.

124 The several texts on which the doctrine is founded have each a different interpretation.

One of the strongest of these texts is Romans v. 19. which we have already quoted, and which our author thus explains. He observes, that the apostle was a Jew, familiarly acquainted with the Hebrew tongue; that he wrote his epistle as well for the use of his own countrymen residing in Rome, as for the benefit of the Gentile converts; and that though he made use of the Greek language, as most generally understood, he frequently employed Hebrew idioms. Now it is certain that the Hebrew words חטאה and עון, "sin and iniquity," are frequently used in the Old Testament to signify *suffering*, by a figure of speech which puts the effect for the cause; and it is surely more probable, that in the verse under consideration, the apostle used the corresponding Greek word ἁμαρτωλοι in the same Hebrew sense, than that he meant to contradict what he had said in the former verse, by teaching that all men were made guilty of an act of disobedience committed thousands of years before the majority of them had any being. In the preceding verse he says, "that by the offence of one, judgement came upon all men to condemnation." But this cannot be true, if by that offence all men were made sinners; for then judgment must have come upon each for his own share in the original disobedience. "Any one may see (says our author) that there is a vast difference between a man's making *himself* a sinner by his *own* wicked act, and his being made a sinner by the wicked act of *another*. In the latter case, he can be a sinner in no other sense but as he is a sufferer; just as Lot would have been made a sinner with the Sodomites, had he been consumed in the iniquity of the city §; and as the subjects of Abimelech would have been made sinners, had he, in the integrity of his heart, committed adultery with Abraham's wife *. That the people of Gerar could have contracted any real gilt from the adultery of their sovereign, or that he, by lying with a woman whom he had reason to believe to be not the wife but the sister of another man, would have incurred all the moral turpitude of that crime, are positions which cannot be maintained. Yet he says, that Abraham had brought upon him and on his kingdom a *great sin*; though it appears, from comparing the 6th verse with the 17th and 18th, that he had not been brought under sin in any other sense than as he was made to suffer for taking Sarah into his house. In this sense, "Christ, though we are sure that he knew no sin, was made sin for us, and numbered with the transgressors," because he suffered death for us on the cross; and in this sense it is true, that by the disobedience of Adam all mankind were made sinners, because, in consequence of his offence, they were by the judgment of God made subject to death.

§ Gen. xix. 15.

* Gen. xx.

But it may be thought that this interpretation of the words *sin* and *sinners*, though it might perhaps be admitted in the 19th verse, cannot be supposed to give the apostle's real meaning, as it would make him employ in the 12th verse an absurd argument, which has been already noticed. But it may perhaps be possible to get quit of the absurdity, by examining the original text instead of our translation. The words are, και ουτως εις παντας ανθρωπους ο θανατος διηλθεν, εφ' ᾡ παντες ημαρτον. In order to ascertain the real sense of these words, the first thing to be done is to discover the antecedent to the relative ᾡ. Our translators seem to consider it as used absolutely without any antecedent; but this is inaccurate, as it may be questioned whether the relative was ever used in any language without an antecedent either expressed or understood. Accordingly, the Calvinist critics, and even many Remonstrants, consider ενος ανθρωπου in the beginning of the verse as the antecedent to ᾡ in the end of it, and translate the clause under consideration thus: "And so death hath passed upon all men, in whom (*viz.* Adam) all have sinned." θανατος, however, stands much nearer to ᾡ than ανθρωπου; and being of the same gender, ought, we think, to be considered as its real antecedent: but if so, the clause under consideration should be thus translated: "and so death hath passed upon all men, unto which (O) all have sinned, or, as the Arminians explain it, have suffered. If this criticism be admitted as just, εφ ᾡ must be considered as standing here under a particular emphasis, denoting the utmost length of the consequences of Adam's sin (P); as if the apostle had said, "so far have the consequences of Adam's sin extended, and spread their influence among mankind, introducing not only a curse upon the earth, and sorrow and toil upon its inhabitants, but even DEATH, UNIVERSAL DEATH, in every part, and in all ages of the world." His words (say the Remonstrants) will unquestionably bear this sense; and it is surely much more probable that it is their true sense, than that an inspired writer should have taught a doctrine subversive of all our notions of right and wrong, and which, if really embraced, must make us incapable of judging when we are innocent and when guilty.

When the apostle says that there is none righteous, no not one, he gives us plainly to understand that he is quoting from the 14th Psalm; and the question to be first answered is, In what sense were these words used by the Psalmist?

(O) That επι, when construed with a dative case, often signifies *to* or *unto*, is known to every Greek scholar. Thus επι τω κλεει, *the way to fame*, (Lucian.) Κακουργος επι τω θανατω, *a criminal unto death*, (Demosth.) Επι θανατω συλλαβειν, *to carry to death or execution*, (Isoc.) Υμεις επ' ελευθερια εκληθητε, *ye have been called to liberty*, (Gal. v. 13.) Κτισθεντες εν Χριστω Ιησου επι εργοις αγαθοις, *created in Christ Jesus unto good works*, (Ephes. ii. 10.) See also 1 Thess. iv. 7.; 2 Tim. ii. 14.; and many other places of the New Testament.

(P) Εφ' ᾡ has likewise this import, denoting the *terminus ad quem* in Phil. iii. 12. and iv. 10.

mist? That they were not meant to include all the men and women then living, far less all that have ever lived, is plain from the fifth verse of the same Psalm, where we are told that those wicked persons "were in great fear, because God was in the congregation of the *righteous*." There was then, it seems, a congregation of righteous persons, in opposition to those called the *children of men*, of whom alone it is said that there was none that did good, no not one. The truth is, that the persons of whom David generally complains in the book of Psalms, constituted a strong party attached to his person and government. That faction he describes as proud and oppressive, as devising mischief against him, as violent men continually getting together for war. He styles them his *enemies*; and sometimes characterizes them by the appellation which was given to the apostate descendants of Cain before the deluge. Thus in the 57th Psalm, which was composed when he fled from Saul to the cave in which he spared that tyrant's life, he complains, "I lie among them that are set on fire, even the SONS OF MEN, whose teeth are spears," &c.; and again, in the 58th Psalm, he says, "Do ye indeed speak righteousness, O congregation? Do ye judge uprightly, O ye sons of men?" By comparing these texts with 1 Sam. xxvi. 19. it will appear evident beyond dispute, that by the SONS OF MEN mentioned in them, he meant to characterize those enemies who exasperated Saul against him. Now it is well known, that there was a party adhering to the interests of the house of Saul which continued its enmity to David during the 40 years of his reign, and joined with Absalom in rebellion against him only eight years before his death. But it is the opinion of the most judicious commentators §, that the 14th Psalm was composed during the rebellion of Absalom; and therefore it is surely much more probable, that by *the children of men*, of whom it is said there is "none that doth good, no not one," the inspired poet meant to characterize the rebels, than that he should have directly contradicted himself in the compass of two sentences succeeding each other. Had he indeed known that all the children of men, as descending from Adam, "are utterly indisposed, disabled, and made opposite to all that is spiritually good, and wholly and continually inclined to all evil," he could not, with the least degree of consistency, have represented the Lord as looking down from heaven upon them, to see if there were any that did understand and seek after God;" but if by the children of men was meant only the rebel faction, this scenical representation is perfectly consistent, as it was natural to suppose that there might be in that faction some men of good principles misled by the arts of the rebel chiefs.

Having thus ascertained the sense of the words as originally used by the Psalmist, the Arminian proceeds to inquire for what purpose they were quoted by the apostle; and in this inquiry he seems to find nothing difficult. The aversion of the Jews from the admission of the Gentiles to the privileges of the gospel, the high opinion which they entertained of their own worth and superiority to all other nations, and the strong persuasion which they had that a strict obedience to their own law was sufficient to justify them before God, are facts universally known; but it was the purpose of the apostle to prove that all men stood in need of a Redeemer, that Jews as well as Gentiles had been under the dominion of sin, and that the one could not in that respect claim any superiority over the other. He begins his epistle, therefore, with showing the extreme depravity of the Heathen world; and having made good that point, he proceeds to prove, by quotations from the book of Psalms, Proverbs, and Isaiah, that the Jews were in nowise better than they, that every mouth might be stopped, and all the world become guilty, or insufficient for their own justification before God.

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The next proof brought by the Calvinists in support of their opinion, that all men derive guilt from Adam by ordinary generation, is that text in which St Paul says that the Ephesians "were by *nature* children of wrath even as others." To this their opponents reply, that the doctrine of original sin is in this verse, as in the last quoted, countenanced only by our translation, and not by the original Greek as understood by the ancient fathers of the Christian church, who were greater masters of that language than we. The words are [illegible]; in which it is obvious, that τεκνα, though in its original sense it signifies the genuine children of parents by natural generation, cannot be so understood here; because no man was ever begotten by, or born of, the abstract notion *wrath*. It must therefore be used figuratively; and in other places of scripture it often denotes a close relation to any person or thing. Thus we read of the children of *God*, of the *kingdom*, the *resurrection*, *wisdom*, *light*, *obedience*, and *peace*; whence it is concluded, that by the children of wrath are meant those who are liable to punishment or rejection. And because there were in those days some children, in a lower and less proper sense, by *adoption*, and others, in a higher and more proper sense, by *natural generation*, of whom the relation of the latter to their parents was much closer than that of the former; the apostle tells the Ephesians, that they were by *nature* children of wrath, to convince them that they were *really* liable to it by the strictest and closest relation possible. That the word φυσει here is of the same import with *really* or *truly*, and that it does not signify what we mean by *nature* in the proper sense of that word, the ancient fathers are generally agreed *; and that the modern Greeks, who still speak a dialect of the noble language of their ancestors, understand the word in the same sense, is apparent from their version of the text before us. In the most correct and elegant edition of the New Testament in their vernacular tongue, the words under consideration are thus rendered; [illegible], where it is impossible that [illegible] can signify *natural*, otherwise the apostle will be made to say, not that we are by the nature derived from Adam liable to wrath, but that we were *naturally begotten by wrath* in the abstract! For taking the word φυσει in the sense of *really* or *truly*, both the ancient and modern Greeks appear indeed to have the authority of St Paul himself; who, writing to Timothy, calls him [illegible] "his true or genuine son;" not to signify that he was the child of the apostle by natural generation, but that he was closely related to him in the faith to which St Paul had converted him. That the words τεκνα φυσει οργης can signify nothing but *truly* or *really relations to wrath*, is still farther evident from the ground assigned of that relation. It is not the sin of Adam, or the impurity of natural generation, "but the trespasses and sins in which the Ephesians in time past *walked*, according to the course of the world, according to the prince of the power of the air," the spirit that at the time of the apostle's writing "worked in the children of disobedience." Surely no man can suppose that the Ephesians at any past time *walked* in Adam's trespass and sin, or that the prince of the power of the air tempted *them* to eat the forbidden fruit.

* See *Hammond and Whitby on the Text*, and Suicer on the word φυσις.

Having thus commented on the principal texts which are cited from the New Testament to prove the doctrine of original sin, the Arminians treat those which are quoted from the Old Testament, in support of the same doctrine, with much less ceremony. Thus, when Job says, "who can

[illegible] can bring a clean thing out of an unclean? Not one," he is speaking, say they, not of the pravity of our nature, but of its frailty and weakness, of the shortness and misery of human life. The sentence is proverbial; and as it is used only to denote, that nothing can be more perfect than its original, it must, wherever it occurs, be understood according to the subject to which it is applied. That in the place under consideration it refers to our mortality, they think plain from the context; and Dr Taylor adds *, with some plausibility, that if the words refer to the guilt which we are supposed to derive from Adam, they will prove too much to serve the common scheme of original sin. They will prove that our natural and inherent pravity, so far far from rendering us fit subjects of wrath, may be urged as a reason why God should not even bring us into judgement; for the patriarch's whole expostulation runs thus, "Dost thou open thine eyes upon such a one, and bringest me into judgement with thee? Who can bring a clean thing out of an unclean?"

* [illegible] Doctrine, part ii.

The other text, quoted from the same book, they think still less to the purpose; for Eliphaz is evidently contrasting the creature with the Creator; in comparison with whom, he might well say, without alluding to original guilt, "what is man that he should be clean? and he who is born of a woman that he should be righteous? Behold he putteth no trust in his saints; yea the *heavens* are not clean in his sight. How much more abominable and filthy is man, who drinketh iniquity like water?" He does not say, who derives by birth an iniquitous nature; for he knew well, that as we are born, we are the pure workmanship of God, "whose hands have fashioned and formed every one of us;" but "who *drinketh* iniquity like water," who maketh himself iniquitous by running headlong into every vicious practice.

On the text quoted from the fifty-first psalm in support of the doctrine of original sin, Dr Taylor labours †, by a long and ingenious criticism, to prove that our translators have mistaken the sense. The word which they have rendered *shapen*, he shews to be used once by Isaiah, and twice in the book of Proverbs, to signify *brought forth*; and that which is rendered *conceived me*, is never, he says, employed in scripture to denote human conception. In this last remark, however, he is contradicted by a great authority, no less indeed than that of Mr Parkhurst ‡, who says, that the LXX constantly render it by [illegible] or [illegible], and the Vulgate generally by *concipio*. Without taking upon us to decide between these two eminent Hebrew scholars, we shall only observe, that upon one occasion || it certainly denotes ideas much grosser than those which the Psalmist must have had of his mother's conception; and that there, at least, Dr Taylor properly translates it *incalescebant*, adding, "de hoc vero incalescendi genere loqui Davidem nemo sanus existimare potest. Matrem enim incaluisse, aut ipsum calefecisse eo modo quo incalescerent Jacobi pecudes Regem dicere, prorsus indecorum et absurdum." He contends, however, that the original force of the word is *to be hot*, and that it is applied to *conception*, to *resentment*, to *warmth* by which the body is nourished, to *idolaters* in love with idols, and to the heat of metals. The heat of idolaters, of resentment, and of metals, are evidently foreign to the Psalmist's purpose; and the idea conveyed by the word *conception* being set aside for the reasons already assigned, there remains only the warmth by which the body is nourished, and of that warmth our author is confident that David spoke.

† Ubi supra.

‡ See his [illegible] on the word [illegible].

|| Gen. xxx. 38, 39, 40. compared with xxxi. 10.

If this criticism be admitted, the whole verse will then run thus: "Behold I was born in iniquity, and in sin did my mother nurse me;" which hath no reference to the original formation of his constitution, but is a periphrasis of his being *a sinner from the womb*, and means nothing more than that he was a *great sinner*, or had contracted *early habits* of sin. He no more designed to signify in this verse, that by ordinary generation he had a nature conveyed to him which was "utterly indisposed, disabled, and opposite to all that is spiritually good, and wholly and continually inclined to evil," than he meant in another ‡ to signify strictly and properly that "the wicked are estranged from the womb, and SPEAK LIES as soon as they are born;" or than Job meant to signify §, that from the moment he came from his mother's womb he had been a guide to the widow and a succour to the fatherless. All these are hyperbolical forms of expression; which, though they appear strained, and perhaps extravagant, to the phlegmatic inhabitants of Europe, are perfectly suited to the warm imaginations of the orientals, and to the genius of eastern languages. They mean not that Job was *born* with *habits* of *virtue*, that the wicked actually *walked*, and *spoke*, and *spoke lies* from the instant of their *birth*, or that the Psalmist was really *shapen* in *sin* and *conceived in iniquity*. This last sentence, if interpreted literally, would indeed be grossly impious: it would make the inspired penman throw the whole load of his iniquity and sin from off himself upon *him* who shaped and upon *her* who conceived him; even upon that God "whose hands had made him and fashioned him, and whom he declares that he will praise for having made him fearfully and wonderfully," and upon that parent who conceived him with sorrow, and brought him forth with pain, and to whom the divine law commanded him to render honour and gratitude. "But if, after all (says Dr Taylor *), you will adhere to the literal sense of the text for the common doctrine of *original sin*, shew me any good reason why you ought not to admit the literal sense of the text, *this is my body*, for *transubstantiation*? If you say, it is absurd to suppose that Christ speaks of his real natural body; I say, it is likewise absurd to suppose that the Psalmist speaks of his being really and properly shapen in iniquity, and conceived in sin. If you say, that the sense of the words *this is my body* may be clearly explained by other texts of scripture where the like forms of speech are used; I say, and have shewn, that the Psalmist's sense may as clearly and evidently be made out by parallel texts, where you have the like kind of expression. If you say that transubstantiation is attended with consequences hurtful to piety, I say that the common doctrine of original sin is attended with consequences equally hurtful; for it is a principle apparently leading to all manner of iniquity to believe that sin is natural to us, that it is interwoven and ingrafted into our very constitution from our conception and formation in the womb."

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‡ Ps. [illegible] 3.

§ Job [illegible] 18.

* Script. Doctr. part ii.

125 The Arminians having thus, as they think, proved that the posterity of Adam are not in any sense rendered guilty by his sin, contend, that the death threatened against his eating of the forbidden fruit, and which, in consequence of his transgression, came upon all men, can mean nothing more than the loss of that vital principle which he received when God breathed into his nostrils the breath of life, and he became a living soul. Every thing beyond this is pure conjecture, which has no foundation in the scriptures of truth, and is directly contrary to all the notions of right and wrong which we have been able to acquire from the study of those very scriptures. It is not conceivable from any thing in the history, that Adam could understand it of the loss of any other life than that which he had lately received, for no other life is spoken of to which the threatened death can be opposed; and in such circumstances it was strange

Consequences of eating the forbidden fruit, according to the Arminians.

ſtrange indeed, if by the word *death* he underſtood either eternal life in miſery, or a neceſſity of continuing in ſin. The ſenſe therefore of the threatening, ſay they, is this; "I have formed thee of the duſt of the ground, and breathed into thy noſtrils the breath of life; and thus thou art become a living ſoul. But if thou eateſt of the fruit of the tree of knowledge of good and evil, thou ſhalt ceaſe to be a living ſoul, for I will take from thee the breath of life, and thou ſhalt return to the duſt of which thou waſt formed."

Thus far the Arminians of the preſent day (Q) are agreed in oppoſing the doctrine of the rigid Calviniſts, and in ſtating their own notions of the conſequences of Adam's fall; but from that event their adverſaries deduce one conſequence, which ſome of them admit and others deny. It is ſaid, that though we cannot poſſibly be partakers in Adam's guilt, we yet derive from him a moral-taint and infection, by which we have a natural propenſity to ſin; that having loſt the image of God, in which he was created, Adam begat ſons in his own image; and in one word, that the ſenſual appetites of human nature were inflamed, and its moral and intellectual powers greatly weakened by the eating of the forbidden fruit. The heathens themſelves acknowledged and lamented this depravity, though they were ignorant of the ſource from which it ſprung. The ſcriptures aſſert it, affirming that no man can be born pure and clean; that whatever is born of the fleſh, or comes into the world by ordinary generation, is fleſh, carnal and corrupt; that the imagination of the thoughts of man's heart is only evil continually; that the heart is deceitful above all things and deſperately wicked; and that out of it proceeds all that is vile and ſinful ‖.

This depravity of human nature, thus clearly deducible from ſcripture, and confirmed by the teſtimony of ages, an ingenious writer of the moderate Arminian ſchool undertakes to illuſtrate upon the principles of natural knowledge. "We know (ſays he†), that there are ſeveral fruits in ſeveral parts of the world of ſo noxious a nature as to deſtroy the beſt human conſtitution upon earth. We alſo know that there are ſome fruits in the world which inflame the blood into fevers and frenzies; and we are told that the Indians are acquainted with a certain juice, which immediately turns the perſon who drinks it into an idiot, leaving him at the ſame time in the enjoyment of his health and all the powers of this body. Now I aſk, Whether it is not poſſible, nay whether it is not rational, to believe, that the ſame fruit, which, in the preſent infirmity of nature, would utterly deſtroy the human conſtitution, might, in its higheſt perfection, at leaſt diſturb, impair, and diſeaſe it? and whether the ſame fruit, which would now inflame any man living into a fever or a frenzy, might not inflame Adam into a turbulence and irregularity of paſſion and appetite? and whether the ſame fluids, which inflame the blood into irregularity of paſſion and appetite, may not naturally produce infection and impair the conſtitution? That the forbidden fruit had the effect to produce irregularity of appetite, appears as from other proofs, ſo I think fully and clearly from the covering which Adam and Eve made uſe of ſoon after their offence; for there is no imaginable reaſon for that covering but one, and that one ſufficiently demonſtrates, that irregularity and violence of appetite, independent of the dominion of reaſon, was the effect of their offence. But the fruit which inflamed the ſenſual appetite might likewiſe debaſe their rational powers; for I aſk, whether the ſame juice, which now affects the brain of an ordinary man ſo as to make him an idiot, might not affect the brain of Adam ſo as to bring his underſtanding down to the preſent ſtandard of ordinary men? And if this be poſſible, and not abſurd to be ſuppoſed, it is evident that the ſubſequent ignorance and corruption of human nature may be clearly accounted for upon theſe ſuppoſitions; nay, I had almoſt ſaid upon any one of them. For it is univerſally known, that the infections and infirmities of the father affect the children yet in his loins; and if the mother be equally infected, muſt, unleſs removed by proper remedies, affect their poſterity to the end of the world, or at leaſt till the race become extinct. Therefore why all mankind might not by their firſt father's ſin be reduced to the ſame condition of infirmity and corruption with himſelf, eſpecially when the mother was equally infirm and infected, I believe no man any way ſkilled in the knowledge of nature will ſo much as pretend to ſay."

Fall of Adam, and its conſequences.

This account of the corruption of human nature ſeems to be generally adopted by moderate divines, as well among the Calviniſts as among the Arminians; but by the high-fliers in both ſchools it is rejected, upon different principles indeed, with great indignation. The zealous Calviniſt contends, that this hereditary corruption is not to be accounted for or attempted to be explained by any principle of phyſical ſcience, ſince it is part of that puniſhment which was inflicted on the race for their original ſin. If we were not partakers of Adam's guilt, ſay they, we ſhould not have been partakers of his corruption. The one is previous to the other, and the foundation of it. The depravity of human nature is a puniſhment for ſin; and ſo it was threatened to Adam, and came upon him as ſuch, and ſo to all his poſterity, by the *ordination* and *appointment of God*; for which there can be no other foundation but the imputation of Adam's diſobedience to them, nor can any thing elſe vindicate the righteouſneſs of God. For if the law of nature

(Q) We ſay the Arminians of the *preſent day*; becauſe in the beginning of this century many of them having imbibed the ſcholaſtic notion of the *natural* and *eſſential* immortality of the ſoul, ſeem to have been at a loſs to conceive how it was to have been diſpoſed of, had there been no redemption from Adam's curſe. They were perſuaded, that for his ſin the ſouls of his poſterity did not deſerve eternal puniſhment; and as eternal *life* is everywhere in the New Teſtament repreſented as the gift of God through Jeſus Chriſt, they thus expreſſed themſelves concerning the death incurred by the fall of Adam. "It is well to be obſerved, that the *death* wherewith God threatened man as his puniſhment if he broke the covenant, is not in reaſon to be underſtood of *eternal death*, any farther than as by eternal death may be ſignified only the *eternal ſeparation* of the *ſoul from the body*, and alſo the *eternal excluſion* of the *man from God*, or *heaven's bleſs*." That the death threatened implied the annihilation of the ſoul, ſeems never to have occurred to them, though the apoſtle expreſsly ſays, that if there be no reſurrection, "then they who are fallen aſleep in Chriſt are periſhed," *απωλοντο* "are loſt." They ſuppoſed that the ſin of Adam would have ſeparated the ſoul from the body, and excluded the former both from heaven and from hell; but what would have become of it in that ſtate of excluſion, both from future happineſs and future miſery, we do not remember at preſent that any one of them has hazarded a conjecture. See *Dr Wells's Help for the Right Underſtanding of the Several Divine Laws and Covenants*; and biſhop Bull's *Harmonia Apoſtolica*, with its ſeveral defences.

[illegible] were sufficient, why should this original taint infect men rather than the sins of their immediate parents?"

The assertors of this [illegible] deny that we inherit any moral taint whatever from Adam, or that the rational powers of our minds are naturally weaker than his were. Of that wonderful degree of perfection which is usually attributed to the first man, they find no evidence in scripture. All that we know of them, say they, is, that they fell from a state of exquisite happiness by yielding to a temptation less powerful by far than some others which many of their degenerate sons have successfully resisted. "I leave [illegible] to judge (says Dr Taylor [illegible]), whether Joseph, when he resisted the solicitations of his mistress, and Moses when he refused to be called the son of Pharaoh's daughter, choosing rather to suffer affliction with the people of God than to enjoy the pleasures of sin for a season, esteeming the reproach of true religion greater riches than the treasures of Egypt, did not exhibit proofs of regularity of passions and appetites equal at least to what Adam displayed in the garden of Eden. When the three young men mentioned in the book of Daniel submitted to be burnt alive in a fiery furnace rather than worship Nebuchadnezzar's golden image; when Daniel himself resolved, rather than conceal the worship of God for one month only of his life, to be torn in pieces by hungry lions; and, to come nearer to our own times, when numbers of men and women, during the reign of Mary Queen of England, chose rather to be burnt at a stake than renounce the reformed religion and embrace the errors of popery—surely all these persons exhibited a virtue, a faith in God, and a steady adherence to what they believed to be the truth, far superior to what Adam displayed, when his wife gave him of the forbidden fruit, and he did eat." If it be said that these persons were supported under their trials by the grace of God strengthening them, the same will be said of Adam. He was undoubtedly supplied with every aid from the spirit of grace which was necessary to enable him to fulfil his duty; for being designed for more than mere animal life, even for the refined enjoyments of heaven, there is every reason to believe, as we have already observed, that he was put under the guidance of the Holy Ghost, to train him for that supernatural state of felicity. These communications of the spirit would of course be withdrawn when he forfeited his right to those privileges, on account of which they were orignally vouchsafed to him; but that any positive malignity or taint was infused into his nature, that his mere rational powers were weakened, or his appetites inflamed by the forbidden fruit, there is no evidence to be found in scripture, or in the known constitution of things. The attributing of this supposed hereditary taint to the noxious qualities of the forbidden fruit, is a whimsical hypothesis, which receives no countenance from any well authenticated fact in natural history. After the numberless falsehoods that have been told of the poison tree of Java (see *Poison Tree*), something more would be requisite than the common evidence of a living voyager to give credit to the qualities of the Indian tree, of which the fruit instantly turns the wisest man into an idiot: and yet for this singular story our ingenious author vouchsafes not even that evidence, slight as it generally is. The inference drawn from the covering used by our first parents is contradicted by every thing that we know of human nature; for surely no man, inflamed to the utmost with the fire of animal love, ever turned his eyes from a naked beauty ready and eager to receive him to her embrace. Yet this, it seems, was the behaviour of Adam and Eve in such a state! According to our author, the juice of the forbidden fruit had rendered their carnal appetites violent and independent of reason; according to the scripture, they were both naked; and as they were husband and wife, there was no law prohibiting them from gratifying these inflamed appetites. In such circumstances, how did they conduct themselves? One would naturally imagine that they immediately retired to some shady grove, and pleased themselves in all the soft dalliancies of wedded love. Their conduct, however, was very different. We are told, that "they sewed fig-leaves together, and made themselves aprons to cover their nakedness:" And this transaction is brought as a proof of the impetuosity of their carnal appetites (R). The truth is, that the carnal appetite appears not to be naturally more violent than is necessary to answer the end for which it was implanted in the human constitution. Among savages the desires of animal love are generally very moderate; and even in society they have not often, unless inflamed by the luxurious arts of civil life, greater strength than is requisite to make mankind attend to the continuation of their species. In the decline of empires highly polished, where the difference of rank and opulence is great, and where every man is ambitious of emulating the expence of his immediate superiors, early marriages are prevented by the inability of most people to provide for a family in a way suitable to what each is pleased to consider as his proper station; and in that state of things the violence of animal love will indeed frequently produce great irregularities. But for that state of things, as it was not intended by the Author of nature, it is perhaps unreasonable to suppose that provision should be made; and yet we believe it will be found, upon due consideration, that if the desires of animal love were less violent than they are, the general consequences would be more pernicious to society than all the irregularities and vices which these desires now accidentally produce; for there would then be no intercourse between the sexes whatever except in the very highest stations of life. That our constitution is attended with many sensual appetites and passions, which, if suffered to grow excessive or irregular, become sinful, is true; and that there is great danger of their becoming excessive and irregular in a world so full of temptation as ours is, is also true; but there is no evidence that all this is the consequence of Adam's fall, and far less that it amounts to a *natural propensity* to sin. "For I presume (says Dr Taylor), that by a natural propensity is meant a necessary inclination to sin, or that we are necessarily sinful from the original bent and bias of our natural powers. But this must be false; for then we should not be

(R) We have never met with a satisfactory reason for the expedient of these fig-leave coverings. To us the following has sometimes occurred as an account of the matter, at least more plausible than that which has been assigned by Dr Delany. Persons under the agonies of remorse, or with the prospect of immediate death before them, have no relish for the pleasures of love: and as our first parents, upon eating the forbidden fruit, must have been in the one or other of these situations, they might think of sewing fig-leaves together, and making themselves aprons, as a mean of subduing an appetite, of which, at that instant, they must have abhorred the gratification. If they had any hope of a reprieve from death, and yet knew all the consequences of their sin, their most ardent wish would be to have no children; and not being acquainted as we are with the effects of dress, they would naturally imagine that their proposed coverings would diminish the force of the sexual appetite.

be finful at all becaufe that which is neceffary, or which we cannot help, is not fin. That we are weak and liable to temptation, is the will of God holy and good, and for glorious purpofes to ourfelves; but if we are wicked, it muft be through our own fault, and cannot proceed from any conftraint, or neceffity, or taint in our conftitution."

Thus have we given as full and comprehenfive a view as our limits will permit of the different opinions of the Calvinifts and Arminians refpecting the confequences of Adam's fall. If we have dwelt longer upon the fcheme of the latter than of the former, it is becaufe every Arminian argument is built upon criticifm, and appeals to the original text; whilft the Calvinifts reft their faith upon the plain words of fcripture as read in our tranflation. If we might hazard our own opinion, we fhould fay that the truth lies between them, and that it has been found by the moderate men of both parties, who, while they make ufe of different language, feem to us to have the fame fentiments. That all mankind really finned in Adam, and are on that account liable to moft grievous torments in foul and body, without intermiffion, in hell fire for ever, is a doctrine which cannot be reconciled to our natural notions of God. On the other hand, if human nature was not fomehow debafed by the fall of our firft partents, it is not eafy to account for the numberlefs phrafes in fcripture which certainly feem to fpeak that language, or for the very general opinion of the Pagan philofophers and poets refpecting the golden age and the degeneracy of man. Cicero, in a quotation preferved by St Auguftine from a work that is now loft, has thefe remarkable words, "Homo non ut a matre fed ut a noverca natura editus eft in vitam corpore nudo, et fragili, et infirmo: animo autem anxio ad moleftias, humili ad timores, molli ad labores, prono ad libidines; in *quo tamen ineft tanquam obrutus quidam divinus ignis ingenii et mentis* †." Nor do we readily perceive what fhould induce the more zealous Arminians to oppofe fo vehemently this general opinion of the corruption of human nature. Their defire to vindicate the juftice and goodnefs of God does them honour; but the doctrine of inherent corruption militates not againft thefe attributes; for what we have loft in the firft Adam has been amply fupplied to us in the fecond; and we know from the higheft authority that the duties required of us are in proportion to our ability, fince we are told, that "unto whomfoever much is given, of him fhall much be required."

Sect. IV. *View of Theology from the fall of Adam to the coming of Chrift.*

We have dwelt long on the original ftate of man, his introduction into the terreftrial paradife, the privileges to which he was there admitted, his forfeiture of thofe privileges, and the ftate to which he was reduced by tranfgreffing the law of his Maker; but the importance of thefe events renders them worthy of all the attention that we have paid to them. They paved the way for the coming of Chrift and the preaching of the gofpel; and unlefs we thoroughly underftand the origin of the gofpel, we cannot have an adequate conception of its defign. By contrafting the firft with the fecond Adam, St Paul gives us clearly to underftand, that one purpofe for which Chrift came into the world and fuffered death upon the crofs, was to reftore to mankind that life which they had loft by the fall of their original progenitor. The preaching of the gofpel therefore commenced with the firft hint of fuch a reftoration; and the promife given to Adam and Eve, that "the feed of the woman fhould bruife the head of the ferpent," was as truly evangelical as thefe words of the apoftle, by which we are taught, that "this is a faithful faying and worthy of all acceptation, that Chrift Jefus came into the world to fave finners *." The former text taken by itfelf is indeed obfcure, and the latter is explicit; but both belong to the fame fyftem, for the fcriptures contain but two covenants or difpenfations of God to man, in which the whole race is included.

Theology from the fall of Adam to the coming of Chrift.

* 1 Tim. i. 15.

Chriftianity therefore is indeed very near as old as the creation; but its principles were at firft obfcurely revealed, and afterwards gradually developed under different forms as mankind became able to receive them, (fee Prophecy, n 5, &c.). All that appears to have been at firft revealed to Adam and Eve was, that by fome means or other one of their pofterity fhould in time redeem the whole race from the curfe of the fall; or if they had a diftinct view of the means by which that redemption was to be wrought, it was probably communicated to them at the inftitution of facrifices, (fee Sacrifice). This promife of a future deliverer ferved to comfort them under their heavy fentence; and the inftitution of facrifices, whilft it impreffed upon their minds lively ideas of the punifhment due to their tranfgreffion, was admirably calculated to prepare both them and their pofterity for the great atonement which, in due time, was to take away the fins of the world.

132 Chriftianity [illegible] with the fall.

Our firft parents, after their fall, were fo far from being left to fabricate a mode of worfhip for themfelves by thofe innate powers of the human mind of which we daily hear fo much and feel fo little, that God was gracioufly pleafed to manifeft himfelf to their *fenfes*, and vifibly to conduct them by the angel of his prefence in all the rites and duties of religion. This is evident from the different difcourfes which he held with Cain, as well as from the complaint of that murderer of being hid from his face, and from its being faid, that "he went out from the prefence of the Lord and dwelt on the eaft of Eden." Nor does it appear that God wholly withdrew his vifible prefence, and left mankind to their own inventions, till their wickednefs became fo very great that his fpirit could no longer ftrive with them. The infant ftate of the world ftood in conftant need of his fupernatural guidance and protection. The early inhabitants of this globe cannot be fuppofed to have been able, with Mofes *, to look up to him who is *invifible*, and perform a worfhip purely rational and fpiritual. They were all tillers of the ground, or keepers of cattle; employed in cultivating and replenifhing this new world; and, through the curfe brought upon it by their forefather, forced, with him, to eat their bread "in the fweat of their brow." Man in fuch circumftances could have little leifure for fpeculation; nor has mere fpeculation, unlefs furnifhed with principles from another fource, ever generated in the human mind adequate notions of God's nature or providence, or of the means by which he can be acceptably worfhipped. Frequent manifeftations, therefore, of his prefence would be neceffary to keep up a tolerable fenfe of religion among them, and fecure obedience to the divine inftitutions; and that the Almighty did not exhibit fuch manifeftations, cannot be inferred from the filence of that very fhort hiftory which we have of thofe early ages. Adam himfelf continued 930 years a living monument of the juftice and mercy of God; of his extreme hatred and abhorrence of fin, as well as of his love and long-fuffering towards the finner. He was very fenfible how fin had entered into the world, and he could not but apprife his children of its author. He would at the fame time inform them of the unity of God, and his dominion over the evil one; of the means by which he had appointed himfelf to be worfhipped; and of his promife of future deliverance from the curfe of the fall. Such information would produce a tolerable idea of the Divine Being,

133 Revelations frequent in the early ages of the world.

* Heb. xi. 23.

Theology from the time of Adam to the coming of Christ.

ing, and afford sufficient motives to obey his will. The effects of it accordingly were apparent in the righteous family of Seth, who soon distinguished themselves from the posterity of Cain, and for their eminent piety were honoured with the appellation of *the sons of God*. Of this family sprung Enoch, so remarkable for virtue and devotion, as to be exempted from the common lot of his race; for after he had walked with God 300 years, and prophecied to his brethren, he was translated that he should not see death. Of this miraculous event there can be no doubt but that his contemporaries had some visible demonstration; and as the death of Abel was an argument to their reason, so the translation of Enoch was a proof to their senses of another state of life after the present. To Adam himself, if he was then alive (s), it must have been a lively and affecting instance of what he might have enjoyed, had he kept his innocence; it must have been a comfortable earnest of the promised victory over the evil one; and have confirmed his hope, that when the head of the serpent should be completely bruised, he and his posterity would be restored to the favour of their Maker, and behold his presence in bliss and immortality.

134
Vice, and probably idolatry, soon became prevalent.

Nothwithstanding this watchful care of God over his fallen creature man, vice, and probably idolatry, spread through the world with a rapid pace. The family of Seth married into that of Cain, and adopted the manners of their new relations. Rapine and violence, unbounded lust and impurity of every kind, prevailed universally; and when those giants in wickedness had filled the earth with tyranny, injustice, and oppression; when the whole race was become entirely carnal—God, after raising up another prophet to give them frequent warnings of their fate for the space of 120 years, was at length obliged, in mercy to themselves as well as to the succeeding generations of men, to cut them off by a general deluge. See DELUGE.

135
Pure religion preserved after the flood;

Thus did God, by the spirit of prophecy, which is by some supposed to have been hereditary in the heads of families; by frequent manifestations of his own presence; and by uninterrupted tradition—make ample provision for the instruction and improvement of the world for the first 1600 years. After the deluge he was pleased to converse again with Noah, and make in his person a new and extensive covenant with mankind, (see PROPHECY, n° 11.). Of his power, justice, and goodness; of his supreme dominion over the earth and the heavens; of his abhorrence of sin, and his determination not to let it go unpunished—that patriarch and his family had been most awfully convinced; nor could they or their children, for some time, want any other argument to enforce obedience, fear, and worship. The sons of Noah were an hundred years old when the deluge overwhelmed the earth. They had long conversed with their ancestors of the old world, had frequented the religious assemblies, observed every Sabbath day, and been instructed by those who had seen Adam. It is therefore impossible that they could be ignorant of the creation of the world, of the fall of man, or of the promise of future deliverance from the consequences of that fall; or that they could offer their sacrifices, and perform the other rites of the instituted worship, without looking forward with the eye of faith to that deliverance seen, perhaps obscurely, through their typical oblations.

In this state of things, with the awful remembrance of the deluge continually present to their minds, religion might for some time be safely propagated by tradition. But when by degrees mankind corrupted that tradition in its most essential parts; when, instead of the one Supreme God, they set up several orders of inferior deities, and worshipped all the host of heaven; when, at the same time they were uniting under one head, and forming a universal empire under the patronage of the Sun their chief divinity (see BABEL)—God saw it necessary to disperse them into distinct colonies, by causing such discord among them as rendered it impossible for any one species of idolatry to be at once universally established.

136
Idolatry however the cause of the dispersion from Babel.

After this dispersion, there is reason to believe that particular revelations were vouchsafed wherever men were disposed to regard them. Peleg had his name prophetically given him from the dispersion which was to happen in his days; and not only his father Eber, but all the heads of families mentioned from Noah to Abraham, are with much plausibility supposed to have had the spirit of prophecy on many occasions. Noah was undoubtedly both priest and prophet; and living till within two years of the birth of Abraham, or, according to others, till that patriarch was near 60 years old, he would surely be able to keep up a tolerable sense of true religion among such of his descendants as sojourned within the influence of his doctrine and example. His religious son Shem, who lived till after the birth of Isaac, could not but preserve in tolerable purity the faith and worship of the true God among such of his own descendants as lived in his neighbourhood.

But though the remains of true religion were thus preserved among a few righteous men, idolatry, with its inseparable attendants, unnatural lusts and cruel superstition (T), had in a short time prevailed so far among the sons of Noah, that God, in his infinite wisdom, saw it expedient not only to shorten the lives of men, but also to withdraw his presence from the generality, who had thus rendered themselves unworthy of such communications; and to select a particular family, in which his worship might be preserved pure amidst the various corruptions that were overspreading the world. With this view Abraham was called; and after many remarkable trials of his faith and constancy, admitted to a particular intimacy and friendship with his Maker. God entered into a peculiar covenant with him, engaging to be his present guide, protector, and defender; to bestow all temporal blessings upon him and his seed; and to make some of those seed the instruments of conveying blessings of a higher kind to all the nations of the earth.

137
The call of Abraham was

It was doubtless for his singular piety that Abraham was fixed upon to be the parent of that people, who should preserve the knowledge of the unity of God in the midst of an idolatrous and polytheistic world; but we are not to imagine that it was for his sake only that all this was done, or that his less worthy descendants were by the equal Lord of all treated with partial fondness for the virtues of their ancestor; it was for the benefit of mankind in general that he was called from his country, and from his father's house, that he might preserve the doctrine of the Divine unity in his own family, and be an instrument in the hand of Providence (and a fit one he was) to convey the same faith to the nations around him. Accordingly, we find him distinguished among the neighbouring princes, and kings reproved for his sake; who being made acquainted with his prophetic character, desire his intercession with God. History tells us of his conversing on the subject of religion with the most learned

138
To prevent the universal spreading of idolatry.

(s) According to the Samaritan chronology, he was alive; according to the Hebrew, he had been dead 57 years.

(T) See the effects of idolatry well described in the Apocryphal book of Wisdom, chap. xiv.

ed Egyptians, who appear to have derived from him or some of his defcendants the rite of circumcifion, and to have been for a while ftopt in their progrefs towards the laft ftage of that degrading idolatry which afterwards rendered their national worfhip the opprobrium of the whole earth, (fee POLYTHEISM, n° 28). We are informed that his name was had in the greateft veneration all over the Eaft; that the Magians, Sabians, Perfians, and Indians, all glory in him as the great reformer of their refpective religions: and to us it appears extremely probable, that not only the Brachmans, but likewife the Hindoo god Brahma*, derive their names from the father of the faithful. As he was let into the various counfels of the Almighty, and taught to reafon and reflect upon them; as he was fully apprifed of the overthrow of Sodom and Gomorrah, with the particular circumftances of that miraculous event; and as he had frequent revelations of the promifed Redeemer, whofe day he longed earneftly to fee, and feeing it was glad—there can be no doubt but that he and his family took care to propagate thefe important doctrines in every nation which they vifited; for the only reafon which we can conceive for his being made to wander from place to place was, that different people might be induced to inquire after his profeffion, his religion, and his hopes.

But though the Supreme Being was pleafed to manifeft himfelf in a more frequent and familiar manner to Abraham, he by no means left the reft of the world without fufficient light. Lot profeffed the true religion in the midft of Sodom. In Canaan we meet with Melchizedeck, king and prieft of the moft high God, who bleffed Abraham, and to whom that patriarch himfelf did homage. Abimelech king of Gerar receiving an admonition from the Lord, immediately paid a due regard to it; and the fame fenfe of religion and virtue defcended to his fon. Laban and Bethuel acknowledged the Lord, and the former of them was even favoured with a vifion. In Arabia, we find Job and his three friends, all men of high rank, entering into the deepeft difquifitions in theology; agreeing about the unity, omnipotence, and fpirituality of God; the juftice of his providence, with other fundamental articles of true religion; and mentioning divine infpiration or revelation as a thing not uncommon in their age and country* (U). Balaam appears to have been a true prophet; and as he was unqueftionably a man of bad morals, the natural inference is, that the gift of prophecy was then, as afterwards, beftowed on individuals, not for their own fakes, but for the fake of the public; and that, as in "every nation, he who feareth God and worketh righteoufnefs is accepted of him;" fo in thofe early ages of the world, when mankind were but children in religious knowledge, they were bleffed with the light of divine revelation wherever they were difpofed to make a proper ufe of it.

Very few, however, appear to have had this difpofition; and therefore God was pleafed to adopt Abraham and part of his pofterity as the race from which the great Redeemer was to fpring, to train them up by degrees in fuitable notions of their Creator, and gradually to open up to them, as they were able to receive it, the nature of that difpenfation under which "all the nations of the earth were to be bleffed in the patriarch's feed, (fee PROPHECY, n° 13). For this purpofe, he held frequent correfpondence with them; and to ftrengthen and confirm their faith, to fix and preferve their dependence on the [illegible] God of heaven and earth, he [illegible] them [illegible] cent than that which preceded it. He bleffed Ifaac, miraculoufly increafed his fubftance, and foon made him the envy of the [illegible]. He [illegible] of his two fons, renewed the promife made to Abraham, and bleffed the adopted fon Jacob, with whom he condefcended to converfe as he had converfed with Abraham and Ifaac; renewed to him the great promife; [illegible] upon him all kinds of riches; and impreffing fuch terror upon all the cities which were round about him as prevented them from hurting either him or his family.

All this was indeed little enough to keep alive even in the mind of Jacob a tolerable fenfe of duty and dependence on his Creator. After the firft vifion he is furprifed, and hefitates, feeming inclined to make a kind of ftipulation with his Maker. "If (fays he) God will be with me, and will keep me in this way that I go, and will give me bread to eat, and raiment to put on, fo that I come again to my father's houfe in peace, *then* fhall the Lord be my God ||." It appears not to have been till after many fuch revelations, bleffings, and deliverances, and being reminded of the vow which on this occafion he had vowed, that he fet himfelf in good earneft to reform the religion of his own family, and to drive out from it all ftrange gods*. So little able, in that age, were the boafted powers of the human mind to preferve in the world juft notions of the unity of the Godhead, that we fee there was a neceffity for very frequent revelations, to prevent even the beft men from running headlong into polytheifm and idolatry.

|| Gen. xxviii. 20, 21.

* Gen. xxxv. 2.

Thus was God obliged to treat even with the patriarchs themfelves, by way of pofitive covenant and exprefs compact; to promife to be their God if they would be his people; to give them a portion of temporal bleffings as introductory to future and fpiritual ones; and to engage them in his fervice by immediate rewards, till they could be led on to higher views, and prepared by the bringing in of a better hope to worfhip him in fpirit and in truth. With regard to what may be called the *theory* of religion, mankind were yet fcarcely got out of their childhood. Some extraordinary perfons indeed occafionally appeared in different countries, fuch as Enoch, Noah, Abraham, and Job, with many others, who had a more enlarged profpect of things, and entertained more worthy fentiments of the divine difpenfations and of the ultimate end of man; but thefe were far fuperior to the times in which they lived, and appear to have been providentially raifed up to prevent the favage ftate and favage idolatry from becoming univerfal among men. See SAVAGE.

141
The patriarchal worfhip of thofe early ages performed in faith

The worfhip which was practifed by thofe holy men appears to have confifted principally of the three kinds of facrifice mentioned elfewhere (fee SACRIFICE); to which were doubtlefs added prayers and praifes, with the more valuable oblation of pure hands and devout hearts. Such of them as looked forward to a future redemption, and had any tolerable notion of the means by which it was to be effected, as Abraham certainly had, muft have been fenfible that the blood of bulls and of goats could never take away fin, and that their facrifices were therefore valuable only when they were offered in faith of that great promife, "which they, having

(U) There are great difputes among the learned refpecting the antiquity and the author of the *book* of Job, and whether it be a hiftory of events, or a poem which has its foundation in hiftory. All fober men, however, are agreed, that there really was fuch a *perfon* as Job, eminent for patience under uncommon fufferings; and that he was of very remote antiquity. The LXX. give us the names of his father and mother, and fay that he was the fifth from Abraham.

[illegible] Chriſt.

having ſeen it afar off, were perſuaded of, and embraced; and confeſſed that they were ſtrangers and pilgrims upon earth."

That ſuch perſons looked for "a better country, even a heavenly one," in a future ſtate, cannot be queſtioned; for they knew well how ſin and death had entered into the world, and they muſt have underſtood the promiſe made to their original progenitor, and repeatedly renewed to themſelves, to include in it a deliverance at ſome period from every conſequence of the firſt tranſgreſſion. They were to all intents and purpoſes Chriſtians as well as we. They in-

142
Of a future Redeemer;

deed placed their confidence in a Redeemer, who in the fulneſs of time was to appear upon earth, while we place ours in a Redeemer that has been already manifeſted; they expreſſed that confidence by one mode of worſhip, we expreſs it by another; but the patriarchal worſhip had the ſame end in view with the Chriſtian—the attainment of everlaſting life in heaven.

143
Such faith, however, not general

The generality of men, however, appear not, in the early age of which we now write, to have extended their views beyond the preſent life. From the confuſed remains of ancient tradition, they acknowledged indeed ſome ſuperior power or powers, to whom they frequently applied for direction in their affairs; but in all probability it was only for direction in temporal affairs, ſuch as the cultivation of the ground, or their tranſactions with each other. In the then ſtate of things, when no part of the world was overſtocked with inhabitants, and when luxury with its conſequences were everywhere unknown, virtue and vice muſt have produced their natural effects; and the good man being happy here, and the wicked man miſerable, reaſon had no data from which to infer the reality of a future ſtate of rewards and puniſhments. Thoſe who were bleſſed with the light of revelation undoubtedly looked forward to that ſtate with a holy joy; but the reſt worſhipped ſuperior powers from worldly motives. How many of thoſe powers there might be, or how far their influence might reach, they knew not. Uncertain whether there be one Supreme Governor of the whole world, or many co-ordinate powers preſiding each over a particular country, climate, or place—gods of the hills and of the valleys, as they were afterwards diſtinguiſhed—they thought that the more of theſe they could engage in their intereſt the better. Like the Samaritans therefore, in after times, they ſought, wherever they came, the "manners of the god of the land," and ſerved him, together with their own gods.

144
The purpoſe for which the Iſraelites [illegible] to ſojourn [illegible]

Thus was the world ready to loſe all knowledge of the true God and his worſhip, had not he been graciouſly pleaſed to interpoſe, and take effectual care to preſerve that knowledge in one nation, from which it might be conveyed to the reſt of mankind at different times, and in greater or leſs degrees, as they ſhould be capable of receiving it. To this purpoſe he made way for the removal of Jacob and his family to one of the moſt improved and poliſhed countries of the world; and introduced them into it in a manner ſo advantageous, as to give them an opportunity of imparting much religious knowledge to the natives. The natives, however, were groſs idolaters; and that his choſen people might be as far as poſſible from the contagion of their example, he placed them upon the borders of Egypt, where, though they multiplied exceedingly, they were by their very occupation † ſtill kept a ſeparate people, and muſt have been rendered, by a long and ſevere oppreſſion, in a great degree averſe from the manners and religion of their neighbours. This averſion, however, ſeems to have gradually become leſs and leſs; and before they were miraculouſly redeemed from their houſe of bondage, they had certainly loſt all correct notions of the unity of God, and the nature of his worſhip, and had adopted the greater part of the ſuperſtitions of their taſk-maſters. Of this we need no other proof than what is implied in the words of Moſes *, when he ſaid unto God, "Behold, when I come unto the children of Iſrael, and ſay unto them, the God of your fathers hath ſent me unto you; and they ſhall ſay unto me, WHAT IS HIS NAME? what ſhall I ſay unto them?" Had not the deſtined lawgiver of the Hebrews been aware that his countrymen had adopted a plurality of gods, this difficulty could not have occurred to him; for *names* are never thought of but to diſtinguiſh from each other beings of the ſame kind; and he muſt have remembered, that in Egypt, where the multitude of gods was marſhalled into various claſſes, the knowledge of their names was deemed of great importance. This we learn likewiſe from Herodotus, who informs us *, that the Pelaſgi, after ſettling in Greece, thought it neceſſary to conſult the oracle of Dodona, whether it would be proper to give to their own gods the names of the Egyptian divinities? and that the oracle, as might have been ſuppoſed, aſſured them that it would. Indeed the Hebrews during their reſidence in Egypt had acquired ſuch an attachment to the idolatrous worſhip of the country, that it appears never to have left them entirely till many ages afterwards, when they were carried captive into Babylon, and ſeverely puniſhed for their repeated apoſtacies; and ſo completely were they infatuated by theſe ſuperſtitions at the era of their exodus, that, as the prophet Ezekiel informs us *, they rebelled againſt God, and would not caſt away their abominations, or forſake the idols of Egypt, even in the *very day* that the hand of Omnipotence was lifted up to bring them forth of that land in which they had been ſo long and ſo cruelly oppreſſed. In ſuch a ſtate of things, to have ſuffered them to remain longer in Egypt, could have ſerved no good purpoſe; and therefore to fulfil the promiſe which he had given to Abraham, God determined to deliver them out of the hand of the Egyptians by means which ſhould convince both them and their offspring of his own ſupremacy over heaven and earth.

† Gen. xlvi. 33, 34.

* Exod. [illegible]

145
Conſeq[illegible] ces of it

* Lib. ii. cap. 52, 53.

* Ch. [illegible]

146
Moſes a[illegible] pointed [illegible] bring [illegible] out of [illegible] Egypt.

As Moſes was the perſon appointed to deliver God's meſſage to Pharaoh, and to demand of him leave for the Iſraelites to go three days journey into the wilderneſs to ſerve the God of their fathers, it was neceſſary that he ſhould be endowed with the power of making miracles to evince the reality of his divine miſſion. Without a conviction that his claims were well-founded, neither Pharaoh nor his own countrymen could reaſonably have been expected to liſten to the propoſals of a man who, though bleſſed in his youth with a princely education, had come directly on his embaſſy from the humble employment of a ſhepherd, which he had for many years exerciſed in the country of Midian. To prove that he was really ſent by God, any viſible and undoubted controul of the laws of nature would have been abundantly ſufficient; but he was to prove not only this truth, but alſo the unity of the Divine nature; and the miracles which he was directed to work were executions of judgments againſt the very gods of Egypt *.

* Exod. 12.

147
The pr[illegible] priety [illegible] the mir[illegible] which [illegible] wrough[illegible]

When Pharaoh firſt turned a deaf ear to his requeſt, tho' enforced by the converſion of a rod into a ſerpent, at the command of Jehovah he ſmote with the ſame rod upon the waters in the river, which were inſtantly converted into blood, and occaſioned the death of all the fiſhes that ſwam in them. To any people this miracle would have been a proof of Divine agency; but it was in a particular manner calculated to open the eyes of the blind and infatuated Egyptians, who conſidered the Nile as one of their greateſt gods, and all the fiſhes that it contained as ſubordinate divinities. They called that noble river ſometimes *Sirius*, ſometimes *Oſiris*, ſometimes *Canobus* (ſee CANOBUS), and not

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not unfrequently Ωκεανος (x); and adored it as the parent of all their deities. What then must the people have thought when they found their most revered god, at the command of a servant of Jehovah, converted into blood, and all his sacred offspring into stinking carcases? To conceive their consternation, if it can be conceived, the reader must remember, that the Egyptian priests held blood in the utmost abhorrence, as a thing of which the very touch would deeply pollute them, and require immediate and solemn expiation. The same sacred river was a second time polluted, when it sent forth frogs, which covered all the land of Egypt, and died in the houses, in the villages, and in the fields; thus rendering it impossible for the people to avoid the touch of dead bodies, though from every such contact they believed themselves to contract an impurity, which, in the case before us, must have been the more grievous, that in the whole country there was not left a pool of uninfected water to wash away the stain.

The third plague inflicted upon the Egyptians was, the converting of the dust of the land into lice, upon man and upon beast, throughout the whole kingdom. To see the propriety of this miracle as a judgment upon their idolatry, we must recollect their utter abhorrence of all kinds of vermin, and their extreme attention to external purity above every other people perhaps that has hitherto existed on the face of the earth. Upon this head they were more particularly solicitous when about to enter the temples of their gods; for Herodotus informs us, that their priests wore linen raiment only, and shaved off every hair from their heads and bodies, that there might be no *louse* or other detestable object upon them when performing their duty to the gods. This plague therefore, while it lasted, made it impossible for them to perform their idolatrous worship, without giving such offence to their deities as they imagined could never be forgiven. Hence we find, that on the production of the lice, the priests and magicians perceived immediately from what hand the miracle had come, and exclaimed, "This is the finger of God!" The fourth plague seems to have been likewise acknowledged to be the finger of God, if not by the magicians, at least by Pharaoh; for in a fit of terror he agreed that the Israelites should go and serve the Lord. That he was terrified at the swarms of flies which infested the whole country, except the land of Goshen, will excite no wonder, when it is known that the worship of the fly originated in Egypt; whence it was carried by the Caphtorim to Palestine; by the Phœnicians to Sidon, Tyre, and Babylon; and from these regions to other parts of the world. The denunciation of this plague was delivered to Pharaoh early in the morning, when he was on the banks of the Nile, probably paying his accustomed devotion to his greatest god; and when he found himself and his people tormented by a swarm of subordinate divinities, who executed the judgment of Jehovah in defiance of the power of the supreme *numen* of Egypt, he must have been convinced, had any candour remained in his mind, that the whole system of his superstition was a mass of absurdities, and that his gods were only humble instruments at the disposal of a Superior Power. He was not, however, convinced; he was only alarmed, and quickly relapsed into his wonted obstinacy. The fifth plague therefore, the murrain among the cattle, brought death and destruction upon his most revered gods themselves. Neither Osiris, nor Isis, nor Ammon, nor Pan, had power to save his brute representatives. The sacred bull, and heifer, and ram, and goat, were carried off by the same malady which swept away all the other herds of deities, these *dii stercorei*, who lived on grass and hay. The impression of this punishment must have been awful upon the minds of the Egyptians, but perhaps not equal to that which succeeded it.

In Egypt there were several altars on which human sacrifices were offered; and from the description of the persons qualified to be victims, it appears that those unhappy beings must have been foreigners, as they were required to have bright hair and a particular complexion. The hair of the Israelites was much brighter than that of the Egyptians, and their complexions fairer; and therefore there can be little doubt but that, during their residence in Egypt, they were made to furnish the victims demanded by the bloody gods. These victims being burnt alive on a high altar, and thus sacrificed for the good of the nation, their ashes were gathered together by the priests, and scattered upwards in the air, that a blessing might be entailed on every place to which an atom of this dust should be wafted. Moses too, by the direction of the true God, took ashes of the furnace, probably of one of those very furnaces in which some of his countrymen had been burnt, and sprinkling them towards heaven in the sight of Pharaoh, brought boils and blains upon all the people, of so malignant a nature, that the magicians and the other ministers of the medical gods, with which Egypt abounded beyond all other countries, could not themselves escape the infection.

The powers of darkness were thus foiled; but the heart of the monarch was still hardened. Destruction was therefore next brought upon him and his country by the elements, which were among the earliest idol deities not only of the Egyptians, but of every other polytheistic nation. "The Lord rained hail upon the land of Egypt; so that there was hail, and fire mingled with the hail, such as there was none like it in all the land of Egypt since it became a nation. And the hail smote throughout all the land of Egypt all that was in the field, both man and beast; and the hail smote every herb of the field, and broke every tree of the field." This was a dreadful calamity in itself; and the horror which it excited in the minds of the people must have been greatly aggravated by the well-known fact, that Egypt is blessed with a sky uncommonly serene; that in the greatest part of it rain has never been seen at any other time since the creation of the world; and that a slight and transient shower is the utmost that in the ordinary course of nature falls anywhere throughout the country. The small quantity of vegetables which was left undestroyed by the fire and the hail was afterwards devoured by locusts, which by a strong east wind were brought in such numbers from Arabia, where they abound at all times, that they covered the whole face of the earth, and did eat every herb of the land, and all the fruit of the trees, so that there remained not any green thing in the trees or in the herbs of the field through all the land of Egypt.

The ninth plague which the obstinacy of Pharoah brought upon his country, whilst it severely punished the Egyptians for their cruelty to the Hebrews, struck at the very foundation of all idolatry. We have elsewhere shown, that the first objects of idolatrous worship were the contending powers of light and darkness (see POLYTHEISM); and that the benevolent principle, or the power of light, was everywhere believed to maintain a constant superiority over the power of darkness. Such was the faith of the ancient Persians; and such, as a very learned writer has lately proved, was like-

wise

(x) Whence came the Greek word ωκεανος, *the ocean*.

with the worship of the earlier Egyptians. It was therefore with wisdom truly divine, that God, to show the vanity of their imaginations, brought upon those votaries of light, who boasted themselves the offspring of the sun, a preternatural darkness, which, for three days, all the power of their supreme deity and his subordinate agents could not dispel!

The tenth and last plague brought upon this idolatrous people was more universally and severely felt than any which had preceded it. It was likewise, in some sense, an instance of the *lex talionis*, which requires an eye for an eye, and a tooth for a tooth, &c. Moses was commanded, at his first interview with Pharaoh, to say, "Thus saith the Lord, Israel is my son, even my first born. Let my son go that he may serve me: and if thou refuse to let him go, behold, I will slay thy son, even thy first born." Before this threat was put in execution, every attempt was made to soften the hardened heart of the obstinate tyrant. The waters of his sacred river were turned into blood; and all the fishes that it contained slain; frogs were brought over all the land to pollute the people; the ministers of religion were rendered so impure by vermin, that they could not discharge their wonted offices; the animals most revered as gods, or emblems of gods, were cut off by a murrain; the elements, that were everywhere worshipped as divinities, carried through the land a devastation, which was completed by swarms of locusts; the ashes from the sacred furnace, which were thought to convey blessings whithersoever they were wafted, were made to communicate incurable diseases; a thick and preternatural darkness was spread over the kingdom, in defiance of the power of the great Osiris; and when the hearts of the people and their sovereign continued still obdurate, the eldest son in each family was slain, because they refused to let go Israel, God's first-born. From this universal pestilence the Israelites were preserved by sprinkling the door-posts of their houses with the blood of one of the animals adored in Egypt; a fact which, as it could not be unknown to Pharaoh or his subjects, ought to have convinced that people of the extreme absurdity of their impious superstitions. This effect it seems not to have had; but the death of the first-born produced the deliverance of the Hebrews; for when it was found that there was not a house where there was not one dead, "Pharaoh called for Moses and Aaron by night, and said, Rise up, and get you forth from among my people, both you and the children of Israel; and bless me also. And the Egyptians were urgent upon the people, that they might send them out of the land in haste; for they said, We be all dead men (Y)." The wonted obstinacy of the monarch indeed very soon returned; and his subjects, forgetting the loss of their children, joined with him in a vain attempt to bring back to bondage the very people whom they had been thus urgent to send out of the land; but their attempt was defeated by Jehovah, and all who engaged in it drowned in the Red Sea.

The God of Israel having thus magnified himself over the Egyptians and their gods, and rescued his people from bondage by such means as must not only have struck terror and astonishment into the whole land, but also have spread his name through all the countries which had any communication with that far famed nation, proceeded to instruct and exercise the Hebrews for many years in the wilderness. He inculcated upon them the unity of the Godhead; gave them statutes and judgments more righteous than those of any other nation; and by every method consistent with the freedom of moral agency guarded them against the contagion of idolatry and polytheism. He sent his angel before them to keep them in the way, took upon himself the office of their supreme civil governor, and by his presence directed them in all their undertakings. He led them with repeated signs and wonders through the neighbouring nations, continued to try and discipline them till they were tolerably attached to his government and established in his worship, and introduced them into the Promised Land when its inhabitants were ripe for destruction. At their entrance into it, he gave them a summary repetition of their former laws, with more such ordinances, both of a ceremonial and moral kind, as were both suited to their temper and circumstances, as well as to prefigure, and by degrees to prepare them for, a more perfect dispensation under the Messiah.

Theolo[gy] from t[he] fall of [A]dam to [the] coming [of] Christ.

149 Reason [for] detaining the Israelites so lo[ng] in the wilderness.

The Jewish law had two great objects in view; of which the first was to preserve among them the knowledge of the true God, a rational worship springing from that knowledge, and the regular practice of moral virtue; and the second was to fit them for receiving the accomplishment of the great promise made to their ancestors, by means analogous to those which a schoolmaster employs to fit his pupils for discharging the duties of maturer years. Every thing in that law peculiar to itself, its various ceremonies, modes of sacrificing, the sanctions by which it was enforced, and the theocratic government by which it was administered, had a direct tendency to promote one or other of these ends; and keeping these ends in view, even the minutest laws, at which impious ignorance has affected to make itself merry, will be discovered by those who shall study the whole system, and are at the same time acquainted with the genuis of ancient polytheism, to have been enacted with the most consummate wisdom.

150 Great ob[jects] of th[e] Jewish la[w].

It is not easy for us, who have been long blessed with the light of revelation, and who have cultivated our minds by the study of the sciences, to conceive the propensity of all nations, in that early age of the world, to the worship of false gods, of which they were daily adding to the number. It is indeed probable, from many passages of Scripture, as well as from profane authors of the greatest antiquity, that one supreme *numen* was everywhere acknowledged; but he was considered as an extramundane being, too highly exalted to concern himself with the affairs of this world, the government of which, it was believed, he had delegated to various orders of subordinate deities. Of those deities, some were supposed to have the charge of one nation and some of another. Hence it is, that we read of the gods of Egypt, the gods of the Amorites, and the gods of the different nations round about Palestine. None of those nations denied the existence of their neighbour's gods; but all agreed, that while the Egyptians were the peculiar care of Osiris and Isis, the Amorites might be the favourites of Moloch, the Phœnicians of Cronus, and the Philistines of Dagon; and they

(Y) For this account of the plagues of Egypt, we are indebted to the very valuable *Observations* on the subject lately published by *Mr Bryant*. We have not quoted the authorities by which the learned and pious author supports his opinions; because it is to be hoped, that for a fuller account of these important transactions the reader will have recourse to his work, of which we have given only a very brief abstract. For much of the preceding parts of this section, we acknowledge our obligations to the late Bishop Law's admirable discourse on the *Several Dispensations of Revealed Religion*.

they had no objection occasionally to join with each other in the worship of their respective tutelary deities. Nay, it was thought impiety in foreigners, while they sojourned in a strange country, not to sacrifice to the gods of the place. Thus Sophocles makes Antigone say to her father, that a stranger should both venerate and abhor those things which are venerated and abhorred in the city where he resides; and another author *, who, though comparatively late, drew much of his information from ancient writings, which are now lost, assures us, that this complaisance proceeded from the belief that the "several parts of the world were from the beginning distributed to several powers, of which each had his peculiar allotment and residence."

From this notion of local divinities, whose power or partial fondness was confined to one people, the Israelites, at their exodus from Egypt, appear not to have been free (z). Hence it is, that when the true God first tells them, by their leader Moses *, that if they would obey his voice indeed and keep his covenant, then they should be a PECULIAR TREASURE to him above all people: to prevent them from supposing that he shared the earth with the idols of the heathen, and had from partial fondness chosen them for his *portion*, he immediately adds, for ALL THE EARTH IS MINE. By this addition he gave them plainly to understand that they were chosen to be his peculiar treasure for some purpose of general importance; and the very first article of the covenant which they were to keep was, that they should have no other gods but him. So inveterate, however, was the principle which led to an intercommunity of the objects of worship, that they could not have kept this article of the covenant but in a state of separation from the rest of mankind †; and that separation could neither have been effected nor continued without the visible providence of the Almighty watching over them as his peculiar treasure. This we learn from Moses himself, who, when interceding for the people after their idolatrous worship of the golden calf, and intreating that the presence of God would still accompany them, adds these words §: "For wherein shall it be known here that I and thy people have found grace in thy sight? Is it not in that THOU GOEST WITH US? So shall we be SEPARATED, I and thy people, from all the people that are upon the face of the earth." Upon this separation every thing depended; and therefore to render it the more secure, Jehovah, who in compliance with their prejudices had already assumed the appellation of their tutelary God, was graciously pleased to become likewise their supreme Magistrate, making them a "kingdom of priests and a holy nation," and delivering to them a digest as well of their civil as of their religious laws.

The Almighty thus becoming their King, the government of the Israelites was properly a THEOCRACY, in which the two societies, civil and religious, were of course incorporated. They had indeed after their settlement in the Promised Land, at first, temporary *judges* occasionally raised up; and afterwards permanent magistrates called *kings*, to lead their armies in war, and to give vigour to the administration of justice in peace: but neither those judges nor those kings could abrogate a single law of the original code, or make the smallest addition to it but by the spirit of prophecy. They cannot therefore be considered as supreme magistrates, by whatever title they may have been known; for they were to go out and come in at the word of the priests, who were to ask counsel for them of the Lord, and with whom they were even associated in all judicial proceedings, as well of a civil as of a spiritual nature *. Under any other than a theocratic government the Hebrews could not have been kept separate from the nations around them; or if they could, that separation would not have answered the great purpose for which it was established. "The people, on their leaving Egypt, were sunk into the lowest practices of idolatry. To recover them by the discipline of a separation, it was necessary that the idea of God and his attributes should be impressed upon them in the most *sensible* manner. But this could not be commodiously done under his character of God of the universe: under his character of King of Israel, it well might. Hence it is, that we find him in the Old Testament so frequently represented with affections analogous to human passions. The civil relation in which he stood to the Israelites made such a representation natural; the grossness of their conceptions made the representation necessary; and the guarded manner in which it was always qualified prevented it from being mischievous *." Hence too it is, that under the Mosaic dispensation, idolatry was a crime of state, punishable by the civil magistrate. It was indeed high treason, against which laws were enacted upon the justest principles, and carried into effect without danger of error. Nothing less indeed than penal laws of the severest kind could have restrained the violent propensity of that headstrong people to worship, together with their own God, the gods of the Heathen. But penal laws enacted by human authority for errors in religion are manifestly unjust; and therefore a theocratic government seems to have been absolutely necessary to obtain the end for which the Israelites were separated from the surrounding nations.

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* Num. xxvii 21. and Deut. xvii 8—13.

* Warburton's Div. Leg. b. v. sec. 2.

153 And of the ritual laws.

It was for the same purpose of guarding them against idolatry, and preventing all undue communications with their Heathen neighbours, that the ritual law was given, after their presumptuous rebellions in the wilderness. Before the business of the golden calf, and their frequent attempts to return into Egypt, it seems not to have been the Divine intention to lay upon them a yoke of ordinances; but to make his covenant depend entirely upon their duly practising the rite of circumcision; observing the festivals instituted in commemoration of their deliverance from bondage, and other signal services vouchsafed them; and keeping inviolate all the precepts of the decalogue (A), which, if they had done, they should have even lived in them *. But after their repeated apostacies, and impious wishes to mix with the surrounding nations, it was necessary to subject them

* Divine Leg. b. iv. sec. 6.

(z) It is not indeed evident that they had got entirely quit of this absurd opinion at a much later period. Jephtha, one of their judges, who, though half paganized (as Warburton observes) by a bad education, had probably as correct notions of religion as an ordinary Israelite, certainly talked to the king of Ammon as if he had believed the different nations of the earth to be under the immediate protection of different deities: "Wilt not thou (says he) possess that which Chemosh THY GOD giveth thee to possess? So whomsoever the Lord OUR GOD shall drive out from before us, them will we possess." (Judges xi. 24).

(A) Of these precepts we think it not necessary, in an abstract so short as this, to waste the reader's time with a formal and laboured defence. To the decalogue no objection can be made by any man who admits the obligations of natural religion; for, except the observation of the Sabbath-day, it enjoins not a single duty which does not by the confession of all men result from our relations to God, ourselves, and our fellow-creatures.

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them to a multifarious ritual, of which the ceremonial parts were solemn and splendid, fitted to engage and fix the attention of a people whose hearts were gross; to inspire them with awful reverence, and to withdraw their affections from the pomp and pageantry of those idle superstitions which they had so long witnessed in the land of Egypt. To keep them warmly attached to their public worship, that worship was loaded with operose and magnificent rites, and so completely incorporated with their civil polity as to make the same things at once duties of religion and acts of state. The service of God was indeed so ordered as to be the constant business as well as entertainment of their lives, supplying the place of all other entertainments; and the sacrifices which they were commanded to offer on the most solemn occasions, were of such animals as the Egyptians and other Heathens deemed sacred.

154
Instanced in their sacrifices.

Thus a heifer without blemish was in Egypt held sacred to the goddess Isis, and actually worshipped as the representative of that divinity; but the same kind of heifer was by the ritual law of the Hebrews commanded to be burnt without the camp, as the vilest animal, and the water of separation to be prepared from her ashes †. The goat was by the Egyptians held in great veneration as emblematical of their ancient god Pan, and sacrifices of the most abominable kind were offered to the impure animal (see PAN); but God, by his servant Moses, enjoined the Israelites to offer goats themselves as sacrifices for sin, and on one occasion to dismiss the live animal loaded with maledictions into the wilderness *. The Egyptians, with singular zeal, worshipped a calf without blemish as the symbol of Apis, or the god of fertility; and it appears from the book of Exodus, that the Israelites themselves had been infected with that superstition. They were, however, so far from being permitted by their Divine lawgiver to consider that animal as in any respect sacred, that their priests were commanded to offer for themselves a young calf as a sin offering ||. No animal was in Egypt held in greater veneration than the ram, the symbol of their god Ammon, one of the heavenly constellations. It was therefore with wisdom truly divine, that Jehovah, at the institution of the passover, ordered his people to kill and eat a young ram on the very day that the Egyptians began their annual solemnities § in honour of that animal as one of their greatest gods; and that he enjoined the blood of this divinity to be sprinkled as a sign upon the two side-posts and upper door-post of the house in which he was eaten. Surely it is not in the power of imagination to conceive a ritual better calculated to cure the Israelites of their propensity to idol worship, or to keep them separate from the people who had first given them that propensity, than one which enjoined them to offer in sacrifice the very creatures which their superstitious masters had worshipped as gods. "Shall we (said Moses) sacrifice the abominations of the Egyptians before their eyes, and will they not stone us?"

† Num. xix.

* Levit. xvi.

|| Lev. ix.

§ *Spencer de Legibus Heb. Rit.* lib. ii. cap. 4.

But it was not against Egyptian idolatry only that the ritual law was framed: the nations of Syria, in the midst of whom the Israelites were to dwell, were addicted to many cruel and absurd superstitions, against which it was as necessary to guard the people of God as against the brute-worship of Egypt. We need not inform any reader of the books of Moses that those nations worshipped the sun and moon and all the host of heaven; or that it was part of their religion to propitiate their offended gods by occasionally sacrificing their sons and their daughters. From such worship and such sacrifices the Israelites were prohibited under the severest penalties; but we cannot consider that prohibition as making part of the *ritual* law, since it relates to practices impious and immoral in themselves, and therefore declared to be abominations to the Lord. The Phœnicians, however, and the Canaanites, entertained an opinion that every child came into the world with a *polluted nature*, and that this pollution could be removed only by a *lustral fire*. Hence they took their new-born infants, and with particular ceremonies made them pass through the flame of a pile sacred to Baal or Moloch, the symbols of their great god the sun. Sometimes this purgation was delayed till the children had arrived at their tenth or twelfth year, when they were made either to leap through the flame, or run several times backwards and forwards between two contiguous sacred fires; and this lustration was supposed to free them from every natural pollution, and to make them through life the peculiar care of the deity in whose honour it was performed *. The true God, however, who would have no fellowship with idols, forbade all such purgations among his people, whether done by fires consecrated to himself or to the bloody deities of the Syrian nations. "There shall not be found (says he) among you any one that maketh his son or his daughter to pass through the fire †."

155
And in the laws relating eating and drinking, and agricult

* *Spencer* lib. ii. c. 13.

† Deut. xvii. 10. 29. and Levit. 2, &c.

There are, in the Jewish law, few precepts more frequently repeated than that which prohibits the seething of a kid in its mother's milk ||; and there being no moral fitness in this precept when considered absolutely and without regard to the circumstances under which it was given, infidel ignorance has frequently thought fit to make it the subject of profane ridicule. But the ridicule will be forborne by those who know that, among the nations round Judea, the feasting upon a kid boiled in its mother's milk was an essential part of the impious and magical ceremonies celebrated in honour of one of their gods, who was supposed to have been suckled by a she-goat. Hence, in the Samaritan Pentateuch, the text runs thus; "Thou shalt not seeth a kid in its mother's milk; for whoever does so, is as one who sacrifices an abominable thing, which offends the God of Jacob §." Another precept, apparently of very little importance, is given in these words: "Ye shall not round the corners of your heads, neither shalt thou mar the corners of thy beard *." But its wisdom is seen at once, when we know that at funerals it was the practice of many of the heathens, in that early period, to round the corners of their heads, and mar their beards, that by throwing the hairs they had cut off upon the dead body, or the funeral pile, they might propitiate the shade of the departed hero; and that in other nations, particularly in Phœnicia, it was customary to cut off all the hair of their heads except what grew upon the crown, which, with great solemnity, was consecrated either to the sun or to Saturn †. The unlearned Christian, if he be a man of reflection, must read with some degree of wonder such laws as these: "Thou shalt not sow thy vineyard with divers seeds, lest the fruit of thy seed which thou hast sown and the fruits of thy vineyard be defiled. Thou shalt not plow with an ox and an ass together. Thou shalt not wear a garment of divers sorts, or of woollen and linen together ‡." But his wonder will cease when he knows that all these were practices from which the Sabian idolaters of the east expected the greatest advantages. Their belief in magic and judicial astrology led them to imagine, that by sowing different kinds of corn among their vines they should propitiate the gods which were afterwards known in Rome by the names of Bacchus and Ceres; that, by yoking animals so heterogeneous as the ox and the ass in the same plough, they should by a charm secure the favour of the deities who presided over the affairs of husbandry; and that a garment composed of linen and woollen, worn under certain conjunctions of the stars, would protect its owner, his flocks, his herds, and his field, from all malign influences, and render him in the highest

|| Exod. 19. xxx 26. Deu xiv. 21.

§ *Spencer* lib. ii. c. 9.

* Levit. xix. 27.

† *Spencer* lib. ii. ca 18.

‡ Deut. xxii. 9, 10, 11

ry degree prosperous through the whole course of his life .. But magical ceremonies, of which the very essence seems to have consisted in uniting in one group or jumble things never brought together by nature, were always performed in order to render propitious good or evil demons (see Magic); and therefore such ceremonies, however unimportant in themselves, were in that age most wisely prohibited in the Mosaic law, as they naturally led those who were addicted to them to the worship of idols and impure spirits.

If the whole ritual of the Jewish economy be examined in this manner, every precept in it will be found to be directed against some idolatrous practice of the age in which it was given. It was therefore admirably calculated to keep the Israelites a separate people, and to prevent too close an intercourse between them and their Gentile neighbours. And their civil institutes, even those which appear the most trifling, were all contrived with the most consummate wisdom to promote the same end. The distinction made by their law between clean and unclean animals (see Slavery, n° 23.) rendered it impossible for them, without a breach of that law, to eat and drink with their idolatrous neighbours; their sacred and civil ceremonies being directly levelled against the Egyptian, Zabian, and Canaanitish superstitions, had a tendency to generate in their minds a keen contempt of those superstitions; and that contempt must have been greatly increased by their yearly, monthly, and daily sacrifices, of the very animals which their Egyptian masters had worshipped as gods.

That these laws might have the fuller effect upon minds gross and carnal, they were all enforced by temporal sanctions. This was indeed the natural and even necessary consequence of the theocratic government established in Israel; for when God condescended to become their supreme civil magistrate, he of course engaged to execute, either immediately by himself, or by the medium of his vicegerents the judges and the kings, all the offices included in such magistracy. Hence it is that Moses assured them, that if they would hearken to God's judgments, and keep them, and do them, they should be blessed above all people; threatening them at the same time with utter destruction if they should at all walk after other gods, and serve them, and worship them ‡. Nor were these temporal rewards and punishments held out only to the nation as a collective body; they were promised and threatened to every individual in his private capacity as the certain consequences of his obedience or disobedience. Every particular Hebrew was commanded to honour his father and mother, that it might go well with him, and that his days might be prolonged; whilst he who cursed his father or his mother was surely to be put to death. Against every idolater, and even against the wilful transgressor of the ceremonial law, God repeatedly declared that he would set his face, and would cut off that man from among his people: and that individuals, as well as the nation, were in this life actually rewarded and punished according to their deserts, has been proved by bishop Warburton with a force of evidence ‖ which must carry conviction to every mind which his lordship's rude railings at some favourite system have not filled with prejudices against all his works. Indeed the Mosaic law, taken in its literal sense, holds out no other prospects to the Israelites than temporal happiness; such as, health, long life, peace, plenty, and dominion, if they should keep the covenant; and temporal misery, *viz.* diseases, immature death, war, famine, want, subjection, and captivity, if they should break it. "See (says Moses), I have set before thee this day life and good, death and evil; in that I command thee this day to love the Lord thy God, to walk in his ways, and to keep his commandments, and his statutes, and his judgments, that thou mayest live and multiply; and the Lord thy God shall bless thee in the land whither thou goest to possess it. But if thine heart turn away, so that thou wilt not hear, but shalt be drawn away, and worship other gods, and serve them; I denounce unto you this day, that ye shall surely perish, and that ye shall not prolong your days upon the land whither thou passest over Jordan to possess it." And elsewhere, having informed them that, upon their apostacy, their land should be rendered like Sodom and Gomorrah, he adds, that all men should know the reason of such barrenness being brought upon it, and should say, "Because they have forsaken the covenant of the Lord God of their fathers, which he made with them when he brought them forth out of the land of Egypt; the anger of the Lord was kindled against this land, to bring upon it all the curses that are written in this book ‡."

Theology from the fall of Adam to the coming of Christ.

‡ Deut. xxx. — 19. xxix. 27.

157
Whence it has been falsely inferred that the ancient Hebrews had no hope beyond the grave.

From this notorious fact, which hardly any man of letters will now dare to deny, some divines have concluded, we think rashly, that the ancient Israelites had no hope whatever beyond the grave; and that in the whole Old Testament there is not a single intimation of a future state. That many of the lowest vulgar, who could neither read nor write, were in this state of darkness, may be true; but it is impossible that such of them as understood the book of Genesis could be ignorant that death came into the world by the transgression of their first parents, and that God had repeatedly promised to redeem mankind from every consequence of that transgression. They must likewise have known that, before the deluge, Enoch was translated into heaven without tasting death; that afterwards Elijah had the same exemption from the common lot of humanity; and that, as God is no respecter of persons, every one who served him with the zeal and fidelity of these two prophets would, by some means or other, be made capable of enjoying the same rewards. The God of Abraham, Isaac, and Jacob, was not the God of the dead, but of the living.

In the earliest periods of their commonwealth, the Israelites could, indeed, only *infer*, from different passages of their sacred books, that there would be a general resurrection of the dead, and a future state of rewards and punishments; but from the writings of the prophets it appears, that before the Babylonish captivity that doctrine must have been very generally received. We shall not, in support of our opinion, quote the famous passage in the book of Job §, because it is not determined at what period that beautiful and sublime poem was admitted into the Jewish canon; but in the Psalms, and in the prophecies of Isaiah, Daniel, and Ezekiel, there are several texts which seem to us to prove, incontrovertibly, that, at the time when these inspired books were written, every Israelite who could read the scriptures must have had some hopes of a resurrection from the dead. We shall consider two of these texts, because they have been quoted by a very learned and valuable writer in support of an opinion the reverse of ours.

§ Chap. xix. verse 25, &c.

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The principal opinion confuted.

In a sublime song, composed with a view to incite the people to confidence in God, the prophet Isaiah has these remarkable words; "Thy dead men shall live; together with my dead body shall they arise. Awake and sing, ye that dwell in the dust; for thy dew is as the dew of herbs, and the earth shall cast out the dead ‡." We agree with bishop Warburton that these words are figurative, and that they were uttered to give the Israelites consolation in very disastrous times. The purpose of the prophet was to assure them, that though their community should, in Babylon, be as completely dissolved as a dead body reduced to dust, yet God would restore them to their own land, and raise that community again to life. This was indeed a prophecy only of a temporal deliverance; but as it is expressed in terms relating

‡ Chap. xxvi. 19.

relating to the death and resurrection of man, the doctrine of a resurrection must then have been well known and generally received, or such language would have been altogether unintelligible. For [illegible]; that the language might be used, it is [illegible] necessary that the Israelites should have entertained ideas of a resurrection from the dead, without assuming that the natural body is indeed to rise again; and as he thinks that such metaphorical expressions as this would have the greatest force where the doctrine of the resurrection was unknown, he concludes that it must have been unknown among the Israelites in the days of Isaiah *.

Christ.

* Div. Leg. book vi. sect. 2.

Had there been no sacred books among the Israelites before this prophecy was uttered, his lordship's reasoning would have been at least plausible, if not conclusive; but that a people who knew how death had entered into the world, who believed that they were by some means or other to be saved from its sting, who, it is natural to suppose, often meditated upon the bruising of the serpent's head, and the nature of the blessing which all nations were to derive from the seed of Abraham, should form distinct *ideas* of a resurrection, and read this prophecy without believing that the natural body is *indeed to rise again*, we cannot possibly conceive. The very supposition is one of his lordship's most irreconcileable paradoxes; and it is a paradox which his system did not require him to support.

The prophet Ezekiel, when the state of things was most desperate, is carried by the Spirit into a valley full of dry bones, and asked this question; "Son of man, can these bones live?" To which he answers; "O Lord God, thou knowest †;" an answer which the same learned prelate thinks the prophet could not have made, had he been brought up in the knowledge and belief of a resurrection from the dead. Our opinion is directly the reverse of that of his lordship, who seems to have mistaken the nature of this scenical representation. The prophet was not asked if *all* the dead would rise at the last day; but only if the particular bones *then* presented to him could live at *that time*, and while other bones were mouldering in corruption: and to such a question we cannot conceive any answer that a man brought up in the belief of a general resurrection could have given, but—"O Lord God, thou knowest." Had Ezekiel been a stranger to the doctrine of a general resurrection, or had he not believed that doctrine, he would doubtless have answered the question that was put to him in the negative; but convinced that *all* men are at *one* period to rise from the dead, "that every one may receive the things done in his body, according to that he hath done, whether it be good or bad," he very naturally said, that God alone knew whether the bones then exhibited to him in the valley would rise before the general resurrection.

† Chap. xxxvii. 3.

But though the more intelligent and righteous Israelites certainly "all died in faith, and not having received the promises, but having seen them afar off, were persuaded of them and embraced them, confessing that they were strangers and pilgrims on earth, who desired a better country, that is, a heavenly one ‡," we are not to suppose that this heavenly desire arose from any thing taught in the law of Moses. That law, when taken by itself, as unconnected with prior and subsequent revelations, makes no mention whatever of a heavenly inheritance, which St Paul assures us § was given 430 years before to Abraham by a promise which may be traced back to the first ray of comfort vouchsafed to fallen man in the sentence passed on the original deceiver. "Wherefore then served the law? It was added (says the apostle), because of transgressions, till the seed should come to whom the promise was made." The transgressions here alluded to were polytheism and idolatry, which, with their never-failing train of cruel and detestable vices, had overspread the whole world; and the primary intention of the law was to stem the torrent of these corruptions, for which we have seen it was admirably calculated; and, like a schoolmaster, to instruct the Israelites in the unity and worship of Jehovah, and thus by degrees bring them to Christ.

‡ Heb. xi. 13, &c.

§ Gal. iii. 16—19.

But though it is apparent that a future state of rewards and punishments made no part of the Mosaic dispensation, yet the law had certainly a spiritual meaning to be understood when the fulness of time should come. Every Christian sees a striking resemblance between the sacrifice of the paschal lamb, which delivered the Israelites from the destroying angel in Egypt, and the sacrifice of the Lamb of God, which taketh away the sin of the world. Indeed the whole ritual of sacrifice must have led the more intelligent of them to faith in a future sacrifice; by which, while the heel of the seed of the woman should be bruised, the head of the serpent should be completely crushed (see SACRIFICE); and as prophets were raised up from time to time, to prepare them for the coming of the Messiah, and to foretel the nature of his kingdom, there can be no doubt but that those inspired teachers would lay open to them, as far as was expedient, the temporary duration of the Mosaic law, and convince them that it was only the shadow of better things to come. From the nature of their ritual, and the different prophecies vouchsafed them, which became more and more explicit as the time approached for their accomplishment, they must surely have been led to expect redemption from the curse of the fall by the sufferings of their Messiah; but that any one of them knew precisely the *manner* in which they were to be redeemed, and the nature of that religion which was to supersede their own, is wholly incredible (B). Such knowledge would have

Why the law was typical.

(B) This doctrine is stated in so clear a light by bishop Bull, whom, as a divine, we think the glory of the church of England, and who has had few superiors in any church, that the learned reader will be pleased to have his opinions in his own words. "An igitur, inquies, fuerunt sub lege, qui vitam æternam sperarent? Resp. Qui meliores erant et perspicaciores in populo Judaico, verosimile est eos seu generalium promissionum vi, seu temporalium bonorum levi æstimatione, seu divinæ bonitatis intuitu, seu animæ suæ, melioris quam caduci boni appetentis, consideratione, seu Enochi exemplo (cui sequiori ævo accessit Eliæ raptus) seu Patriarcharum traditione, (quibus Deus multis indiciis spem futurorum bonorum fecerat. in quorum indiciorum genere non minimum erat et illud, quod multi eximie boni terrestris felicitatis expertes vixerint. quod argumentum late exsequitur Scriptor ad Hebræos cap. 11.) seu aliis rationibus adductos credidisse, Deum, præter specialia ista bona ad hanc vitam pertinentia, et legibus Mosaicis comprehensa, etiam alia post mortem cultoribus suis bonis largiri velle. Imo statuendum illud omnino est, ne viros sanctos eximiosque in populo Dei tam indar tum vixisse, tum devixisse credatur. Nec refert, quod hujus fidei vix ac ne vix quidem ulla in Canonicis V. T. Scripturis mentio fiat. Nam certum est, Abrahamum filium promissionis, mactare jussum non recusasse, hac ratiocinatione sustentatum, Deum potentia tanta præditum esse, ut filium jam mortuum in vitam revocare, eumque ei redivivum restituere possit. Certum, inquam, illud est, quia divinus Autor Epistolæ ad Hebræos id diserte testatur, cap.

gy have made them impatient under the yoke of ordinances to which they were subjected; for after the Christian faith came into full splendour, mankind could be no longer under the tuition of such a schoolmaster as the law, which "had only a *shadow* of good things; and so far from their reality, not even the very *image* of them †." Through these shadows, however, the Jews, aided by the clearer light of prophecy, though it too shone in a dark place, might have seen enough of God's plan of redemption to make them acknowledge Jesus of Nazareth, when he came among them working miracles of mercy, for the Messiah so long promised to their forefathers, and in whom it was repeatedly said, that all the nations of the earth should be blessed.

While such care was taken to prepare the descendants of Abraham for the coming of the Prince of Peace, we must not suppose that God was a respecter of persons, and that the rest of the world was totally neglected. The dispersion of the ten tribes certainly contributed to spread the knowledge of the true God among the eastern nations. The subsequent captivity of the tribes of Judah and Benjamin must have confirmed that knowledge in the great empires of Babylon and Persia; and that particular providence of God which afterwards led Ptolemy Philadelphus to have the Jewish scriptures translated into the Greek language, laid the divine oracles open to the study of every accomplished scholar. At last, when the arms of Rome had conquered the civilized world, and rendered Judea a province of the empire; when Augustus had given peace to that empire, and men were at leisure to cultivate the arts and sciences; when the different sects of philosophers had by their disputations whetted each others understandings so that none of them was disposed to submit to an imposture; and when the police of the Roman government was such that intelligence of every thing important was quickly transmitted from the most distant provinces to the capital of the empire; "when that fulness of time was come, God sent forth his Son made of a woman, made under the law, to redeem them that were under the law, that we might receive the adoption of sons," and be restored to that inheritance of which the forfeiture introduced the several dispensations of revealed religion into the world.

Sect. V. *View of Theology, more peculiarly Christian.*

Mankind being trained by various dispensations of providence for the reception of that seed of Abraham, in whom all the nations of the earth were to be blessed, and the time fixed by the Jewish prophets for his coming being arrived, "a messenger was sent before his face to prepare his way before him by preaching the baptism of repentance for the remission of sins." This messenger was John the Baptist, a very extraordinary man, and the greatest of all the prophets. His birth was miraculous, the scene of his ministry the wilderness, his manners austere, and his preaching energetic, without respect of persons. He candidly told his audience that he was not the Messiah, that the Messiah would soon appear among them, that "he was mightier than himself, and that he would baptise them with the Holy Ghost and with fire."

Mightier indeed he was; for though born of a woman, the Messiah was not the son of a human father; and though living for the first thirty years of his life in obscurity and poverty, he was the lineal descendant of David, and heir to the throne of Israel. But the dignity of his human descent, great as it was, vanishes from consideration when compared with the glory which he had with his Father before the world was. The Jewish dispensation was given by the ministry of Moses, and illustrated by subsequent revelations vouchsafed to the prophets; the immediate author of the Christian religion is the λογος or second person of the blessed Trinity, of whom St John declares, that "he was in the beginning with God, and was God; that all things were made by him; and that without him was not any thing made that was made." We have already proved that in the one Godhead there is a Trinity of persons; and that the λογος is one of the three, is apparent from these words of the apostle, and from many other passages of sacred scripture. Thus he is called *the Lord of hosts himself; the first and the last, besides whom there is no God; the most high God; God blessed for ever; the mighty God, the everlasting Father, Jehovah our righteousness*; and *the only wise God our Saviour* (c). This great Being, as the same apostle assures us, was made flesh, and dwelt among men; not that the divine nature was or could be changed into humanity, for God is immutable, the same Almighty and incomprehensible Spirit yesterday, to-day, and forever; but the word or second person in the godhead, assuming a human soul and body into a personal union with himself, dwelt upon earth as a man, veiling his divinity under mortal flesh. Hence he is said elsewhere to have been "manifested in the flesh," and "to have taken upon him the nature of man;" phrases of the same import with that which asserts "the Word to have been made flesh."

162 Objections to the incarnation of the word

This incarnation of the Son of God is perhaps the greatest mystery of the Christian faith, and that to which ancient and modern heretics have urged the most plausible objections. The doctrine of the Trinity is indeed equally incomprehensible; but the nature of God and the mode of his subsistence, as revealed in scripture, no man, who thinks, can be surprised that he does not comprehend; for a revelation which should teach nothing mysterious on such a subject would be as incredible and as useless as another which contained

cap. 11. 19. Hujus tamen vere admirandæ fidei, atque Evangelicæ supparis, in historia Abrahami nec volam, nec vestigium reperias. Præterea floruerunt singulis sæculis in populo Judaico Viri Dei ac Prophetæ cœlitus electi, quos, inter tot arcana ipsis patefacta, mysticum hunc legis sensum penitus ignorasse, nihilque de futura vita intellexisse, nemo prudens suspicabitur. Cum autem nefas sit vel cogitasse, Viros optimos sapientiam, qua ipsi pollebant, aliis invidisse, credendum omnino est, eos, *sicubi idoneos invenerint Auditores*, evolvisse iis obtecta in lege mysteria, singulaque tantum aperuisse, quantum captus ipsorum et utilitatis ratio ferebat. In publicis autem concionibus Prophetæ ac Sapientes ita loquebantur, ut nec in contemptum adducerent arcana sanctioris disciplinæ, et tamen Auditorem attentum ad investigandi sollicitudinem excitarent. Atque hinc natum arbitratur maximus Grotius discrimen antiquitus inter Judæos celebratum, scriptæ legis, et legis oralis, quam et קבלה i. e. παράδοσιν seu *Traditionem* vocant; utramque dicentes a Mose profectam: non quod res aliæ fuerint in traditione quam in lege scripta; sed quod ea quæ in lege scripta occultius continebantur, studiosis indagatoribus enodaret accuratior interpretatio. *Harmonia Apostolica*, Dissert. post. cap. 10.

(c) Isaiah viii. 13, 14. compared with 1 Peter ii. 7, 8; Isaiah vi. 5. compared with John xii. 41.; Isaiah xliv 6. compared with Revelation xxii. 13.; Psalm lxxviii. 56. compared with 1 Corinthians x. 9. Romans ix. 5. Isaiah ix. 6. Jeremiah xxiii. 6. Jude.

Theology not repugnant to Christian

contained nothing but *mystery*. The difficulty respecting the incarnation, which forces itself upon the mind, is not how two natures so different as the divine and human can be so intimately united as to become one person; for this union in itself is not more inconceivable than that of the soul and body in one man: but that which at first is apt to stagger the faith of the reflecting Christian is the infinite distance between the two natures in Christ, and the comparatively small importance of the object, for the attainment of which the eternal Son of God is said to have taken upon him our nature.

164 Obviated.

Upon mature reflection, however, much of this difficulty will vanish to him who considers the ways of Providence, and attends to the meaning of the words in which this mystery is taught. The importance of the object for which the WORD condescended to be made flesh, we cannot adequately know. The oracles of truth indeed inform us, that Christ Jesus came into the world to save sinners; but there are passages scattered through the New Testament * which indicate, not obscurely, that the influence of his sufferings extends to other worlds besides this: and if so, who can take upon him to say, that the quantity of good which they may have produced was not of sufficient importance to move even to this condescension a Being who is emphatically styled LOVE?

* Eph. i. 10. Col. i. 19, 20.

But let us suppose that every thing which he did and taught and suffered was intended only for the benefit of man, we shall, in the daily administration of providence, find other instances of the divine condescension; which, though they cannot be compared with the incarnation of the second person in the blessed Trinity, are yet sufficient to reconcile our understandings to that mystery when revealed to us by the Spirit of God. That in Christ there should have dwelt on earth "all the fulness of the Godhead bodily ‖," is indeed a truth by which the devout mind is overwhelmed with astonishment; but it is little less astonishing that the omnipotent Creator should be intimately present at every instant of time to the meanest of his creatures, "upholding all things, the vilest reptile as well as the most glorious angel, by the word of his power ‡." Yet it is a truth self-evident, that without this constant presence of the Creator, nothing which had a beginning could continue one moment in being; that the visible universe would not only crumble into chaos, but vanish into nothing; and that the souls of men, and even the most exalted spirits of creation, would instantly lose that existence, which, as it was not of itself, and is not necessary, must depend wholly on the will of him from whom it was originally derived. See METAPHYSICS, nº 272—276, and PROVIDENCE, nº 3.

‖ Col. ii.

‡ Heb. i. 3.

In what particular way God is present to his works, we cannot know. He is not diffused through the universe like the *anima mundi* of the ancient Platonists, or that modern idol termed the *substratum of space* (METAPHYSICS, nº 309, 310.); but that he is in power as intimately present now to every atom of matter as when he first brought it into existence, is equally the dictate of sound philosophy and of divine revelation; for "in him we live and move and have our being;" and power without substance is inconceivable. If then the divine nature be not debased, if it cannot be debased by being constantly present with the vilest reptile on which we tread, why should our minds recoil from the idea of a still closer union between the second person of the ever blessed Trinity and the body and soul of Jesus Christ? The one union is indeed different from the other, but we are in truth equally ignorant of the nature of both. Reason and revelation assure us that God must be present to his works to preserve them in existence; and revelation informs us farther, that one of the persons in the Godhead assumed human nature into a personal union with himself, to redeem myriads of rational creatures from the miserable consequences of their own folly and wickedness. The importance of this object is such, that, for the attainment of it, we may easily conceive that he who condescends to be potentially present with the worms of the earth and the grass of the field, would condescend still farther to be personally present with the spotless soul and body of a man. Jesus Christ lived indeed a life of poverty and suffering upon earth, but his divine nature was not affected by his sufferings. At the very time when, as a man, he had not a place where to lay his head; as God, he was in heaven as well as upon earth *, dwelling in light inaccessible; and while, as a man, he was increasing in wisdom and stature, his divinity was the fulness of him who filleth all in all, and from whom nothing can be hid.

The more ... larly ... sti...

* John ... 13.

Perhaps the very improper appellation of *mother of God*, which at an early period of the church was given to the Virgin Mary, may have been one cause of the reluctance with which the incarnation has been admitted; for as we have elsewhere observed (see NESTORIUS), such language, in the proper sense of the words, implies what those, by whom it is used, cannot possibly believe to be true; but it is not the language of scripture. We are there taught, that "Christ being in the form of God, thought it no robbery to be equal with God; but made himself of no reputation, and took upon him the form of a servant, and was made in the likeness of man †;" that "God sent forth his Son made of a woman, made under the law, to redeem them that were under the law, that we might receive the adoption of sons ‖;" and that "the WORD who was in the beginning with God, and was God, by whom all things were made, was made flesh, and dwelt among men (who beheld his glory, the glory as of the only begotten of the Father), full of grace and truth ‡:" but we are nowhere taught that, as God, he had a mother! It was indeed the doctrine of the primitive church ‖, that the very principle of personality and individual existence in Mary's son, was union with the uncreated word; and this doctrine is thought to imply the miraculous conception, which is recorded in the plainest terms by two of the evangelists; for he was conceived by the Holy Ghost and born of a virgin §; but, as God, he had been begotten from all eternity of the Father, and in order of nature was prior to the Holy Ghost. This is evident from the appellation of ὁ λογος given to him by St John; for the term being used in that age, both by the Jewish Rabbies and the heathen philosophers, to denote the second divine subsistence, which they considered as an eternal and necessary emanation from the first, sometimes called τ'αγαθον and sometimes το ἑν; and the apostle giving no intimation of his using the word in any uncommon sense, we must necessarily conclude, that he meant to inform us that the divinity of Christ is of eternal generation. That the term λογος was used in this sense by the later Platonists, and in all probability by Plato himself, we have sufficiently shewn in another place (see PLATONISM); and that a similar mode of expression prevailed among the Jews in the time of St John, is apparent from the Chaldee paraphrase; which, in the 110th psalm, instead of the words "the Lord said unto my Lord," has, "the Lord said unto his WORD." Again, where we are told in the Hebrew that Jehovah said to Abraham §, "I am thy shield and thy exceeding great reward," we read in the Chaldee, "my WORD is thy shield, and thy exceeding great reward." Where it is said, "your new moons and your appointed feasts my soul hateth *," the paraphrast hath it, "my WORD hateth;" and where it is said, that "Israel shall be saved in the Lord with an everlasting salvation †," in the same paraphrase it is, "Is-

† Phil. ii. 6, 7.

‖ Gal. iv. 4, 5.

‡ John i.

‖ Hors. Serm. on the Incarnation.

166 His divine nature begotten of the Fa...

§ St Matth. i. 18 &c. Luke i. &c.

§ Gen. xv. 1.

* Isaiah i. 14.

† Isaiah xlv. 17.

rael shall be saved by the WORD of the Lord with everlasting salvation." But there is a passage in the Jerusalem Targum which puts it beyond a doubt, that by the LOGOS the Jews understood a divine person begotten of his Father before all worlds; for commenting on Genesis iii. 22. the authors of that work thus express themselves: "The WORD of the Lord said, behold Adam, whom I created, is the only begotten upon earth, as I AM THE ONLY BEGOTTEN IN HEAVEN:" in conformity with which, Philo introduces ‡ the Logos speaking thus of himself; [illegible] *I am neither unbegotten, as God, nor begotten after the same manner as you are.*

166 From these quotations we may justly conclude, that the Nicene fathers expressed themselves properly when they declared that the only begotten Son of God was begotten of his Father before all worlds, and is God of God; for if St John had believed the LOGOS or WORD to be unbegotten, contrary to the belief of all who made use of the phrase at the time when he wrote, he would surely have expressed his dissent from the generally received opinion. But he is however so far from doing this, that he gives the amplest confirmation of that opinion, by declaring, that "he beheld the glory of the WORD incarnate as the glory of the only begotten of the Father;" for this declaration is true only of the divinity of Christ, his human nature not being begotten of the Father, but conceived by the Holy Ghost of the Virgin Mary. Hence our blessed Lord assures us, that "as the Father HATH life in HIMSELF, so hath he GIVEN the Son to have life in himself;" that "the Son can do nothing of *himself*, but what he seeth the Father do ‖;" and that "he knew the Father, because he was from him and sent by him †." We must therefore agree with bishop Pearson (D), that "though the Father and Son are both truly God, and therefore equal in respect of nature, yet the one is greater than the other, as being the fountain of the Godhead. The Father is God, but *not of God*; Light, but *not of Light*. Christ is God, but *of God*; Light, but *of* Light. There is no difference or inequality in the nature or essence, because the same in both; but the Father of our Lord Jesus Christ hath that essence of himself, from none; Christ hath the same essence, not of himself, but from him."

167 The great purpose for which this divine person was sent into the world, and born of a woman, was to bruise the head of the serpent, and restore mankind to the inheritance which had been forfeited by Adam's transgression. Every dispensation of Providence from the fall had been preparatory to this restoration. Prophets had been raised from time to time to preserve in the early ages of the world the knowledge and worship of the true God: the children of Abraham, as we have seen, had been separated from the surrounding nations for the same purpose; and by the dispersion of the ten tribes, the captivity of the other two in Babylon, and the translation of the Hebrew scriptures into the Greek language, much of the knowledge which had been revealed to the Israelites was gradually diffused over the eastern world.

But while the Jews were thus rendered the instruments of enlightening the heathen nations of antiquity, their intercourse with those nations made them almost unavoidably acquainted with the philosophy which was cultivated among the Chaldeans, the Persians, and the Egyptian Greeks; and ingrafting many of the opinions derived from those schools upon the doctrines of Moses and the prophets, they corrupted their own religion while they improved that of their neighbours. Hence, by the time that Christ came among them, they had made the word of God of none effect through a number of idle fancies which they inculcated on the people as the traditions of the elders; and as they had attached themselves to different masters in philosophy, their unauthorised opinions were of course different according to the different sources whence they were drawn. The peculiar tenets of the ESSENES seem to have been a species of mystic Platonism. The PHARISEES are thought to have derived their origin from a Jewish philosopher of the Peripatetic school; and the resemblance between the doctrines of the SADDUCEES and the philosophy of Epicurus has escaped no man's observation. 168

Though these sects maintained mutual communion in public worship, they abhorred each other's distinguishing tenets; and their eternal wranglings had well nigh banished from them every sentiment of true religion. They agreed, however, in the general expectation of the Messiah promised to their fathers; but, unhappily for themselves, expected him as a great and temporal prince. To this mistake several circumstances contributed: some of their prophets had foretold his coming in lofty terms, borrowed from the ritual law, and the splendour of earthly monarchs. The necessity of casting this veil over those living oracles we have shewn in another place (see PROPHECY, n° 17.). At the time when the predictions were made, the Mosaic system had not run out half its course, and was therefore not to be exposed to popular contempt by an information that it was only the harbinger of one more easy and perfect. To prevent, however, all mistakes in the candid and impartial, when the Messiah should arrive with the credentials of miraculous powers, other prophets had described him in the clearest terms as having no form nor comeliness, as a sheep dumb before his shearers, and as a lamb brought to the slaughter; but the Jews had suffered so much from the Chaldeans, the Greeks, and other nations by whom they had been conquered, and were then suffering so much from their masters the Romans, that their carnal minds could think of no deliverance greater than that which should rescue their nation from every foreign yoke.

What men earnestly wish to be true, they very readily believe.

(D) We beg leave to recommend to our readers this author's excellent exposition of the apostle's creed, as a work which will render them great assistance in acquiring just notions of the fundamental articles of the Christian faith. They will find it, we think, a complete antidote against the poison of modern Unitarians and modern Tritheists; of whom the former teach that Jesus Christ was a mere man, the son of Joseph as well as of Mary; while the latter, running to the other extreme, maintain, that, with respect to his divinity, he is in no sense subordinate to the Father, but might have been the Father, the Son, or the Holy Ghost, according to the good pleasure of the eternal three. We have been at some pains to prove his divinity, and likewise his eternal generation; but in such a short compend as we must give, it seems not to be worth while to prove his miraculous conception. That miracle is plainly asserted in the New Testament in words void of all ambiguity; and as it is surely as easy for God to make a man of the substance of a woman as of the dust of the earth, we cannot conceive what should have induced any person professing Christianity to call it in question. The natural generation of Christ is a groundless fancy, which can serve no purpose whatever, even to the Unitarians.

believe. Hence that people, losing sight of the yoke under which they and the other Roman subjects were taught by the first Adam, mistaking the nature of the blessings promised to all nations through the seed of Abraham, and devoting their whole attention to the most magnificent descriptions of the Messiah's kingdom, expected in him a prince who should conquer the Romans, and establish on earth a universal monarchy, of which Jerusalem was to be the metropolis.

169
The subject of his preaching.

As our Saviour came for a very different purpose, the first object of his mission was to rectify the notions of his erring countrymen, in order to fit them for the deliverance which they were to obtain through him. Accordingly, when he entered upon his office as a preacher of righteousness, he embraced every opportunity of inveighing with becoming firmness against the false doctrines taught as traditions of the elders; and by his knowledge of the secrets of all hearts, he exposed the vile hypocrisy of those who made a gain of godliness. The Jews had been led, by their separation from the rest of the world, to consider themselves as the peculiar favourites of Jehovah; and the consequence was, that, contrary to the spirit of their own law, and the explicit doctrines of some of their prophets, they looked upon all other nations with abhorrence, as upon people physically impure. These prejudices the blessed Jesus laboured to eradicate. Having desired a lawyer, by whom he was tempted, to read that part of the law of Moses which commanded the Israelites to love their neighbours as themselves, he compelled him, by means of a parabolical account of a compassionate Samaritan, to acknowledge, that under the denomination of neighbour the divine lawgiver had comprehended all mankind as the objects of love ‖. The importance in which Moses held the ritual law, and to which, as the means of preserving its votaries from the contagion of idolatry, it was justly intitled, had led the Jews to consider every ceremony of it as of intrinsic value and perpetual obligation: but Jesus brought to their recollection God's declared preference of mercy to sacrifice; shewed them that the weightier matters of the law, judgment, mercy, and faith, claimed their regard in the first place, and its ceremonial observances only in the second; and taught them, in conformity with the predictions of their own prophets †, that the hour was about to come when the worship of God should not be confined to Jerusalem, but that "true worshippers should everywhere worship the Father in spirit and in truth ‡."

‖ St Luke x. 25—38.

† Jeremiah xxxi. 31, &c.

‡ John iv. 25—27.

It being the design of Christ's coming into the world to break down the middle wall of partition between the Jews and Gentiles, and to introduce a new dispensation of religion which should unite all mankind as brethren in the worship of the true God, and fit them for the enjoyment of heaven; he did not content himself with merely restoring the moral part of the Mosaic law to its primitive purity, disencumbered of the corrupt glosses of the Scribes and Pharisees, but added to it many refined and spiritual precepts, which, till they were taught by him, had never occurred either to Jew or Gentile. The Hebrew lawgiver had prohibited murder under the penalty of death; but Christ extended the prohibition to causeless anger, and to contemptuous treatment of our brethren, commanding his followers, as they valued their everlasting salvation, to forgive their enemies, and to love all mankind. Adultery was forbidden by the law of Moses as a crime of the deepest dye; but Jesus said to his disciples, "that whosoever looketh on a woman to lust after her, hath committed adultery with her already in his heart," and is of course liable to the Divine vengeance. The *lex talionis* was in force among the Jews, so that the man who had deprived his neighbour of an eye or a tooth, was to suffer the loss of an eye or a tooth himself; but this mode of punishment, which inflicted *blemish* for *blemish*, though suited to the hardness of Jewish hearts, being inconsistent with the mild spirit of Christianity, was abolished by our blessed Lord, who severely prohibited the indulgence of revenge, and commanded his followers to love even their enemies. Perjury has in every civilized nation been justly considered as a crime of the highest atrocity, and the Mosaic law doomed the false witness to bear the punishment, whatever it might be, which he intended by swearing falsely to bring upon his brother; but the Author of the Christian religion forbade not only false swearing, but swearing at all, except on solemn occasions, and when an oath should be required by legal authority. See OATH.

170
In which he executed the office of a prophet.

By thus restoring the law to its original purity, and in many cases extending its sense, the blessed Jesus executed the office of a Preacher to the lost sheep of the house of Israel; but had he not been more than an ordinary prophet, he could not have abrogated the most trivial ceremony of it, nor even extended the sense of any of its moral precepts; for their great lawgiver had told them, that "the Lord their God would raise up unto them but one Prophet, like unto him, to whom they should hearken ‡." That Prophet was by themselves understood to be the Messiah, whom they expected to tell them all things. It was necessary therefore that Jesus, as he taught some new doctrines, and plainly indicated that greater changes would soon be introduced, should vindicate his claim to that exalted character which alone could authorise him to propose innovations. This he did in the amplest manner, by fulfilling prophecies and working miracles (see MIRACLE and PROPHECY); so that the unprejudiced part of the people readily acknowledged him to be of a truth "that prophet which should come into the world—the Son of God, and the King of Israel." He did not, however, make any change in the national worship, or assume to himself the smallest civil authority. He had submitted to the rite of circumcision, and strictly performed every duty, ceremonial as well as moral, which that covenant made incumbent upon other Jews; thus fulfilling all righteousness. Though the religion which he came to propagate was in many respects contrary to the ritual law, it could not be established, or that law abrogated, but in consequence of his death, which the system of sacrifices was appointed to prefigure; and as his kingdom, which was not of this world, could not commence till after his resurrection, he yielded during the whole course of his life a cheerful obedience to the civil magistrate, and wrought a miracle to obtain money to pay the tribute that was exacted of him. Being thus circumstanced, he chose from the lowest and least corrupted of the people certain followers, whom he treated with the most endearing familiarity for three years, and commissioned at his departure to promulgate such doctrines as, consistently with the order of the divine dispensations, he could not personally preach himself. With these men, during the course of his ministry on earth, he went about continually doing good, healing the sick, casting out devils, raising the dead, reproving vice, preaching righteousness, and instructing his countrymen, by the most perfect example which was ever exhibited in the world, of whatsoever things are true, or honest, or just, or pure, or lovely, or of good report. The Scribes and Pharisees, however, finding him not that conqueror whom they vainly expected, becoming envious of his reputation among the people, and being filled with rancour against him for detecting their hypocritical arts, delivered him up to the Roman governor, who, though convinced of his innocence, yielded to the popular clamour, and crucified him between two thieves, as an enemy to Cæsar.

‡ Deut. xviii. 15.

171
His strict obedience to the law.

Just before he expired, he said, It is finished, intimating that the purpose was now fulfilled for which he had come into the world, and which, as he had formerly told his disciples, "was not to be ministered unto but to minister, and to give his life a ransom for many ||." For his blood, as he assured them at the institution of the Eucharist, "was to be shed for the remission of sins." That Christ died voluntarily for us, the just for the unjust, and that "there is none other name under heaven given among men whereby we must be saved;" is the uniform doctrine of the prophets who foretold his coming, of John the Baptist who was his immediate harbinger, and of the apostles and evangelists who preached the gospel after his ascension into heaven. Thus Isaiah says of the Messiah ¶, that "he was wounded for our transgressions, and bruised for our iniquities; that the chastisement of our peace was upon him, and that with his stripes we are healed; that we had all like sheep gone astray, turning every one to his own way, and that the Lord laid on him the iniquity of us all; that he was cut off out of the land of the living, and stricken for the transgression of God's people; that his soul or life was made an offering for sin; and that he bore the sin of many, and made intercession for the transgressors." The Baptist, "when he saw Jesus coming unto him, said to the people, Behold the Lamb of God, which taketh away the sin of the world;" plainly intimating that his death was to be a sacrifice, since it it was only as a sacrifice that the Jews could form any conception of a lamb taking away sin. The epistles of St Paul are so full of the doctrine of Christ's satisfaction, that it is needless from his writings to quote particular texts in proof of it. He tells the Romans, that Jesus Christ was set forth to be a propitiation through faith in his blood; that he was delivered for our offences, and "raised again for our justification; that he died for the ungodly; and that God commendeth his love towards us, in that while we were yet sinners Christ died for us." He assures the Corinthians that Christ died for all; that they who live should not henceforth live unto themselves, but to him who died for them and rose again; and that God made him to be sin for us who knew no sin, that we might be made the righteousness of God in him." He informs the Galatians, that Christ "gave himself for our sins, that he might deliver us from this present evil world, according to the will of God and our Father; and that he redeemed us from the curse of the law, being made a curse for us." St Peter and St John talk the very same language; the former teaching us, that "Christ suffered for us, and bare our sins in his own body on the tree †; the latter, that the blood of Jesus Christ cleanseth us from all sin, and that he is the propitiation for our sins; and not for ours only, but also for the sins of the whole world ‡." That he came into the world for the purpose of suffering, appears from his own words: for "no man (said he) taketh my life from me, but I lay it down of myself: I have power to lay it down, and I have power to take it again. This commandment have I received from my Father." And that he voluntarily laid it down for mankind, is evident from his calling himself the Good Shepherd, and adding, that "the Good Shepherd giveth his life for the sheep *."

That Christ died for the benefit of the human race, is a truth so apparent from these texts, and from many others which might be quoted, that no man professing Christianity has hitherto called it in question. Very different opinions have been formed indeed concerning the nature and extent of that benefit, and the means by which it is applied; but that the passion and death of the blessed Jesus were essential parts of his ministry on earth, has never been controverted, unless perhaps by those modern Unitarians who have corrected the errors of the apostles and evangelists, and with whose writings we acknowledge ourselves to be very little acquainted. That on the cross he made satisfaction to his Father for the sins of the world, is the general belief of Christians; but presumptuous men, aiming at being wise beyond what is written, have started a thousand idle questions concerning the necessity of such satisfaction, and the manner in which it was made. Some limiting the power and mercy of the Omnipotent, have dared to affirm that God *could not* have pardoned man without receiving full satisfaction for his offences; that nothing but the shedding of the blood of Christ could make that satisfaction; that his death was indeed sufficient to atone for a thousand worlds; that, however, he did not die for all mankind, but only for a chosen few, ordained to eternal life by a secret decree before the foundation of the world; and that the rest of the race are passed by, and doomed to eternal perdition, for the glory of God's justice. Others, convinced by every thing around them that the Creator and Governor of the universe is a being of infinite benevolence, whose only end in giving life must have been to communicate happiness, have contended, that no atonement whatever could be necessary to obtain from him the forgiveness of sin upon sincere repentance; that it is contrary to all our notions of justice to punish the innocent for the guilty; and that therefore the death of Christ, though an essential part of his ministry, could not be necessary, but at the most expedient.

We enter not into these impious debates. The Scriptures have nowhere revealed what God could or could not do; and on this subject we can know nothing but what they have taught us. That "we are reconciled to God by the death of his Son," is the principal doctrine of the New Testament; and without pretending to limit the power, the mercy, or the wisdom, of him who created and sustains the universe, we shall endeavour to show that it is a doctrine worthy of all acceptation. In doing this, we shall state impartially the opinions which men really pious have held respecting the form or manner in which Christ by his death made satisfaction to God for the sins of the world; and we hope that our readers, disregarding what may be prejudices in us, will embrace that opinion which shall appear to them most consonant to the general tenor of sacred Scripture.

174 Opinions of the Calvinists.

The rigid adherents to the theological system of Calvin, interpreting literally such texts of Scripture as speak of his being *made sin* for us, of his *bearing our sins in his own body on the tree*, and of the Lord's *laying on him the iniquity of us all*, contend, that the sins of the elect were lifted off from them and laid upon Christ by *imputation*, much in the same way as they think the sin of Adam is imputed to his posterity. "In bearing the sins of his people (says Dr Gill *), he took them off from them, and took them upon himself, bearing or carrying them as a man carries a burden on his shoulders. There was no sin in him inherently, for if there had, he would not have been a fit person to make satisfaction for it; but sin was put upon him by his Divine Father, as the sins of the Israelites were put upon the scape-goat by Aaron. No creature (continues he) could have done this; but the LORD hath laid on him, or made to meet on him, the iniquity of us all, not a single iniquity, but a whole mass and lump of sins collected together, and laid as a common burden upon him; even the sins of all the elect of God. This phrase of laying sin on Christ is expressive of the *imputation* of it to him; for it was the will of God not to impute the transgressions of his elect to themselves, but to Christ, which was done by an act of his own; for he hath made him to be sin for us; that is, by *imputation*, in which way we are made the righteousness of God in him: that

* Body of Divinity, vol. ii. book iii. chap. v. § 4.

[illegible] sins being imputed really by him as our sins were to Christ. They (says our author) it is a charge of sin was brought against him, as the surety of his people. He was numbered with the transgressors; for bearing the sins of them, he was reckoned one, he bore them in himself, being imputed to him, and was dealt with as such. Sin being found upon him by imputation, a demand of satisfaction for sin was made, and he answered it to the full. All this was with his own consent. He agreed to have sin laid upon him, and reputed to him, and a charge of it brought against him, to which he engaged to be responsible; yea, he himself took the sins of his people upon him; so the evangelist Matthew has it, 'Himself took our infirmities, and bore our sicknesses †.' As he took the nature of men, so he took their sins, which made his flesh to have *the likeness of sinful flesh*, though it really was not sinful. What Christ bore being laid upon him, and imputed to him, were sins of all sorts, original and actual; sins of every kind, open and secret, of heart, lip, and life; all acts of sin committed by his people, for he has redeemed them from all their iniquities; and God, for Christ's sake, forgives all trespasses, his blood cleanses from all sin, and his righteousness justifies from all; all being imputed to him as that is to them. Bearing sin supposes it to be a burden; and indeed it is a burden too heavy to bear by a sensible sinner (r). When sin is charged home upon the conscience, and a saint groans, being burdened with it, what must that burden be, and how heavy the load which Christ bore, consisting of all the sins of all the elect from the beginning of the world to the end of it? and yet he sunk not, but stood up under it; failed not, nor was he discouraged, being the mighty God, and the Man of God's right hand, made strong for himself."

† Matth. viii. 17.

175 To the Arminians or Remonstrants, this doctrine of the imputation of the sins of men to the Son of God appears as absurd as the similar doctrine of the imputation of the sin of Adam to his unborn posterity; and it is certainly attended with consequences which have alarmed serious Christians of other denominations.

Were it possible in the nature of things, says the Arminian, to transfer the guilt of one person to another, and to lay it upon him as a burden, it could not be done without violating those laws of equity which are established in the scripture and engraven on the human heart. But this is not possible. To talk of lifting lumps of sin or transferring them like burdens from the guilty to the innocent, is to utter jargon, says he, which has no meaning; and we might with as much propriety speak of lifting a scarlet colour from a piece of cloth and laying it on the sound of a trumpet, as of literally lifting the sins of the elect from them and laying them on Christ. Guilt is seated in the mind; and no man can become a sinner but by an act of volition. If Christ therefore *really* took upon him the sins of his people, he must have deliberately formed a wish to have actually *committed* all those sins; but such a wish, though it would have made him inherently guilty, and therefore incapable of satisfying for sin, could not have cancelled deeds that were done before he was born, or have made those innocent who had really been sinners. A deed once done cannot be undone; a volition which has been formed cannot be annihilated. By sincere repentance, the habitual dispositions are indeed changed, and those who have been sinners become objects of mercy; but no power can recal the hours that are past, or make those actions which have been performed to have been not performed. To remove guilt from the sinner and lay it upon the innocent may therefore be safely pronounced impossible even for Omnipotence itself, for it implies that a thing may be and not be at the same instant of time; and the doctrine which teaches that this removal was made from the elect to Christ, is an imagination of yesterday, which has no countenance from scripture, and is contrary to the established constitution of things. Those who imagine that guilt may be propagated from father to son, have something like an argument to urge for the imputation of Adam's sin to his numberless posterity; for all the men and women who have by ordinary generation been introduced into the world, have undoubtedly derived their nature from the primeval pair. But Christ did not derive his nature from the *evil*, that their sins should be communicated to him; nor, as he was miraculously conceived by the Holy Ghost, can we attribute to him any degree of that *taint* which is supposed to have been conveyed from Adam to all the other generations of men.

176 Nothing more, therefore, can be meant by "Christ's being made sin for us," and "bearing our sins in his own body on the tree," or by God's "laying upon him the iniquity of us all," than that by his sufferings we are freed from the punishment of our sins; it being in scripture a common figure of speech, as even Dr Gill has somewhere acknowledged, to denote by the word *sin* the *consequences* of sin. That this figure is used in those texts from which he infers that Christ took the sins of the elect upon himself, is evident from the verse which he quotes from the gospel of St Matthew; in which it is said, that "himself took our infirmities and bore our sicknesses." The sicknesses and infirmities there alluded to are the leprosy, the palsy, the fever, and demoniacal possessions: but when our blessed Lord cured these diseases, surely he did not by his omnipotent word lift them off from the patients and take them on himself, so as actually to become a leper, a paralytic, and a demoniac, or even to be reckoned as such either by the multitude, or by the priests whose duty it was to take cognizance of every legal uncleanness *. And if his inveterate enemies did not *impute* to him the leprosy when he removed that plague from others, why should it be supposed that his own Father, to whom he was at all times well-pleasing, *imputed* to him those sins of which, by his sufferings, he removed the punishment from those who were guilty? To impute to a person any action, whether virtuous or vicious, which he did not perform, can proceed only from ignorance, or malice, or partiality; but God is no respecter of persons, and from ignorance and malice he is removed to an infinite distance. It is indeed an undoubted truth, that "the Lord Jesus, by his perfect obedience and sacrifice of himself, which he through the eternal spirit once offered up unto God, hath fully satisfied the justice of his Father; and purchased not only reconciliation, but an everlasting inheritance in the kingdom of heaven for all those whom the Father hath given him †;" but that he actually took upon himself the sins of mankind, or that those sins were imputed to him by God, who punished him as a person whom he considered as guilty, is a doctrine equally injurious to the justice of the Father and to the immaculate purity of the Son.

* Levit. xiii.

† Confess. of Faith, chap. viii. § 5.

177 The earnestness with which this doctrine was inculcated by some of the earliest reformers, and the impossibility of admitting it, which every reflecting and unprejudiced mind must feel, was probably one of the causes which drove Socinus

(r) By the phrase *a sensible sinner*, the learned author means a sinner who is not past feeling, but has a conscience alive to the sense of remorse.

Soc. [illegible] Chr. [illegible] cinus and his followers to the other extreme of denying Christ's satisfaction altogether, and considering his death as nothing more than that of an ordinary martyr, permitted for the purpose of attesting the truth of his doctrine, and paving the way for his resurrection, to confirm the great promise of immortality. According to these men, forgiveness is freely dispensed to those who repent, by the essential goodness of God, without regard to the merit or sufferings of any other being; and the gospel is said to save from sin, because it is the most perfect lesson of righteousness. The great objection of *Crellius* to the doctrine of the satisfaction is, that it is a hinderance to piety; for if Christ has paid the whole debt, he thinks that we must have nothing to do, as nothing more can be required of us. And if it were indeed true that our sins are imputed to Christ, and his righteousness imputed to us, this objection would be insurmountable; for God could not justly exact a double punishment for the same sin, or inflict misery upon those to whom he imputes perfect righteousness. But as to this imaginary transferring of virtues and vices from one person to another, the Christian scriptures give no countenance; so they nowhere call the death of Christ a *satisfaction* for the sins of men. The term has indeed been long in use among divines, and when properly explained it may be retained without any danger; but in treating of this subject, it would perhaps be more prudent to restrict ourselves to the use of scripture language, as the word *satisfaction* carries in it the ideas of a debt paid and accepted; whereas it is said by St Paul, that "eternal life is the *gift* of God through Jesus Christ our Lord; and that we are justified *freely by his grace* through the redemption that is in Jesus Christ, whom God hath set forth to be a propitiation through faith in his blood."

178 The death of Christ [illegible] what they lost in Adam.

To clear up this matter, and attain adequate notions of redemption and justification, it will be necessary to look back to the fall of our first parents; for the great purpose for which Christ was promised, and for which he came into the world, was, by bruising the head of the serpent, to restore mankind to the inheritance which they had lost through the transgression of Adam. This is apparent not only from the original promise made to the woman, but also from different passages in the epistles of St Paul, who expressly calls Christ the second Adam, and says, that, "as by the offence of one, judgment came upon all men to condemnation; even so by the righteousness of one, the free-gift came upon all men unto justification of life;" that "as by one man's disobedience many were made sinners, so by the obedience of one shall many be made righteous;" and that, "as in Adam all die, even so in Christ shall all be made alive." Hence it was that John the Baptist, when he saw Jesus coming to him, said to his disciples †, "Behold the Lamb of God which taketh away, not the *sins*, but the *sin* of the world," evidently alluding to Adam's sin and its consequences, since no other sin was ever committed of which the consequences extend to the whole world.

† [illegible] Ch. i. ver. [illegible]

This being the case, it is undeniable, that whatever we lost in the first Adam is restored to us by the second; and therefore they who believe that the punishment denounced against eating the forbidden fruit was death *corporal*, *spiritual*, and *eternal*, must believe that we are redeemed from all these by Christ; who having "appeared once in the end of the world to put away sin by the sacrifice of himself, died for us, that whether we wake or sleep we should live together with him *." If the image of God in which man was created was lost by the breach of the first covenant, it is more than restored to us "by the Mediator of a better covenant, which is established upon better promises;" if by the sin of Adam we were utterly indisposed, disabled, and made opposite to all that is spiritually good, and wholly inclined to all evil, and that continually, we are freed from that dreadful curse by "our Saviour Jesus Christ, who gave himself for us, that he might redeem us from all iniquity, and purify to himself a peculiar people, zealous of good works †;" and if for our share in the first transgression we be justly liable to all punishment in this world and in that which is to come, the apostle assures us, that "when we were enemies we were reconciled to God by the death of his Son, because that God was in Christ reconciling the world to himself, not imputing their trespasses unto them ‡." As Jesus is "the Lamb slain in the divine decree from the foundation of the world," these beneficial consequences of his death have been extended by a retrospective view to all in every age whose names are written in the book of life, though it is absurd to suppose that he literally took their sins upon him, and impious to imagine that he suffered under the imputation of sin.

* Heb. ix. [illegible] 1 Thess. v. 10.

The [illegible] of the ordinary Christian.

† Titus ii. [illegible]

‡ Rom. v. [illegible] 2 Cor. v. 19.

179 Doctrine of the moderate Calvinists and Remonstrants of the same opinion.

Such is the general doctrine of redemption, as it is taught by the more moderate Calvinists and more moderate Remonstrants; for moderate Christians of all denominations, though they express themselves differently, have nearly the same views of the fundamental articles of their common faith. It must not, however, be concealed, that many divines of great learning and piety, though removed to an infinite distance from the school of Socinus, contend strenuously against the doctrine of vicarious atonement for actual transgressions of the moral law. These are the more zealous Arminians, who deny that we inherit any moral taint or intellectual weakness from our first parents, whom they believe never to have been in a state of greater perfection than many of their posterity who are called [illegible]. According to them, we lost nothing by the fall of Adam but our title to eternal life or perpetual existence, together with those graces of the Holy Spirit which were bestowed under the first covenant to train mankind for the society of heaven; and as eternal life and supernatural grace constituted one free-gift, not due to the nature of man, or indeed of any created being, they might, when forfeited, be restored by any means or upon any condition which should seem expedient to the all-wise Donor. These means, and that condition, human reason cannot indeed discover; but it seems very fit that they should be different from the means by which moral agents under the law of nature can secure to themselves the favour of their Creator, or recover it when occasionally lost. The former depends on arbitrary will and pleasure, or at least upon no other principles discoverable by us; while the latter ariseth out of the established and well-known constitution of things. Thus moral virtue, comprehending piety, was the condition of that favour and protection which the creature man, in his original state, could claim from his Maker; but obedience to a positive command was the condition of the free gift of immortality conferred upon Adam on his introduction into paradise. The claim arising from the relation between the creature and the Creator is indissoluble, because that relation cannot be dissolved: so that the man who, by a transgression of the moral law, or of any part of that system which is called the *religion of nature*, has forfeited the favour of God, may reasonably hope to recover it by sincere repentance and a return to his duty; and nothing but such repentance and reformation can recover it, because, in a moral agent, nothing can be agreeable to God but moral dispositions, which cannot be transferred from one person to another, and for the want of which nothing can atone. Our virtues are not required nor our vices punished, as if the one could benefit and the other injure him who created us; for "is it any *pleasure* to the Almighty that we are righteous? or is it

180 Doctrine of the more zealous Arminians.

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gain to him that we make our ways perfect? Will he reprove us for fear of us?" No! He commands us to be virtuous, and forbids us to be vicious, only because virtue is necessary to our own happiness, and vice productive of everlasting misery.

Were an immoral man to be introduced into the society of angels and just men made perfect, he would not experience in that society what we are taught to expect from the joys of heaven; because to such joys his acquired dispositions would be wholly repugnant. Nor could the sufferings of any person whatever, or the imputation of any extraneous righteousness, make that mind which had long been immersed in the grossest sensuality relish the intellectual and refined enjoyments of heaven; or the man who had been the habitual slave of envy, malice, and duplicity, a fit inhabitant of that place where all are actuated by mutual love. On the other hand, say the divines whose doctrine we are now detailing, it is impossible to suppose that the Father of mercies, who knows whereof we are made, should have doomed to eternal misery any moral agent who had laboured through life to serve him in sincerity and in truth; or that any atonement could be necessary to redeem from the pains of hell the man whose pious and virtuous dispositions have through penitence and prayer become suited to the society of heaven. Unsinning perfection never was nor ever could be expected in man. He is brought into the world free indeed from vice, but equally destitute of virtue; and the great business of his life is to guard his mind from being polluted by the former, and to acquire dispositions habitually leading to the practice of the latter. Till these habits be fairly formed, it seems impossible that he should not sometimes deviate from the paths of rectitude, and thereby incur a temporary forfeiture of the divine favour; but the very constitution of his mind, and the purpose for which he is placed in a state of probation, show that the divine favour thus forfeited can be recovered only by repentance and reformation.

Widely different, however, is the case with respect to the forfeiture and recovery of a free gift, to which man has no natural claim. When the condition is broken on which

181 [illegible]

such a gift was bestowed, repentance can be of no avail; it must be either irrecoverably lost, or restored by the mere good pleasure of the giver. Immortality or perpetual existence is a gift which upon certain terms was freely bestowed upon the human race, and forfeited by the transgression of their first parent violating those terms. It was restored by the free grace of God, who was pleased to ordain, that "since by man came death, by man should also come the resurrection of the dead; for as in Adam all die, even so in Christ shall all be made alive." "Hence the apostle, writing to the Romans of the benefits of being the children of God, and joint heirs with Christ, summeth up those benefits with the resurrection from the dead." For the creature, *i. e.* mankind, was made subject (says he *) to vanity or death, not willingly, but by reason of him who hath subjected the same in hope; because the creature itself also shall be delivered from the bondage of corruption into the glorious liberty of the children of God. For we know that the whole creation groaneth, and travaileth in pain together until now; and not only *they*, but *ourselves* also, who have the first fruits of the spirit, even we ourselves, groan within ourselves, waiting for the adoption, viz. *the redemption of our body* (F). That this redemption of our body is the consequence of the sacrifice of Christ, is taught in the most explicit terms in the epistle to the Hebrews; of which the inspired author informs us, that "forasmuch as the children are partakers of flesh and blood, he also himself likewise took part of the same; that through *death* he might destroy him that had the power of death, that is the devil; and deliver them, who through fear of death were all their life-time subject to bondage ‡." A vicarious atonement made with this view, the divines, whose theory we are now considering, acknowledge to be perfectly rational and consistent with the strictest justice. "The law of nature (say they §) allows not of vicarious atonements; but ordains that the man who transgresseth shall himself bear the punishment of his iniquity; a punishment which no man deserves for the faults of another, unless he be partaker of the guilt by joining in the transgression." And in proof of this their opinion, they appeal to the words of God himself, declaring to Moses, — "Whosoever hath sinned against me, him will I blot out of my book *." But when the free gift of immortality was lost, it was with great wisdom, say they, that God restored it through a Mediator who should make atonement by his blood for the breach of the first covenant; since such a mediation implies that the gift restored is merely of grace, to the attainment of which man could no further co-operate than by his hopes and wishes.

182 An objection.

To this view of redemption, and indeed to every view of it which we have yet taken, an objection forces itself upon the mind. Throughout the New Testament LIFE AND IMMORTALITY are considered as a *free gift*, and called so in express words by St Paul *. To the scheme under consideration it is essential to consider them as such; and yet we know that a large price was paid for them, as St Paul likewise acknowledges, when he twice tells the Corinthians that they were bought with a price §.

183 Obviated.

"To clear up this matter (says bishop Warburton), and to reconcile the apostle to himself, who certainly was not defective either in natural sense or artificial logic, let us once again remind the reader, that life and immortality bestowed on Adam in paradise was a FREE *gift*, as appears from the history of his creation. As a *free gift*, it was taken back by the Donor when Adam fell; to which resumption our original natural rights are not subject, since natural religion teacheth, that sincere repentance alone will reinstate us in the possession of those rights which our crimes had suspended. So that when this free gift, forfeited by the *first* Adam, was recovered by the *second*, its nature continuing the same, it must still remain a *free gift*—a gift to which man, by and at his creation, had no claim; a gift which natural religion did not bestow. But if misled by measuring this *revealed mystery* of human redemption by the scant idea of human transactions, where a *free gift* and *purchased benefit* are commonly opposed to one another, yet even here we may be able to set ourselves right, since, with regard to man, the character of a *free gift* remains to *immortality restored*. For the price paid by forfeited man was not paid by him, but by a Redeemer of divine extraction, who was pleased, by participating

* Rom. viii. 20—23.

‡ Heb. ii. 14, 15.

§ Warburton's Div. Leg. b. ix. and Warburton's Theory of Religion, part iii.

* Exod. xxxii. 33.

* Rom. v. 15.

§ 1 Cor. vi. 20. vii. 23.

(F) That by the words *creature* and *creation* the apostle here means all mankind, and by *vanity* and *corruption*, death, the reader will find proved by Dr Whitby, in his note on the place, with a strength of argument which cannot be shaken; and that the whole creation, the Gentiles as well as the Jews, groaned and travailed in pain together under the apprehension of death, is apparent from the writings of Cicero, who always seems doubtful whether death be a good or an evil; and from the lamentation of Hezekiah, when desired by the prophet to set his house in order because he should die and not live.

ticipating of man's nature, to stand in his stead. Hence the sacred writers seeing, in this case, the perfect agreement between a *FREE GIFT* and a *PURCHASED POSSESSION*, call it sometimes by the one and sometimes by the other name *."

A restoration to life and immortality from that state of unconsciousness or extinction as living agents, to which all mankind were doomed in consequence of the fall of Adam, is that great salvation which we have obtained through the blood of our Redeemer; and according to the theologians whose theory we are now considering, it was the only thing in the divine intention when the promise was given to the first mother that the seed of the woman should bruise the head of the serpent. But though they contend thus earnestly that the death of Christ does not operate *directly* as an atonement for the *actual* sins of men, they admit that it does so *indirectly* and by necessary consequence, since it gives opportunities for repentance and newness of life, which under the first covenant they did not enjoy. Had a man under that covenant transgressed any moral precept, he would of course have forfeited the favour of his God, and either been subjected to punishment or to a long course of repentance; but supposing the efficacy of repentance under the law of nature to be what they suppose it to be, he might before it was perfected have lost his existence by the eating of the forbidden fruit; and thus his penitence or punishment have ended in everlasting death. This can never be the issue of things under the new covenant, which, by the death of Christ, secures immortality to man, and gives to him opportunities, as long as he shall be in a state of probation, of recovering the divine favour when forfeited, whether by a moral transgression or a temporary violation of the peculiar condition of the covenant. Hence they admit the truth of the apostle's doctrine, that we are gainers by the fall of Adam and the redemption wrought by Christ; which will appear when we come to consider their notions of Christian justification. In the mean time it may be proper to observe, that they consider it as no small confirmation of their opinion, that it tends to put an end to the long agitated disputes concerning the *extent* of redemption, and to reconcile passages of scripture which, on the commonly received theories both of Calvinists and Arminians, seem to be at variance with each other.

It is well known to be one of the fundamental doctrines of the Calvinistic school, that "none are *redeemed* by Christ, effectually called, justified, adopted, sanctified, and saved, but the elect only †;" and if the notions of redemption, which, in the end of the last century, were very generally embraced, be admitted as just, it will not be easy to overturn the arguments by which that doctrine is supported. Such of them as are connected with the great question of election and reprobation, and enter into the decision of it, we have stated in another place (see PREDESTINATION, n° 14); but it is farther argued ‡, that the doctrine of *universal* redemption reflects on the wisdom, the justice, and the power of God, and robs him of his glory.

The scriptures assure us that all men shall not be saved; but how can this be, if Christ died for all, and the scheme of salvation by his death was formed by infinite wisdom? The Arminians indeed say, that those who fail of salvation, fail through their own fault in not performing the conditions required of them; but God either *knew* or knew *not* that such men would not perform those conditions. If he knew it not, his knowledge is limited; if he did know it, where was his wisdom in providing a scheme of redemption for men to whom he was aware that it would be of no benefit? "God, we are told, is righteous in all his ways and holy in all his works;" but there is no righteousness in making Christ bear the sins of *all* men, and suffer the punishment due to them, if any one of those men shall be afterwards punished everlastingly. If Christ has already paid the debts of the whole world, it cannot be just to cast a single inhabitant of the world into the prison of hell, there to be detained till he shall again have paid the uttermost farthing. "The Lord's hand is not shortened that it cannot save;" for he is and always will be the same Almighty power that he was from eternity; but if by the divine decree Christ died for all men, and yet all men shall not be saved, it would appear that man is mightier than his Maker! The ultimate end of God in the redemption of man is admitted to have been his own glory; but if any individual of the human race, who was redeemed by Christ, shall not be saved, God will so far lose his end, and be deprived of his glory. For, if this were the case, where would be the glory of God the Father in forming a scheme which, with respect to multitudes, does not succeed? and where would be the glory of the Son of God, the Redeemer, in working out the redemption of men who are yet not to be saved by him? and where would be the glory of the spirit of God, if redemption were not by him effectually applied to every individual for whom it was wrought? By such arguments as these do the Calvinists oppose the scheme of universal redemption, and contend that Christ died only for the *elect*, or such as shall be placed on his right hand at the day of judgment. This notion of a limited redemption, as they think it more worthy of the sovereignty of God, they believe to be taught by our Saviour himself, when he saith *, "All that the Father *giveth* me shall come to me; and him that cometh to me, I will in nowise cast out. For I came down from heaven, not to do mine own will, but the will of him that sent me. And this is the Father's will who hath sent me, that of all which he hath *given* me I should lose nothing, but should raise it up again at the last day."

186
According to the Arminians he died for all men.

The Arminians, on the other hand, contend, that it is impious to limit the effects of Christ's death to a chosen few, since it appears from scripture, that by the decree and intention of his Father he tasted death for every man, that all, without exception, might through him obtain remission of their sins. Thus our Lord himself told Nicodemus †, that "as Moses lifted up the serpent in the wilderness, even so must the Son of Man be lifted up; that *whosoever* believeth in him, should not perish, but have everlasting life. For God so loved the *world*, that he gave his only begotten Son, that whosoever believeth in him should not perish, but have everlasting life. For God sent not his Son into the world to condemn the world, but that the *world* through him might be saved." In perfect conformity with the doctrine of his divine Master, St Paul teaches ‡, that "Christ died for *all*; that God was in Christ reconciling the *world* to himself, not imputing their trespasses unto them;" that "he will have *all* men to be saved, and to come unto the knowledge of the truth;" that "Christ gave himself a ransom for *all*;" and that "Jesus was made a little lower than the angels, that by the grace of God he should taste death for *every man*." The very same thing is taught by St Peter and St John, when the former says §, that "the Lord is not willing that *any* should perish, but that *all* should come to repentance;" and the latter ||, that "Jesus Christ the righteous is the propitiation for our sins; and not for our's only, but for *the whole world*."

Upon these texts, without any commentary, the Arminians are willing to rest their doctrine of universal redemption; though they think that a very strong additional argument for its truth arises from the numberless absurdities which flow from the contrary opinion. Thus, say they *, the apostles were commanded by our Saviour † to "go into *all* the world and preach the gospel to *every creature*."

* John vi. 37—40.

† John iii. 14—17.

‡ 2 Cor. v. 14—20. 1 Tim. ii. 4—7. Heb. ii. 9.

§ 2 Peter iii. 9

|| 1 John ii. 2.

* *Limborch's Theologia Christiana*, Eng. *Transl.* book 4. ch.

† Mark xvi. 15, 16. and

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and all who hear it preached are required to believe it: but no man, as the Calvinists themselves confess, can believe the gospel as a Christian, without believing that Christ died for him; and therefore, if it be true that Christ died only for the elect, a great part of mankind are required to believe a lie, and a lie too making the object of divine faith. Again, if Christ did not die for all, then no man can be sure that he is bound to believe in Christ when preached to him; nor can any man be justly condemned for incredulity: which is not only absurd in itself, but directly contrary to what we are taught by our blessed Lord, who assures us*, that unbelief is the cause of condemnation. Lastly, if Christ died not for all, then is it certain that he cannot claim dominion over all as the purchase of his death and resurrection; but St Paul says expressly†, that "to this end Christ both *died*, and *rose*, and *revived*, that he might be the Lord both of the *dead* and *living*." The Arminians acknowledge, that though Christ died for all, there are many who will not be saved; for, say they‡, the death of Christ did not literally pay the debts incurred by sinners, but only obtained for them the gracious covenant of the gospel, by which all who believe in him, and sincerely endeavour to work out their own salvation with fear and trembling, are entitled to forgiveness of sins and eternal life.

* St John iii. 18, 19, and 36.

† Rom xiv. 9.

‡ Whitby's Dis. [illegible] Five Points, part [illegible] ch. 3.

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Wherein the modern Arminians [illegible]

Such is the state of this controversy as it was agitated between the Calvinists and Arminians of the last century; but the present leaders of this latter school are of opinion, that it never could have been started, had not both parties mistaken the purpose for which Christ died. It is not conceivable, say they, that any thing for which the eternal Son of God took upon him human nature, and in that nature suffered a cruel and ignominious death, shall not be fully accomplished; and therefore, if in the divine intention he died to make atonement for the sins of man actual as well as original, we must of necessity conclude that those for whom he died shall certainly be saved. Yet we learn from scripture that many shall go away into everlasting punishment, though the same scripture repeatedly assures us that Christ gave his life a ransom for *all*, and that he is the propitiation for *the whole world*. To reconcile these different passages of scripture is impossible, if we suppose that he laid down his life to atone for the *actual* transgressions of men; but if the direct purpose of the Godhead in forming this stupendous plan of redemption was, that the death of Christ should be the ransom of all from the grave or utter extinction, every difficulty is removed; for we know that all, the wicked as well as the righteous, shall through him be raised to life at the last day. That this was the purpose for which he died, they think apparent from the very words quoted by the Calvinists to prove that redemption was not universal; for he declares that it was his Father's will, "that of all which had been given him he should lose nothing," *not* that he should save it all from *future punishment*, but only that he "should raise it up at the last day." When St John calls him a propitiation for our sins, which, as we have seen, the divines whose doctrine we are now stating hold him to be indirectly, he does not add, as in our translation, for the *sins* of the whole world, but [illegible], for the whole world, which, by his death, he redeemed from that vanity and corruption under which, according to St Paul, it had groaned from the fall till the preaching of the gospel. Hence it is that our blessed Lord calls himself "the resurrection and the life," and always promises to those who should believe in him that though they were dead, yet should they live, and that he would raise them up at the last day.

Among these various opinions respecting the destination of the death of Christ, it belongs not to us to decide. The serious reader, divesting himself of prejudice in favour of the system in which he has been educated, will search the scriptures, and adopt the theory which he shall find most explicitly taught in that sacred volume; but as in every system it is admitted, that *one purpose* for which Christ died was to redeem mankind from the everlasting power of the grave, and bring to light life and immortality, it is of the utmost importance to know whether that purpose has been fully attained. Death we see still triumphing over all the generations of men; and as the scriptures give us no hopes of being rescued from its dominion but through the medium of a resurrection, some sensible evidence seems necessary to evince that a general resurrection shall actually take place. This we are promised as one great benefit purchased for us by the sufferings of Christ sacrificed on the cross. And since the price has been *paid*, and paid thus *visibly*, the nature of the covenant requires that the benefit should be as *visibly enjoyed* by the person whose sufferings obtained it for his brethren. "If the Redeemer himself had not been seen to enjoy the fruits of the redemption procured, what hopes could have remained for the rest of mankind? Would not the natural conclusion have been, that the expedient of *redemption*, by the death and sacrifice of Jesus, had proved ineffectual?" This is the conclusion which St Paul himself draws: "If Christ be not risen (says he*), then is our preaching vain, and your faith is also vain; ye are yet in your sins. Then they also, who are fallen asleep in Christ, are perished—ἀπώλοντο—are lost, as if they had never existed. But now (adds he) is Christ risen from the dead, and become the first fruits of them that *slept*. For since by man came *death*, by man came also the *resurrection* of the dead: For as in Adam *all die*, even so in Christ shall *all be made alive*."—So necessarily connected, in the opinion of the apostle, is the resurrection of Christ with the very essence of Christianity †.

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188
One purpose for which he died was to bring to light life and immortality.

* 1 Cor. xv. 15—

† Warburton's Sermon on the Resurrection.

Though we have in another place (see Resurrection, n° 50.) stated such arguments for the truth of this fundamental article of our common faith, as must carry conviction to every mind capable of estimating the force of evidence; yet as attempts are daily made, sometimes openly and sometimes with the most insidious art, to propagate in this nation the French doctrine concerning the eternal sleep of death (G), we trust that we shall not trespass on the serious reader's patience if we here resume the subject, and endeavour to show that it was absolutely impossible for the apostles to persuade the world, or to think of persuading the world, that their Master rose from the dead, if his resurrection was not real.

In the article Miracle *, we have said, that "the very *resolution* of the apostles to propagate the belief of false miracles in support of such a religion as that which is taught in

* Vol. [illegible] p. 173

(G) Once we intended (see Vol. XVI. page 140. note A) to notice in this place some of the most recent of those attempts, and to expose them to that indignation with which, we trust, the good sense of our countrymen shall alway treat such [illegible] as have no other object than to diminish the sum of human happiness. On maturer reflection, however, it seems more expedient to state one decisive argument for the resurrection of Christ, which may be safely opposed to any new sophisms of our minute philosophers, when those which are at present in fashion shall have sunk through their own weakness into oblivion, or quietly retired with their authors to that place "Where Tindal dictates and Silenus snores." *Dunciad.*

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in the New Teſtament, is itſelf as great a miracle as human imagination can eaſily conceive." We ſhall illuſtrate this poſition by the reſurrection of Jeſus, which we are to ſuppoſe the apoſtles reſolving to publiſh as an unqueſtionable fact, whilſt they were conſcious that they themſelves ſtole the body from the ſepulchre, and ſaw it in their cuſtody under the dominion of death. On ſuch an enterpriſe they could not enter without much deliberation; and we may conceive him to whom the thought of propagating this fable firſt occurred, addreſſing his companions in ſome ſuch terms as the following:—

139 The truth of the reſurrection demonſtrated.

"The Maſter whom we ſerved is now no more, and the magnificent hopes which we had formed with reſpect to him and to ourſelves are blaſted by his death. The time which he fixed for his reſurrection is paſſed; and it is folly to cheriſh any expectation of that event, as we ſee his body which we ſtole a prey to corruption. We muſt therefore either ſeparate and return to our former profeſſions, the obſcurity of which will ſcreen us from the diſgrace of having been deceived: or, remaining united, take the generous reſolution of ſupporting our glory, by ſaying to every body that our Maſter is riſen from the dead, and is the true Meſſiah expected by our nation, and foretold by the prophets. To return to our profeſſions would be cowardly and mean; to propagate the ſtory of the reſurrection will be attended with infinite difficulty and danger; but to deſpiſe danger and to conquer difficulties, is worthy of great ſouls ſuch as ours; and therefore I take it for granted that this is the part which you have all reſolved to act.

"To ſucceed in our glorious enterpriſe, it will be abſolutely neceſſary to admit into our moſt ſecret counſels, not only the ſeventy diſciples whom our Lord ſent before him, in pairs, into every city and place which he viſited *, but alſo that crowd of women ‡ who followed him from Galilee, were preſent at his crucifixion, and viſited his ſepulchre; for all theſe perſons are ſo intimately acquainted with every circumſtance of his life and death, that they have it in their power completely to defeat our project in ſpite of our utmoſt art; and that power, it cannot be doubted, they will exert, unleſs admitted to ſhare with us the glory of deceiving the world. The taſk which they and we have to perform is no ordinary one; for we muſt all ſpeak the ſame things, and things which each of us knows to be falſe. Yet we muſt advance them with an air ſo intrepid as to remove ſuſpicion, and be able to bury in profound ſecrecy the reſolutions which in concert we take to-day.

* Luke x. 1.—18.

‡ Matth. xxvii. 55, St Luke xxiii. 55, xxiv. 1—12.

"No truth can be ſo deeply impreſſed upon our minds as that our Maſter continues under the dominion of death; and we all know that truth ſtands ſo ready at the door of the lips, that the greateſt liar among us has hitherto uttered a thouſand truths for one falſehood (H); but henceforth, on this moſt intereſting ſubject, we muſt never let a ſingle truth eſcape us either in our moſt unguarded moments or when put to the torture; for all will be loſt, if any one perſon in whom we may place confidence ſhall reveal to our enemies what ſhould be known to ourſelves alone. It is therefore neceſſary to foreſee all that is capable of extorting ſecrets from ſuch perſons as are not like us proof againſt every thing. We ſhall be expoſed to much bad treatment, to priſons, to ſevere examinations, to death itſelf, and even to the moſt cruel and lingering kinds of death, ſufficient to ſhake any but the moſt invincible reſolutions. All this ſhould be foreſeen, and muſt be deſpiſed by every perſon among us, man and woman!

"But I muſt forewarn you, that under the greateſt tortures we are not to hope for the ſmalleſt ſupport from the teſtimony of a good conſcience and the proſpect of a future reward; for the very conflict of our ſufferings will ariſe from the remorſe of conſcience, unleſs we fortify ourſelves againſt it by the moſt determined reſolution. Others have indeed been wonderfully ſupported under violent and tedious ſufferings, by the internal perſuaſion that they ſuffered for truth and righteouſneſs ſake; but as we are called upon to give new proofs of courage by ſuffering for what we know to be an impious falſehood, every reflection which tended to ſupport them will torment us, and tempt us, in the moſt forcible manner, to betray our cauſe. From him, for whom we are to ſuffer and be ſacrificed, we have nothing to expect: for ſince he could neither reſcue himſelf from the violence of his enemies, nor fulfil his promiſe of riſing from the dead, it would be madneſs to ſuppoſe that he will deliver us from our perſecutors, or afford us the ſmalleſt conſolation when ſinking under the crueleſt tortures which malicious ingenuity can invent. He was a deceiver, and has deceived us. He promiſed, a few hours before he was taken, that he would riſe from the dead and go before us into Galilee; but God has ordered things otherwiſe; and as he is ſupreme Lord, we are not to ſound his judgements, or even to *think* too much of them.

"You ſeem aſtoniſhed at this counſel! It is new indeed, but neceſſary; and neceſſary to ſuch a degree, that all our deſigns will prove abortive if we ſuffer the fear of God to get poſſeſſion of our minds, and make us timid and puſillanimous in the teſtimony which we are determined to give againſt him, by maintaining that he raiſed from the dead a man whom he has without doubt condemned as an uſurper of the glory which was not his due. Such aſſertions in favour of falſehood will no doubt coſt us ſomething in the beginning; but we muſt endeavour to make ourſelves as eaſy as we can, by inculcating ſtrongly on our minds how glorious and diſintereſted it will be to ſuffer without hope either from God or man, and even with the certainty of being puniſhed both by God and man, not only in this life, but eternally in the next, if there be another. For let me not attempt to conceal from you, that preſent and future miſery muſt be our inevitable portion; and that we muſt therefore become inacceſſible to fear, even to ſuch fear as religion itſelf ought to inſpire, or return ignobly to our nets and boats; there is abſolutely no other alternative. He whom we lament has not only aſſumed openly the character of the Meſſiah, but has dared even to call himſelf the Son of God; and though we have ſeen him ready to be ſtoned for theſe pretenſions, and cannot doubt but that God was highly provoked at them, we muſt, in defiance of the divine vengeance, undertake to make them good, or at leaſt cauſe him to be worſhipped as the Son of God; whom to our own knowledge God has expreſsly diſavowed. This might frighten timid and vulgar ſouls; but we muſt have none ſuch among us. All the men and women of our company muſt be capable of braving Omnipotence, and of deriving new vigour and reſolution from the proſpect of uninterrupted miſery.

"Let us now conſider how this great deſign is to be carried into execution; for it would be the exceſs of folly to enter upon

(H) To the moſt illiterate fiſherman of Galilee this muſt have been known as a *fact*; for no man can ſpeak an intelligible ſentence without uttering a truth or a falſehood, and ſurely every man ſpeaks a thouſand ſentences for one in which he either utters or intends to utter a falſehood. How it muſt neceſſarily be ſo we have ſhown in another place. See METAPHYSICS, n° 135, &c.

Theolo- more p- liarly ftian.

upon it without preparing the means of fuccefs. Firft of all, we will concert together a hiftory of the pretended apparitions of our common Mafter. Thofe who have the beft memories fhall be employed in it; the reft of us fhall revife and correct the work; and all muft ftrongly imprint on their memories the pretended facts and difcoveries which fhall be agreed upon; becaufe we muft never think of retracting, and the leaft contradiction in our evidence would be of fatal confequence (1). To this labour we muft join another, which requires more knowledge of the Scriptures than we poffefs; but we will fupply our deficiencies by ftudy. Our rulers, and indeed our countrymen in general, expect that the Meffiah fhall be a great and invincible hero; that he fhall deliver his country from the dominion of the Romans; that he fhall conquer all nations, and eftablifh on earth an univerfal monarchy, of which Jerufalem is to be the capital. As fuch (they fay) he is foretold by the prophets; but the perfon whom we mean to impofe upon them as the Meffiah, exprefsly difclaimed all worldly greatnefs, and made the fufferings of himfelf and his followers one teft of the truth of his pretentions to the character which he affumed. Some of the moft fubtile among us therefore muft carefully examine the books of Mofes, the Pfalms, and the Prophets, and wreft all the prophecies of the true Meffiah in favour of him whom we know to be an impoftor. The enterprife, as it is directly oppofed, not only by truth, but alfo by all the prejudices and hopes of the nation, is indeed bold: but what is the whole of our defign but the excefs of boldnefs?

"We have hitherto believed that the religion of our forefathers is true, and was given by God to Mofes. It is certainly the moft ancient, the moft authorized, the pureft religion in the world; and the only one founded on divine revelation, or that boafts of fuch a foundation. But if we are to preach to the whole world, that our Mafter, whom we know to be an impoftor, is the true and only Meffiah; and if we are to apply to him prophecies which have another object, we muft neceffarily defpife this moft ancient religion, which our fathers and we have hitherto deemed divine and incontrovertible; and this is the ultimate point to which it has been my aim to bring you. I defire not that you fhould confent immediately, for to abandon one's religion is a thing which fhould not be done without maturely weighing the confequences; but what I defire is, that you will diligently compare all the parts of the plan which I have fuggefted to you, examine their ftrict and neceffary union, and fatisfy yourfelves completely, that we muft *adopt* the whole or *reject* the whole; for it is obvious that modifications and exceptions are here abfolutely impoffible.

"I hope you will not deliberate long on my propofal; for we fhall have much to do after your refolution is formed, and the time in which I propofe to concert and finifh the whole fcheme is very fhort. We have but the interval betwixt the prefent moment and the feaft of Pentecoft in which to prepare the order of falfe apparitions, and fix it in the memories of our numerous coadjutors, male and female; to ftudy in the Scripture all that relates to the Meffiah; to form the plan and adjuft the parts of a new religion;

(1) Deiftical writers have laboured ftrenuoufly, though in vain, to find fuch contradictions in the different accounts of the circumftances attending the refurrection as may difcredit the evidence of the evangelifts to the principal fact.—This gave occafion to Mr Weft's admirable *Obfervations on the Refurrection*; and were there any candour or modefty among our minute philofophers, the appearance of that book would have filenced them for ever. This, however, it has not done. The old cavils have, without the leaft notice of Mr Weft, been again brought forward by Thomas Paine, and again obviated by the Bifhop of Landaff in his mafterly *Apology for the Bible*. "If the writers of the Gofpels (fays Paine) had gone into any court of juftice to prove an *alibi* (for it is of the nature of an alibi that is here attempted to be proved, namely, the abfence of a dead body by fupernatural means), and had given their evidence in the fame contradictory manner as it is here given, they would have been in danger of having their ears cropt for perjury, and would have juftly deferved it." In reply to this impious farcafm, the right reverend apologift thus addreffes its author: "As we cannot have this *viva voce* examination of all the witneffes, let us call up and queftion the evangelifts as witneffes to a fupernatural alibi.—Did you find the fepulchre of Jefus empty? One of us actually faw it empty, and the reft heard from eye-witneffes that it was empty.—Did you, or any of the followers of Jefus, take away the dead body from the fepulchre? All anfwer, No.—Did the foldiers, or the Jews, take away the body? No.—How are you certain of that? Becaufe we faw the body when it was dead, and we faw it afterwards when it was alive.—How do you know that what you faw was the body of Jefus? We had been long and intimately acquainted with Jefus, and knew his perfon perfectly.—Were you not affrighted, and miftook a fpirit for a body? No; the body had flefh and bones; we are fure that it was the very body which hung upon the crofs, for we faw the wound in the fide, and the print of the nails in the hands and feet.—And all this you are ready to fwear? We are; and we are ready to die alfo, fooner than we will deny any part of it.—This is the teftimony which all the evangelifts would give, in whatever court of juftice they were examined; and this, I apprehend, would fufficiently eftablifh the alibi of the dead body from the fepulchre by fupernatural means."

"The book of Matthew (fays Paine) continues its account, that at the end of the Sabbath, as it began to *dawn*, towards the firft day of the week, came *Mary Magdalene* and the other *Mary* to fee the fepulchre. Mark fays it was fun rifing, and John fays it was dark. Luke fays it was Mary Magdalene, and Joanna, and *Mary the mother of James*, and *other women*, that came to the fepulchre. And John fays that Mary Magdalene came alone. So well do they agree about their firft evidence! they all appear, however, to have known moft about Mary Magdalene; fhe was a woman of a large acquaintance; and it was not an ill conjecture that fhe might be upon the ftroll."

"This (replies the Bifhop) is a long paragraph, and I will anfwer it diftinctly: Firft, There is no difagreement of evidence with refpect to the time when the women went to the fepulchre; all the evangelifts agree as to the day on which they went; and as to the time of the day, it was early in the morning: what court of juftice in the world would reject this evidence as infufficient to fubftantiate the fact of the womens having gone to the fepulchre, becaufe the witneffes differed as to the degree of twilight which lighted them on their way? Secondly, There is no difagreement of evidence with refpect to the perfons who went to the fepulchre. John ftates that Mary Magdalene went to the fepulchre; but he does not ftate, *as you make him ftate*, that Mary Magdalene went alone; fhe might, for any thing you have proved or can prove to the contrary, have been accompanied by all the women mentioned by Luke. Is it an unufual thing to diftinguifh by name a principal perfon going on a vifit or an embaffy, without mentioning his fubordinate attendants?

gion; to efface in our mind all traces and ideas of the ancient one; and to fortify ourselves against our prejudices, our fears, and our worldly interests: for we must get quit of all these, since we are going most generously to renounce all the goods of this life, and all the hopes of the next.—What makes me choose the feast of Pentecost for our first public appearance in our new capacity, is the great concourse of people from all nations which will be then at Jerusalem; for it will be a favourable opportunity to preach to them the resurrection of him whom our rulers have crucified, and by their means to spread the news quickly over the whole world. We are ignorant indeed of foreign tongues, and we are without interpreters; but our presence will suffice. Some will comprehend by signs what we would say to them, and others, who hear and understand our language, will assist them. We cannot, it is true, work a miracle; but was there ever such a miracle thought of as our daring to resist all that is mighty and respectable in our nation? There would perhaps be more prudence in not appearing altogether; and as we have nothing extraordinary or divine to command respect, nor any protection to hope from God or man, in not exposing ourselves in a *body* on the first day of our enterprize; but in a design like ours, singular in its whole nature, and contrary to common rules, of what use would prudence be? I am sure that with our Galilean pronunciation, and with the goodly appearance that we shall make in our fishermens garments, we shall persuade a multitude of people. Nay, so confident am I of our success, that I include in my design not only Judea but all the nations upon earth. Nor shall I be discouraged by the diversity of religions, manners, and tongues, which prevail in the world; be affrighted by the hostile power of all mankind; or have my zeal in the least abated for him who hath deceived us, by the improbability of being able to make the Gentiles, who know nothing of the Scriptures or the Messiah, adore as the Son of God the man whom the Jews have crucified as an impostor.

"In the mean time, it will be proper to accustom ourselves to the most inhuman spectacles, in order to arrive by degrees at such a hardness of heart as nothing can be supposed to move. You may depend upon it, that we shall see multitudes of people, seduced by our discourses, proscribed, banished, thrown into dark prisons, torn in pieces by engines of torture, condemned to wild beasts, to the fire, and to the most shameful and insupportable punishments, for preaching with us the resurrection of Jesus. Now, as we are all by nature inclined to compassion, we might be tempted to relieve them from such exquisite misery, since we could effectually do it by a single word; but this word, which would discover the whole mystery, must never slip from our mouths. There must not be so much as one sigh or one groan to betray us. Instead of unseasonably reproaching ourselves with our imposture by which we deceived them, we must applaud ourselves for their seduction; we must place our own joy in their wretchedness; and we must not be afraid to honour, and cause them to be honoured, as illustrious witnesses of the truth, though we know them to be only martyrs to our hypocrisy, and to their own facility in believing falsehood *."

This is a faithful view of the outlines of that plan which *must have been formed* by the apostles, if they intended to deceive the world with respect to the resurrection of their Master. It is of no consequence to the argument whether it grow gradually out of the joint deliberations of the whole body, or was completely digested, as we have supposed, by one of the number, and implicitly adopted by the rest: it is enough that every circumstance which we have mentioned must have occurred to them, and that every resolution must have been unanimously adopted which we have made to flow from the mouth of this daring orator. But surely the bare recital of such an oration is sufficient to show the impossibility of carrying into effect so absurd, so horrible, and so impious a measure—a measure diametrically opposite to all the principles and motives of human actions.

Archbishop King has supposed *, that the human will is a faculty distinct from the understanding and the appetites; that activity is essential to it; and that previous to an election formed, it is equally indifferent to all objects. He thence infers, that a man may choose, and even take delight in, what is not naturally agreeable to any of his appetites; because

The apostles not impostors.

* See the ... Mr Lally.

* Origin of Evil, 4th edition ... 4.

dants? Thirdly, In opposition to your insinuation, that Mary Magdalene was a common woman, I wish it to be considered whether there is any scriptural authority for that imputation; and whether there be or not, I must contend, that a repentant and reformed woman ought not to be esteemed an improper witness of a fact. The conjecture which you adopt concerning her is nothing less than an illiberal, indecent, unfounded calumny, not excusable in the mouth of a libertine, and intolerable in your's.

"The book of Matthew (continues Paine) goes on to say: 'And behold there was an earthquake, for the angel of the Lord descended from heaven, and came and rolled back the stone from the door, and *sat upon it*:—but the other books say nothing about any earthquake.'—What then? does their silence prove that there was none?—'Nor about the angel rolling back the stone and sitting upon it.'—What then? does their silence prove that the stone was not rolled back by an angel, and that he did not sit upon it?—'And according to their accounts there was no angel sitting there.'—This conclusion (says his Lordship) I must deny; their accounts do not say there was no angel sitting there at the time that Matthew says he sat upon the stone. They do not deny the fact, they simply omit the mention of it; and they all take notice that the women, when they arrived at the sepulchre, found the stone rolled away: hence it is evident that the stone was rolled away *before* the women arrived at the sepulchre; and the other evangelists, giving an account of what happened to the women *when* they reached the sepulchre, have merely omitted giving an account of a transaction previous to their arrival. Where is the contradiction? What space of time intervened between the rolling away the stone and the arrival of the women at the sepulchre, is nowhere mentioned; but it certainly was long enough for the angel to have changed his position; from sitting on the outside he might have entered into the sepulchre, and another angel might have made his appearance, or, from the first, there might have been two, one on the outside rolling away the stone, and the other within. Luke, you tell us, 'says there were two, and they were both standing: and John says there were two, and both sitting.'—It is impossible, I grant, even for an angel to be sitting and standing at the same instant of time: but Luke and John do not speak of the same instant, nor of the same appearance.—Luke speaks of the appearance to all the women: and John of the appearance to Mary Magdalene alone, who tarried weeping at the sepulchre after Peter and John had left it. But I forbear making any more minute remarks on still minuter objections, all of which are grounded on this mistake—that the angels were seen at one particular time, in one particular place, and by the same individuals."

[illegible] is formed between the will and the object of desire, which [illegible] being originally [illegible] now become [illegible] object. But neither [illegible] nor any other advocate of human liberty, has ever affirmed or suspected, that any man or body of men could deliberately choose evil for its own sake, or enter seriously upon a tedious and difficult enterprise, from which no good could possibly result, and from which *unmixed misery* was clearly foreseen as the *necessary result of every step of the progress*. Such, however, must have been the choice and the conduct of the apostles, when they resolved to preach a new religion founded on the resurrection of Jesus, if they did not certainly know that Jesus had risen from the dead. And this conduct must have been adopted, and in opposition to every motive which can influence the human mind; have been persevered in by a great number of men and women, without one single contradiction having ever appeared in their various testimonies, which at different times, and under the cruellest tortures, they all gave to a variety of circumstances, of which not one had its foundation in truth. He who can admit this supposition, will not surely object to the incredibility of miracles. The resurrection of a man from the dead is an event so different indeed from the common course of things, that nothing but the most complete evidence can make it an object of rational belief; but as the resurrection of Jesus has always been said to have had God for its Author, it is an effect which does not exceed the power of the cause assigned, and is therefore an event possible in itself and capable of proof. It is a deviation from the laws of nature, but it is not contradictory to any one of those laws.

That a great number of men and women should deliberately form a plan of ruin and misery to themselves, without a prospect of the smallest advantage either in this world or in the next, is as different from the common course of things as the resurrection from the dead; and therefore in itself at least as great a miracle: but that they should persist in prosecuting this plan in the midst of torments; that they should spread themselves over the whole world, and everywhere publish a number of falsehoods, without any one of them contradicting the rest; that truth should never escape them either in an unguarded moment, or when lingering on the rack, and yet that all their lies should be in perfect agreement with each other; that they should every one of them court sufferings for a person whom they knew to be an impostor; that not one of the number—not even a single woman—should have so much compassion for a fellow-creature, as to rescue him from the flames by confessing a truth which could injure nobody—not even the suffering deceivers themselves:—all this is not only different from the common course of things, but directly contrary to the most known laws of nature, and is therefore not miraculous, but may be pronounced impossible. Yet this impossibility we must admit, or acknowledge, that as "Christ died for our sins, according to the Scriptures, and was buried; so he rose again the third day according to the Scriptures; that he was seen of Cephas, then of the twelve; after that of above five hundred brethren at once; after that of James; then of all the apostles; and that he was last of all seen of St Paul *," who was converted by the vision to preach the faith which till then he had persecuted.

* 1 Cor. xv. 3—8.

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Hence we are assured of our own resurrection.

Thus are we assured, that "those who have fallen asleep in Christ are not lost, since he is risen from the dead, and become the first-fruits of them that slept. For since by man came death, by man came also the resurrection of the dead. For as in Adam all die, even so in Christ shall all be made alive. But every man in his own order: Christ the first-fruits, afterwards they that are Christ's at his coming; for all that are in the grave shall hear his voice, and shall come forth; they that have done good unto the resurrection of life, and they that have done evil to the resurrection of damnation *."

* 1 Cor. xv. 20 and Se[q]. [John] v. 28.

Theo[logy] more [sum]mary [bene]fi[ts]

Our blessed Lord having conversed familiarly with the eleven apostles for forty days after his resurrection, instructing them in the things pertaining to the kingdom of God; having extended their authority as his ministers, by giving them a commission to teach all nations, and make them his disciples, by baptizing them in the name of the Father, and of the Son, and of the Holy Ghost; and having promised them power from on high to enable them to discharge the duties of so laborious an office—led them out as far as Bethany, that they might be witnesses of his ascension into heaven. "When they therefore were come together, they asked of him, saying, Lord, wilt thou at this time restore again the kingdom to Israel? And he said, It is not for you to know the times and the seasons, which the Father hath put in his own power. But ye shall receive power after that the Holy Ghost is come upon you; and ye shall be witnesses unto me, both in Jerusalem, and in all Judea, and in Samaria, and unto the uttermost parts of the earth. But tarry ye in the city of Jerusalem, until ye be endued with power from on high; and he lift up his hands and blessed them; and it came to pass while he blessed them, he was parted from them, and a cloud received him out of their sight. And while they looked stedfastly towards heaven, as he went up, behold, two men stood by them in white apparel; who also said, ye men of Galilee, why stand ye gazing up into heaven? This same Jesus, who is taken up from you into heaven, shall so come, in like manner as ye have seen him go into heaven. And they worshipped him, and returned to Jerusalem with great joy ‡."

‡ St Luke xxiv. 44—53. and Acts i. 12.

19[1]
Proofs of Christ's ascension.

That our blessed Lord ascended into heaven, will hardly be denied in the present age by any one who admits that he rose from the dead. The ascension was indeed the natural consequence of the resurrection; for we cannot suppose that a man would be called back from the grave to live for ever in a world where all other men fall in succession a prey to death. The purpose for which he died was to recover for the descendants of Adam every privilege which they had forfeited through his transgression; and if, as has been generally believed, mankind were by the terms of the first covenant to enjoy eternal life in heaven, some proof was necessary that Christ by his death and resurrection had opened the kingdom of heaven to all faithful observers of the terms of the second. Hence it was prophesied § of the Messiah, in whom all the nations of the earth were to be blessed, that "he should ascend on high, lead captivity captive, and sit on the right hand of God until his enemies should be made his footstool." It was therefore of the greatest importance to the apostles to have sufficient proof of their Master's exaltation to the right hand of the Majesty on high; for otherwise they could neither have looked for an entrance into heaven themselves, by a new and living way, as the author of the epistle to the Hebrews expresses it, nor have preached Jesus as the Messiah promised to their fathers, since they could not have known that in him these prophecies were fulfilled. But the proof vouchsafed them was the most complete that the nature of the thing would bear. The spectators of the ascension were many; for, according to the history of St Luke *, those who returned from the Mount of Olives to Jerusalem, and prepared themselves for the coming of the Holy Ghost, were in number about six score; and to such a cloud of witnesses the evangelist would not have appealed, had not the fact he was recording been very generally known. Yet these were perhaps but part of the witnesses; for since Christ had told to his disciples that he was to ascend

§ Psal. [lxviii. 18.] cx. [1.] Micah [ii.] 13.

* Acts i. [1]2—[15.]

...tory, ...ecu ...Chri...ian.

cend to his Father and their Father, to his God and their God, and that he was going to prepare a place for them, that where he is there they might be likewise; we can hardly doubt but that all who believed in him as the Redeemer of the world would take care to be present, not only to view their Master's triumph over all his enemies, but also to have a sight of that glory which awaited themselves. It was on this occasion probably that he was seen after his resurrection by above five hundred brethren at once, of whom the greater part were alive at the writing of St Paul's first epistle to the Corinthians.

But though such multitudes of people saw Jesus lifted up from the mount, and gradually vanish out of their sight, some other evidence seemed necessary to certify them of the place to which he had gone. Two angels therefore appear, and attest what human eyes could not see, but what was indeed the consequence of what they had seen. They attest that Christ had ascended to heaven, not to descend again till the last day; and surely, with respect to this point, the citizens of heaven were the most unexceptionable witnesses. We must therefore acknowledge and confess, against all the wild heresies of old (K), that Jesus Christ the Son of God, who died and rose again, did with the same body and soul with which he had lived upon earth ascend up "into heaven, there to appear in the presence of God for us *." Having in the outward tabernacle of this world once offered up himself a pure and perfect sacrifice for the expiation of our sins, he entered within the veil into the most holy place, there to present his blood before God himself, in order to obtain mercy for us, and restore us to the Divine favour. So that, "if any man sin, we have an advocate with the Father, Jesus Christ the righteous, who is the propitiation for our sins, and not for ours only, but also for the sins of the whole world; and he is able to save to the uttermost those that come to God by him, seeing he ever liveth to make intercession for us." "Seeing then that we have a great high-priest, who is passed into the heavens, Jesus the Son of God, we may through him come boldly unto the throne of grace, that we may obtain mercy, and find grace to help in time of need."

192 ...Heaven ...Savi... ...exe... ...s the ...e of a ...st

* ...eb. ix. 24.

193 ...d a king.

But it is not the office of a priest only that our Lord discharges in heaven; he is represented as sitting on the right hand of God, to denote that regal authority with which he is now vested; "angels, and authorities, and powers, being made subject to him ‡." Hence it is, that after his resurrection, he said of himself †, "all power is given unto me in heaven and in earth;" for, as St Paul informs us ‡, "because he humbled himself and became obedient unto death, even the death of the cross, therefore God hath highly exalted him, and given him a name which is above every name; that at the name of Jesus every knee should bow, of things in heaven, and things in earth, and things under the earth." And this submission is due to him, because "God raised him from the dead, and set him at his own right hand in the heavenly places, far above all principalities and powers, and might, and dominion, and every name that is named, not only in this world, but also in that which is to come; and hath put all things under his feet, and gave him to be head over all things to the church *." As God, Christ possessed a kingdom, which as it had not a beginning, can never have an end: but the dominion, of which the apostle is here treating, was conferred upon him as the mediator of the new covenant, and will no longer continue than till his enemies shall be subdued; for we are told, that "he must reign till he hath put all enemies under his feet; and that the last enemy which shall be destroyed is death." "He will ransom his subjects from the power of the grave; he will redeem them from death. O death, he will be thy plague; O grave, he will be thy destruction ‡." The trumpet shall sound, the graves shall be opened, all the sons and daughters of Adam shall return to life, and death shall be swallowed up in victory. "Then cometh the end, when the office of mediator ceasing, he shall have delivered up the kingdom to God, even the Father, when he shall have put down all rule and all authority and power. For when all things shall be subdued unto him, then shall the Son also himself be subject unto him that put all things under him, that God may be all in all ‡."

‡ 1 Peter iii. 22. † Matth. xxviii. 18. ‡ Phil ii. 9, 10.

* Eph. i. 20, &c.

‡ Hosea xiii. 14.

‡ 1 Cor. xv. 24—28.

194 Descent of the Holy Ghost on the apostles.

The first conspicuous proof which our blessed Lord gave of being vested with supreme power, and made head over all things to the church, was on the day of Pentecost. He had told the apostles that he would pray the Father to give them another comforter, who should abide with them for ever, even the Spirit of truth, which should teach them all things, and bring all things to their remembrance which he had said unto them. He had assured them, that it was expedient for them that he himself should go away; "for if I go not away (said he ‡), the Comforter will not come unto you; but if I depart, I will send him unto you." At his last interview with them, just before his ascension, he had desired them to tarry at Jerusalem till they should be endued with power from on high, before they entered upon their great work of converting the nations. These promises were amply fulfilled; for "when the day of Pentecost was fully come, they were all with one accord in one place. And suddenly there came a sound from heaven as of a rushing mighty wind, and it filled all the house where they were sitting. And there appeared unto them cloven tongues, like as of fire, and it sat upon each of them. And they were all filled with the Holy Ghost, and began to speak with other tongues, as the Spirit gave them utterance. And there were dwelling at Jerusalem Jews, devout men, out of every nation under heaven. Now when this was noised abroad, the multitude came together, and were confounded, because that every man heard them speak in his own language. And they were all amazed, and marvelled, saying one to another, Behold, are not all these who speak Galileans? And how hear we every man in our own tongue, wherein we were born? Parthians, and Medes, and Elanites, and the dwellers in Mesopotamia, and in Judea, and Cappadocia, in Pontus and Asia, Phrygia and Pamphylia, in Egypt and in the parts of Libya about Cyrene, and strangers of Rome, Jews and proselytes, Cretes and Arabians—we do hear them speak in our tongues the wonderful works of God. And they were all amazed, and were in doubt, saying one to another, What meaneth this *?"

‡ John xvi. 7.

* Acts ii. 1—13.

That those who heard the apostles speak so many different

(K) There was one Apelles in the primitive church, who was condemned as a heretic for teaching that Christ's body was dissolved in the air, and that he ascended to heaven without it. The opinions of this man and his followers are stated at large and confuted by Tertullian, Gregory Nazianzen, and Epiphanius; and the reader who thinks such ridiculous notions worthy of his notice, will find enough said of them in the Notes to the sixth article of Pearson's Exposition of the Creed. Perhaps it may be from a hint communicated in these Notes, that our great modern corrector of the evangelists has discovered, if it be indeed true that he pretends to have discovered, that Jesus Christ is still upon earth.

ferent languages were amazed, is what we should naturally suppose; but that a single individual among them remained unconvinced, is astonishing: for the gift of tongues on the day of Pentecost is one of the most palpable miracles that was ever wrought. It is likewise one of the best authenticated miracles; for the book entitled *the Acts of the Apostles* was written not more than 30 years after the event took place (see SCRIPTURE, n° [illegible]); and it is not conceivable that, within so short a period, St Luke, or any man of common sense, would have appealed for the truth of what he recorded to so many inveterate enemies of the Christian name, had he not been aware that the miraculous gift of tongues was a fact incontrovertible. We all know how desirous the Jewish rulers were to stop the progress of the faith, by whatever means, whether of fraud or force; but if this miracle was not really performed, they had now an opportunity of doing it effectually by means to which truth and honour would give their approbation. Thousands must have been alive in the city of Jerusalem who were men and women at the time when the apostles were said to have been thus suddenly inspired with the tongues of the Parthians, Medes, and Elamites, &c.; and as these foreigners were themselves either Jews by descent, or at least proselytes to the Jewish religion, surely the chief-priests would have found multitudes ready, both at home and abroad, to contradict this confident appeal of St Luke's, if contradiction had been possible. We read however of no objection whatever being made to this miracle. Some of the audience, indeed, when the apostles addressed people of so many nations in all their respective languages, not understanding what was said, and taking it for jargon which had no meaning, concluded, not unnaturally, that the speakers were full of new wine, and mocked them for being drunk so early in the day; but this is a circumstance which, so far from rendering the miracle doubtful, adds much to the credit of the historian, as it would hardly have occurred to the writer of a narrative wholly false, and would certainly not have been mentioned, had he known that the apostles really attempted to impose upon the multitude unmeaning sounds for foreign languages.

106
The gift of tongues permanent with the apostles.

As it is thus certain that the apostles were miraculously furnished with the gift of tongues, so the elegance and propriety of that miracle to attest the real descent of the Spirit of truth, who was to teach them all things, and endue them with power from on high to convert the nations, can never be enough admired by the pious Christian; for words being the vehicle of knowledge, an ability to speak the different languages of the earth was absolutely necessary to enable those who had been originally fishermen to go into all the world and preach the gospel to every creature. Yet there have been writers ‡, who, though unable to call in question the reality of the gift of tongues on the day of Pentecost, have contended that it was a gift "not lasting, but instantaneous and transitory; not bestowed upon them for the constant work of the ministry, but as an occasional sign only, that the person endowed with it was a chosen minister of the gospel; which sign, according to them, ceased and totally vanished as soon as it had served that particular purpose." The chief argument upon which this opinion is attempted to be built, is drawn from the scripture Greek, which is said to be "utterly rude and barbarous, and abounding with every fault which can possibly disgrace a language; whereas we should naturally expect to find an inspired language pure, clear, noble, and affecting, even beyond the force of common speech; since nothing can come from God but what is perfect in its kind. In short, we should expect, says the objector, the purity of Plato and the elegance of Cicero ‡."

‡ Dr Middleton and Lord Shaftesbury.

‡ Middleton's Essay on the Gift of Tongues.

Theology more peculiarly Christian.

In reply to this objection, it has been well observed †, that it supposes what is called the purity, elegance, and sublimity, of language, to be something natural and essential to human speech, and inherent in the constitution of things. "But the matter is far otherwise. These qualities are accidental and arbitrary, and depend on custom and fashion; modes of humanity as various as the differing climes of the earth; and as inconstant as the tempers, genius, and circumstances, of its inhabitants. For what is *purity*, but the use of such terms and their combinations as the caprice of a writer or speaker of authority hath preferred to their equals? what is *elegance*, but such a turn of idiom as a fashionable fancy hath brought into credit? and what is *sublimity*, but the application of such images as arbitrary and casual connections, rather than their own native grandeur, have dignified and ennobled? The consequence of this is, that the mode of composition which is a model of perfection to one nation or people, has always appeared either extravagant or mean to another. Asiatic and Indian eloquence was esteemed hyperbolical and unnatural by the Greeks and Romans, and is so esteemed by us; whilst the Greek and Roman eloquence in its turn appeared cold and insipid to the warm inhabitants of the east; and ours would appear perhaps still colder. But the New Testament was designed for the rule of life to all mankind. Such a rule required inspiration; and inspiration, say the objecters, implies the most perfect eloquence. What human model then was the Holy Ghost to follow? for a human model it must have been, because there was no other; and if there had, no other would have answered the purpose, which was to make a due impression on the mind and affections. Should the eastern eloquence have been employed? But it would have been too swelling and animated for the west. Should the western? This would have been too still and inactive for the east. Or suppose us only solicitous for what we best understand; which species of this latter genus should the sacred writers have preferred? The dissolute softness of the Asiatic Greeks, or the dry conciseness of the Spartans? The flowing exuberances of Attic eloquence, or the grave severity of the Roman?

† Warburton's Doctrine of Grace.

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Answered.

"But are there not some general principles of eloquence in common to all the species? There are. Why then should not these have been employed to credit the apostolic inspiration? Because the end even of these (replies our author) is to mislead reason, and inflame the passions; which being abhorrent to the truth and purity of our holy religion, were very wisely rejected by the inspired penmen. Besides, it might easily be known to have been the purpose of Providence, though such purpose had not been expressly declared, that the gospel should bear all possible marks of its divine original, as well in the course of its progress as in the circumstances of its promulgation. To this end, the human instruments of its conveyance were mean and illiterate, and chosen from among the lowest of the people, that when the world saw itself converted by the *foolishness of preaching*, as the only learned apostle thinks fit to call it, unbelievers might have no pretence to ascribe its success to the parts, or stations, or authority, of the preachers. Now had the language inspired into these illiterate men been the eloquence of Plato or Tully, Providence would have appeared to counteract its own measures, and to defeat the purpose best calculated to advance its glory. But God is wise, though man is a fool. The course of Providence was uniform and constant: It not only chose the weakest instruments, but carefully kept out of their hands that powerful weapon of WORDS which their adversaries might so easily have wrested to the dishonour of the gospel. Common sense tells us, that the style of an universal law should retain

The logos, are peculiarly Christian. tain what is common to all languages, and neglect what is peculiar to each. It should retain nothing but CLEARNESS and PRECISION, by which the mind and sentiments of the writer are intelligibly conveyed to the reader. This quality is essential, invariably the same, and independent of custom and fashion. It is the consequence of syntax, the very thing in language which is least positive, as being formed on the principles of philosophy and logic: whereas all besides, from the very power of the elements and signification of the terms, to the tropes and figures in composition, are arbitrary; and, as deviating from these principles, frequently vicious. But this quality of clearness and precision eminently distinguishes the writings of the New Testament; insomuch that it may be easily shown, that whatever difficulties occur in the sacred books do not arise from any imperfect information caused by this local or nominal barbarity of style; but either from the sublime or obscure nature of the things treated of, or from the intentional conciseness of the writers; who, in the casual mention of any thing not essential to the dispensation, always observe a studied brevity."

After much ingenious and sound reasoning on the nature of language in general, our author concludes, that the STYLE of the New Testament, even on the supposition of the truth of what has been said to its discredit, is so far from proving the language not to be divinely inspired, that it bears one certain mark of that original. "Every language consists of two distinct parts, the single terms, and the phrases and idioms. Suppose now a foreign language to be instantaneously introduced into the minds of illiterate men like the apostles; the impression must be made either by fixing in the memory the terms and single words only with their signification, as, for instance, Greek words corresponding to such or such Syriac or Hebrew words; or else, together with that simple impression, by enriching the mind with all the phrases and idioms of the language so inspired. But to enrich the mind with the peculiar phrases and idiom of a foreign language, would require a previous impression to be made of the manners, notions, fashions, and opinions, of the people to whom that language is native; because the idiom and phrases arise from and are dependent on these manners. But this would be a waste of miracles without sufficient cause or occasion; for the Syriac or Hebrew idiom, to which the Jews were of themselves enabled to adapt the Greek or any other words, abundantly served the useful purposes of the gift of tongues, which all centered in those tongues, being so spoken and written as to be CLEARLY UNDERSTOOD. Hence it follows, that if the style of the New Testament were indeed derived from that language which was miraculously impressed upon the apostles on the day of Pentecost, it must be just such a one as in reality we find it to be; that is, it must consist of Greek words in the Syriac or Hebrew idiom."

199 Divinity of the Holy Ghost. The immediate author of this gift, so necessary to the propagation of the gospel, was the Spirit of truth, or the Comforter, who is the Holy Ghost and the third person in the blessed Trinity. That there are three persons in the one Godhead, has been shewn at large in a former section of this article; and that the Holy Ghost is one of these three, might be safely concluded from the form of baptism instituted by Christ himself. But as more plausible objections have been urged against his divinity than any that we have met with against the divinity of Christ, it may not be improper to consider these before we proceed to give an account of the graces which he imparted to the infant church, and of the apostles preaching under his influence. By the Arians the Holy Ghost is considered as a creature; by the Socinians and modern Unitarians, as they call themselves, the words *Holy Ghost* are supposed to express, not a person or spiritual subsistence, but merely an energy or operation, a quality or power, of the Father, whom alone they acknowledge to be God. If this doctrine can be confuted, the Arian hypothesis will fall to the ground of itself; for it is not conceivable that any inspired teacher should command his followers to be baptized in the name of the self-existent God and two creatures. The logos, more peculiarly Christian.

200 Objections. It is admitted by the Socinians themselves, that in the scriptures many things are spoken of the Holy Ghost which can be properly predicated only of a person; but the inference drawn from this concession they endeavour to invalidate by observing, that in scripture there are likewise expressions in which things are predicated of abstract virtues, which can be literally true only of such persons as practise these virtues. Thus when St Paul says *, that "charity suffereth long and is kind, charity envieth not, charity vaunteth not itself, is not puffed up, &c." we cannot suppose his meaning to be, that these actions are performed by charity in the abstract, but that every charitable person, in consequence of that one Christian grace, suffereth long and is kind, envieth not, vaunteth not himself, and is not puffed up, &c. In like manner, say they, personal actions are attributed to the Holy Ghost, which itself is no person, but only the virtue, power, or efficacy, of God the Father; because God the Father, who is a person, performs such actions by that power, virtue, or efficacy, in himself, which is denominated the Holy Ghost. Thus when we read ‡ that "the Spirit said unto Peter, Behold three men seek thee; arise therefore and get thee down, and go with them, doubting nothing, for I have sent them;" we must understand that God the Father was the person who spoke these words and sent the three men; but because he did so by that virtue in him which is called the *Spirit*, therefore the *Spirit* is said to have spoken the words and sent the men. Again, when "the Holy Ghost said ‖ to those at Antioch, Separate me Barnabas and Saul for the work whereunto I have called them;" we are to conceive that it was God the Father who commanded the two apostles to be separated for the work to which he had called them; but because he had done all this by that power within him which is called the Holy Ghost, therefore his words and actions are attributed to the Holy Ghost, just as long-suffering in men is attributed to charity.

* 1 Cor. xiii. 4—8.
‡ Acts x. 19, 20.
‖ Acts xiii. 2.

201 Answered. This reasoning has a plausible appearance, and would be of much force were *all* the actions which in scripture are attributed to the Holy Ghost of such a nature as that they could be supposed to have proceeded from the person of God the Father in consequence of any particular power or virtue in him; but this is far from being the case. Thus "the Spirit is said † to make intercession for us;" but with whom can we suppose God the Father, the fountain of divinity, to intercede? Our Saviour assured ‡ his disciples, that the Father would, in his name, send to them the Holy Ghost, who is the Comforter; that he would himself send the Comforter unto them from the Father; that the Comforter should not speak of himself, but speak only what he should hear; and that he should receive of Christ's, and shew it unto them. But we cannot, without blasphemy and absurdity, suppose that the Father would, in the name of Christ, send himself; that the Son would send the Father from the Father; that the Father would not speak of himself, but speak only what he heard; or that either the Father in person, or a quality of the Father, should receive any thing of Christ to shew unto the apostles.

† Rom. viii. 26, 27.
‡ St John xiv. 26. xv. 26. xvi. 13, 14, 15.

The sagacity of Socinus perceived the force of such objections as these to his notion of the Holy Ghost, being nothing more than the power of the Father personified; and therefore he invented another *prosopopoeia* to serve his

[illegible] purpose in the interpretation of those texts to which this [illegible] cannot be applied. "The Spirit of God (says he) may be considered either as a property or power in God, or as the things on which that power is working. When taken in the former sense, the Spirit, where any personal attribute is given to it, means God the Father; when taken in the latter sense, it means the man on whom the power of the Father is working; who, as long as he is affected by that power, is therefore called the Spirit of God;" and he quotes, we think most absurdly, the tenth verse of the second chapter of the first epistle to the Corinthians, as a text in which by the Spirit is meant an inspired man who could search all things, yea, even THE DEEP THINGS OF GOD.

How his modern followers, who deny the plenary inspiration even of Christ, will relish such a degree of inspiration as this, which raises mere man to a temporary equality with God, we know not; but leaving them to settle the dispute with their master as they best can, we shall produce one or two passages in which personal attributes are given to the Spirit of God, when it is impossible to conceive that Spirit either as a power inherent in the Divine Father, or as the person on whom that power is operating. We need not bring new texts into view, as some of those already quoted will serve our purpose. When our Saviour promises that the *Holy Ghost, the Comforter, the Spirit of truth*, should be sent by the Father and the Son to the apostles, we have seen, that by this Spirit he could not mean the Father or a property of the Father; neither could he possibly mean the apostles themselves, unless we are to suppose that the Father and the Son sent St Peter to St Peter, and that St Peter, so sent, came to St Peter! Again, when Christ saith of the Holy Ghost, "he shall receive of mine, and shall shew it unto you," he could not, for the reason already assigned, mean by the Holy Ghost the Father or the power of the Father; and surely his meaning was not, that the apostles, under the influence of the power of the Father, should receive something and shew it each to himself! The Holy Ghost therefore is unquestionably a person; for tho' there are many passages of scripture in which the *gifts* of the Holy Ghost are called the *Holy Ghost*, they are so called by a very common figure of speech, in which the effect receives the name of its cause: and since this person is joined with the Father and the Son in the formula of Christian baptism; since they who lied to the Holy Ghost are said † to have lied unto God; since blasphemy against him is a more heinous offence than the same sin against even the Father or the Son ‡; and since it was by the operation of the Holy Ghost that Jesus Christ was conceived of the Virgin Mary, and even on that account † called the Son of God—it follows undeniably, that the Holy Ghost is God, of the same substance with the Father and Son.

† Acts v. 4.

‡ Mark iii. 29.

† Luke i. 35.

The apostles miraculously inspired [illegible]

It was this divine Spirit which, on the day of Pentecost, inspired the apostles with the knowledge of different languages; and as these were given only to enable them to preach the gospel to every creature, it can admit of no doubt but that he, who so amply provided the means of preaching, would take care that the gospel should be preached in purity. Our Saviour had told his apostles that the Comforter would guide them into all the truth (εις πασαν την αληθειαν), and bring all things to their remembrance, whatsoever he had said unto them; but if they had not comprehended the meaning of what he said, the bare remembrance of his sayings would have been of little importance. That before this miraculous shedding abroad of the Spirit they had but a very imperfect knowledge of his doctrines, and of the purpose for which he had come into the world, is apparent from that unseasonable question which they put to him when assembled to witness his glorious ascension; "Lord, wilt thou at this time restore again the kingdom to Israel?"

203 The [illegible] need of such instruction.

Their minds still cherished with fondness the vain prospect of temporal power; but after the day of Pentecost they were directed to nobler objects. From the same Spirit they received diversities of gifts besides that of language; for we are assured by St Paul *, when speaking of the early converts to Christianity in general, that "to one was given by the Spirit the word of WISDOM; to another the word of KNOWLEDGE by the same Spirit; to another FAITH by the same Spirit; to another the gifts of HEALING by the same Spirit; to another the working of MIRACLES; to another PROPHECY; to another DISCERNING OF SPIRITS; to another DIVERS KINDS OF TONGUES; to another the INTERPRETATION of tongues:" and these gifts, which were severally divided either among private Christians or among the inferior orders of ministers in the church, we have reason to believe were all bestowed in a greater or less degree upon each of the apostles.

* 1 Cor. xii. 8—11.

Men thus endowed were well qualified to declare unto the world all the council of God. By the word of *wisdom* they communicated to the Gentile nations a pure system of what is called *natural religion*; turning them from the vanity of idols to the worship of the living God: by the word of *knowledge*, they preached the great doctrines of revelation both to Jews and Gentiles, shewing them that there is none other name under heaven given unto men whereby they may be saved than the name of Jesus Christ (L); and by their gifts of *healing* and of *miracles*, &c. they were enabled to prove unanswerably that their doctrines were divine. They taught everywhere the unity of God, the creation of the world, the fall of man, the necessity of redemption, the divinity of the Redeemer, his sacrifice on the cross to restore mankind to their forfeited immortality, and the terms of the new covenant into which they had through him been graciously admitted by God.

Such a view as our limits would admit of we have given of all these doctrines, except that which respects the terms of the gospel covenant; but these being explicitly stated only by St Paul and St James, we could not till now investigate them, without violating the historical order into which, for the sake of perspicuity, we have digested the several parts of this short system. Our Saviour himself has indeed taught with great plainness the necessity of faith and baptism

(L) It is not perhaps easy to determine what is here meant by the word of WISDOM and the word of KNOWLEDGE, as distinguished from each other. By the former (λογος σοφιας), bishop Warburton understands all the great principles of natural religion. "The ancients (says he) used the word σοφια in this peculiar sense; it is used in the same sense by St Paul in Col. iv. 5.; and we can hardly give it any other in the place before us, where we see the word of wisdom distinguished from the word of knowledge (λογος γνωσεως), which evidently means all the great principles of revelation; the term γνωσις being as peculiarly applied by Christian writers to revealed religion as σοφια is by the Gentiles to the natural. St Paul uses the word in this sense in 2 Cor. xi. 6. where he says, Ει δε και ιδιωτης τῳ λογῳ αλλ ου τῃ γνωσει; and St Peter in his first epistle, chap. iii. verse 7. Hence those early heretics, who so much deformed the simplicity and purity of the Christian faith by visionary pretences to superior knowledge of revelation, took from this word the name of Gnostics." See *Warburton's Sermon on the Office and Operation of the Holy Ghost*.

baptiſm to the ſalvation of thoſe who have an opportunity of hearing the goſpel preached with power (ſee BAPTISM); and in his ſermon on the mount, which is ſuch a lecture of ethics founded on religion as the Son of God only could have delivered, we learn, that "unleſs our righteouſneſs ſhall exceed the righteouſneſs of the Scribes and Phariſees, we ſhall in no caſe enter into the kingdom of heaven; that not every one who ſaith unto Chriſt, Lord, Lord, ſhall enter into the kingdom of heaven, but he who doth the will of his Father who is in heaven; and that many will ſay to him at the day of judgment, Lord, Lord, have we not propheſied in thy name? and in thy name done many wonderful works?" which could not be done without faith; "to whom he will, notwithſtanding, ſay, Depart from me, ye that work iniquity ‡." St Paul, however, ſeems to attribute our juſtification to the bare act of believing; for he repeatedly aſſures us, "that a man is juſtified by faith without the deeds of the law;" while St James, on the other hand, affirms, "that by works a man is juſtified, and not by faith only."

This apparent difference in the language of the two apoſtles, for we hope to ſhow that it is only apparent, has produced among divines opinions really different reſpecting the juſtification of Chriſtians; and the principal of theſe opinions it is our duty to ſtate. But previous to this, it will be neceſſary to aſcertain the meaning of the word *juſtification;* for we are ſorry to ſay, that for want of accurate definitions, many theological controverſies are nothing better than empty logomachies; and perhaps againſt no controverſy can this charge be brought with greater truth than againſt that which, in the end of the laſt century and in the beginning of the preſent, was ſo violently agitated concerning the *cauſes*, the *inſtruments*, and the *conditions*, of juſtification.

Between *pardon* of ſin and *juſtification* there is ſo cloſe a connection, that many writers ſeem to conſider the terms as ſynonymous, and to infer, that he who is pardoned is *ipſo facto* juſtified. That every Chriſtian, who ſhall be pardoned at the judgment of the great day, will likewiſe be juſtified, is indeed true; but in propriety of ſpeech, *juſtification* is a word of very different import from *pardon*, and will entitle the Chriſtian to what mere pardon could not lead him to expect. An innocent perſon, when falſely accuſed and acquitted, is *juſtified* but not *pardoned;* and a criminal may be *pardoned*, though he cannot be *juſtified* or declared innocent. A man whoſe ſins are pardoned is free from puniſhment; but the juſtified Chriſtian is entitled to everlaſting life, happineſs, and glory. If we were only pardoned through Chriſt, we ſhould indeed eſcape the pains of hell, but could have no claim to the enjoyments of heaven; for theſe, being more than the moſt perfect human virtue can merit, muſt be, what in the Scriptures they are always ſaid to be, "the gift of God through Jeſus Chriſt our Lord." Hence it is that St Paul, diſtinguiſhing, as we have done upon his authority, between mere remiſſion of ſins and juſtification of life, declares ‡, that "Jeſus our Lord was *delivered* for our *offences*, and *raiſed* again for our *juſtification*."

The word juſtification, as uſed both by St Paul and St James, has been very generally conſidered as a forenſic term expreſſing the ſentence of a judge. The moſt eminent reformed divines of all denominations *, and even many of the Romaniſts themſelves, have ſtrenuouſly contended, that this is its genuine ſenſe, when it is diſtinguiſhed from mere remiſſion of ſins, regeneration, and ſanctification; and if ſo, it will ſignify God's pronouncing a perſon *juſt*, either as being perfectly blameleſs, or as having fulfilled certain conditions required of him in the Chriſtian covenant. But that "there is not a juſt man upon earth, who doth good and ſinneth not," is made known to us by the moſt complete evidence poſſible, the joint dictates of our own conſciences and of divine revelation; and therefore whoſoever is pronounced juſt by the Judge of all the earth, muſt be ſo, either becauſe, though not abſolutely blameleſs, he has performed the conditions required of him in the covenant of grace, or becauſe Chriſt has fulfilled all righteouſneſs in his ſtead.

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If this be the Scripture notion of juſtification, it muſt be wholly the act of God, and cannot be the effect either of our faith or of our virtue. Accordingly, we are ſaid by the apoſtle to be juſtified freely by his grace through the redemption that is in Jeſus Chriſt; whom *God hath ſet forth* to be a propitiation through faith in his blood †. The act of juſtification therefore proceeds from the divine philanthropy, and cannot be performed by the inſtrumentality of faith; for it is not God, but man, who believes; and man is not the juſtifier of himſelf. To talk of any kind of *inſtrument* of juſtification beſides the propitiation ſet forth by God, is indeed to make uſe of very improper language: "Omnis cauſa inſtrumentalis (ſays Biſhop Bull ‡), ſuo modo in effectum influit, eique effecti productio proprie attribui poteſt. Jam vero, cum juſtificatio nihil aliud ſit quam gratioſus Dei actus, quo peccata noſtra nobis condonet, ac nos ad ſalutem acceptet, valde abſurdum eſſet dicere, vel fidem, vel opera noſtra, vel quidvis aliud noſtri aut remittere peccata noſtra, aut perſonas noſtras acceptare: quod tamen, ſi inſtrumentalis cauſa juſtificationis fides ſit, plane dicendum eſſet."

† Rom. iii. 24, 25.

‡ *Harmonia Apoſt.* diſs. 2. cap. 11. § 9.

In this ſentiment of the illuſtrious Biſhop of St David's, ſome of the moſt eminent divines both among the Calviniſts and Arminians agree; and indeed it is not eaſy to be conceived how any man can entertain a different ſentiment, when conſidering juſtification in its proper ſenſe. Many, however, have choſen to treat of juſtification not only in the active ſenſe, as it is the act of God, for all admit that it is he who juſtifies; but likewiſe in a paſſive ſenſe, as it means our *privilege* or *poſſeſſion* holden of him, when we are ſaid to be juſtified by his grace. In this view of the ſubject they may talk, with ſufficient propriety, of an inſtrument of juſtification, not as the mean by which it is conveyed, but as the medium through which it is received by the true Chriſtian. And hence it follows, that the Doctors Waterland and Warburton, of whom the former was not a thorough Calviniſt, and the latter was a profeſſed Arminian, ſtrenuouſly maintain the doctrine of the Weſtminſter Confeſſion, that "faith receiving and reſting on Chriſt is the alone inſtrument of juſtification; though it cannot be alone in the perſon juſtified, but muſt ever be accompanied with all other ſaving graces, and be a faith which worketh by love."

But notwithſtanding this agreement between the leaders of the rival ſects, they have found abundant matter of controverſy reſpecting faith and works, in deciding the great queſtion, "Whether, when God juſtifies man, he conſiders him as abſolutely righteous on account of Chriſt's righteouſneſs performed in his ſtead; or only as juſt, becauſe he has fulfilled the conditions of the covenant of grace, which does not require of him perfect righteouſneſs?" The former is the doctrine of the more rigid Calviniſts, the latter that of the Arminians or Remonſtrants.

"A notion (ſays Dr Gill ‡) obtained ſome years ago, that a relaxation of the law and the ſeverities of it has been obtained by Chriſt; and a new law, a remedial law, a law of milder terms, been introduced by him, which is the goſpel; the terms of which are, faith, repentance, and new obedience; and though theſe be imperfect, yet, being ſincere, they are accepted by God in the room of a perfect righteouſneſs. But every article of this ſcheme (continues he) is wrong:

‡ Body of Div. vol. ii. book i. chap. 8. § 5.

Theology, not yet half-Christian. for the law is not relaxed, nor any of its severities abated; Christ came not to destroy, but to fulfil it; and therefore it requires the same holy, just, and good things, as ever. Nor is the gospel a new law. There is nothing in it (he says) which looks like a law; for it has no commands in it, but all promises, being a pure declaration of grace and salvation by Christ; nor are faith, repentance, and new obedience, required by it as conditions of men's acceptance with God. Faith and repentance are gospel doctrines, and parts of the gospel ministry; they are graces, and not terms required to be performed by men of themselves. Faith is the gift of God, and repentance is a grant from him. It is not true (continues our author) that God will accept of an imperfect righteousness in the room of a perfect one; nor can any thing more highly reflect upon the justice and truth of God, who is the judge of all the earth, than to suppose that he can ever account that as a righteousness which is not one."

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Doctrine of the Calvinists respecting it.

Having thus proved by arguments which were almost in the same words stated long before by Bishop Beveridge ‡, that the gospel is no relaxation of the law, he proceeds to lay down his own notions of justification, of which (he says) "the sole matter, or that for the sake of which a sinner is justified before God, is the righteousness of Christ—that which he did and suffered on earth, in our nature, in our stead, and as our representative. This is commonly called his active and passive obedience; and when the purity and holiness of his own nature was added to it, the whole made up the δικαιωμα του νομου, *the righteousness of the law*, which was fulfilled by him as the head and representative of his people *; for whatever the law required is necessary to a sinner's justification before God, and it required of sinners more than it did of man in innocence. Man was created with a pure and holy nature, conformable to the pure and holy law of God; and it was incumbent on him to continue so, and to yield in it perfect and sinless obedience; in the failure whereof he was threatened with death. Man did fail; by which his nature was vitiated and corrupted, and his obedience became faulty and imperfect. He therefore became liable to the penalty of the law, and still perfect obedience was required of him. To the justification of a sinner therefore is required the most complete obedience, active and passive; or, in other words, purity of nature, perfect obedience, and the sufferings of death; all which meet in Christ, the representative of his people, in whom they are justified. There are indeed some divines (continues our author) who exclude the active obedience of Christ from being any part of the righteousness by which men are justified. They allow it to have been a condition requisite in him as a Mediator, qualifying him for his office; but deny that it is the matter of justification, or reckoned for righteousness to man. But without the active obedience of Christ the law would not be satisfied; the language of which is, *Do and live*; and unless its precepts be obeyed, as well as its penalty endured, it cannot be satisfied; and unless it be satisfied, there can be no justification. If therefore men are justified by the righteousness of Christ, it must be by his active obedience imputed and made over to them, so as to become theirs, *even as David describeth the blessedness of the man unto whom God imputeth righteousness without works* *. That this is really the way in which men are justified, our author thinks evident, because they must be justified either by an inherent or by an imputed righteousness; but they cannot be justified by their own inherent righteousness, for that is imperfect, and therefore not justifying. Hence the apostle 'counts all things but dung, that he may win Christ and be found in him; not having his own righteousness, which is of the law, but that which is *through the faith of Christ*, the righteousness which is of *God by Faith* §.' But by such a righteousness as this a man cannot be justified in any other way than by an imputation of it to him. Whence it follows, that '*as by one man's disobedience many were made sinners* by imputation, so *by the obedience of one shall many be made* righteous, by having that obedience placed to their account."

‡ See his *Private Thoughts of Religion.*

* Rom. viii. 4.

* Rom. iv. 6.

As this author properly considers justification as the act of God, he does not approve of the language in which faith is called the instrument either of conferring or receiving it. "Faith (says he *) is merely the evidence of justification to the person justified; for 'faith is the evidence of things not seen.' The righteousness of God, of the God-man and Mediator Jesus Christ, is revealed from faith to faith in the everlasting gospel ‡; and therefore must be before it is revealed, and before the faith to which it is revealed. Faith is that grace whereby a soul, having seen its guilt and its want of righteousness, beholds in the light of the Divine Spirit a complete righteousness in Christ, renounces its own, lays hold on that, puts it on as a garment, rejoices in it, and glories of it; the Spirit of God witnessing to his spirit that he is a justified person: and so he is evidently and declaratively 'justified in the name of the Lord Jesus, and by the Spirit of our God †'. Faith adds nothing to the *esse*, only to the *bene esse* of justification; which is a complete act in the eternal mind of God, without the being or consideration of faith, or any foresight of it. In the account of God, a man is as much justified before his faith as after it; and after he does believe, his justification depends not on his acts of faith, for though *we believe not, yet God abides faithful* to his covenant-engagements with his Son, by whose suretyship-righteousness the elect are justified; but by faith men have a comfortable sense, perception, and apprehension, of their justification, and enjoy that peace of soul which results from it. It is by that only, under the testimony of the Divine Spirit, that they know their interest in it, and can claim it, and so have the comfort of it."

Though this language differs from that of the Westminster Confession, the author seems not to teach a different doctrine; for if faith be that grace by which a soul renounces its own righteousness, and lays hold of Christ's, which it puts on as a garment, it must be that very thing which the compilers of the Confession meant by their definition of faith receiving and resting on Christ and his righteousness, when they called it "the alone instrument of justification." Accordingly our author elsewhere * teaches, that "true faith in sensible sinners assents to Christ and embraces him, not merely as a Saviour of man in general, but as a special suitable Saviour for them in particular. It proceeds upon Christ's being revealed *in* them as well as *to* them, by the spirit of wisdom and revelation, in the knowledge of him as a Saviour that becomes them. It comes not merely through external teachings by the hearing of the word from men; for no man, saith our blessed Lord, can come to me except the Father draw him; but such souls as are thus drawn, having heard and learned of the Father, believe not only in the *doctrine* of Christ, but also in *himself*, trusting in him alone for everlasting life and salvation."

Were it not that this author, in every thing that he writes, has an eye to the doctrine of election and reprobation, which he screws up to a greater height than almost any other divine with whose works we are acquainted, he would differ little in his notions of justification from the more moderate Arminians. "Justification (says Limborch) is the merciful and gracious act of God, whereby he fully absolves from all guilt the truly penitent and believing soul, through and for the sake of Christ apprehended by a true faith; or gratuitously remits sins upon the account of faith in

y, in Jesus Christ, and graciously imputes that faith for righteousness." Here indeed the imputation of Christ's righteousness is expressly denied; but our countryman Dr Waterland, who can hardly be considered as a Calvinist, seems to contend for the imputation of that righteousness to the sinner, as well as for faith being the instrument by which it is received.

"It cannot be for nothing (says that able writer *) that St Paul so often and so emphatically speaks of man's being justified by faith, or through faith in Christ's blood; and that he particularly notes it of Abraham, that he *believed*, and that his faith was counted to him for justification, when he might as easily have said that Abraham, to whom the gospel was preached, was justified by gospel faith and obedience, had he thought faith and obedience equally instruments of justification. Besides, it is on all hands allowed, that though St Paul did not directly oppose faith to *evangelical works*, yet he comprehended the works of the *moral law* under those which he excluded from the office of *justifying*, in his sense of the word justification. He even used such arguments as extended to all kinds of works; for Abraham's works were excluded, tho' they were undoubtedly evangelical. To prove that he interprets the apostle's doctrine fairly, our author quotes, from the genuine epistle of Clemens of Rome, a passage, in which it appears beyond a doubt that this fellow-labourer of St Paul so understood the doctrine of justifying faith as to oppose it even to evangelical works, however exalted. It is true (continues our author), Clemens elsewhere, and St Paul almost everywhere, insists upon true holiness of heart and obedience of life as indispensable conditions of salvation or justification; and of that, one would think, there could be no question among men of any judgment or probity. But the question about conditions is very distinct from the other question about instruments; and therefore both parts may be true, viz. that faith and obedience are equally conditions, and equally indispensable where opportunities permit; and yet faith over and above is emphatically the instrument both of receiving and holding justification, or a title to salvation.

"To explain this matter more distinctly, let it be remembered, that God may be considered either as a party contracting with man on very gracious terms, or as a Judge to pronounce sentence on him. Man can enter into the covenant, supposing him adult, only by assenting to it, and accepting it, to have and to hold it on such kind of tenure as God proposes: that is to say, upon a self-denying tenure, considering himself as a guilty man standing in need of pardon, and of borrowed merits, and at length resting upon mercy. So here, the previous question is, Whether a person shall consent to hold a privilege upon this submissive kind of tenure or not? Such assent or consent, if he comes into it, is the very thing which St Paul and St Clemens call *faith*. And this previous and general question is the question which both of them determine against any proud claimants who would hold by a more self-admiring tenure.

"Or if we next consider God as sitting in judgment, and man before the tribunal going to plead his cause; here the question is, What kind of plea shall a man resolve to trust his salvation upon? Shall he stand upon his innocence, and rest upon strict law? or shall he plead guilty, and rest in an act of grace? If he chooses the former, he is proud, and sure to be cast: if he chooses the latter, he is safe so far in throwing himself upon an act of grace. Now this question also, which St Paul has decided, is previous to the question, What conditions even the act of grace itself finally insists upon? A question which St James in particular, and the general tenure of the whole Scripture, has abundantly satisfied; and which could never have been made a question by any considerate or impartial Christian. None of our works are good enough to stand by themselves before him who is of purer eyes than to behold iniquity. Christ only is pure enough for it at first hand, and they that are Christ's at second hand in and through him. Now because it is by faith that we thus interpose, as it were, Christ between God and us, in order to gain acceptance by him; therefore faith is emphatically the instrument whereby we receive the grant of justification. Obedience is equally a condition or qualification, but not an instrument, not being that act of the mind whereby we look up to God and Christ, and whereby we embrace the promises." The [illegible] peculiarly Christian.

209 But though our author contends that faith is the instrument of justification, he does not, like the Antinomians, teach that it will save men without works. "The covenant of grace (says he) has conditions annexed to it of great importance, for without them no instruments can avail. These are faith and obedience, as St James hath particularly maintained. St Paul had before determined the general and previous question respecting the plea by which we ought to abide; and when some libertines, as is probable, had perverted his doctrine of faith and grace, St James showed that the very faith which rests in a covenant of grace implies a cordial submission to the conditions of that covenant, otherwise it would be nothing but an empty ceremony. The perfect agreement between St Paul and St James in the article of *justification*, appears very clear and certain. St Paul declares, that in order to come at justification, it is necessary to stand upon grace, not upon merit; which St James does not deny, but rather confirms, in what he says of the perfect law of liberty (James i. 25. ii. 12). St Paul makes faith the instrument of receiving that grace; which St James does not dispute, but approves by what he says of Abraham (ii. 23.); only he maintains also, that, in the conditionate sense, justification depends equally upon faith and good works; which St Paul also teaches and inculcates in effect, or, in other words, through all his writings. If St Paul had had precisely the same question before him which St James happened to have, he would have decided just as St James did; and if St James had had precisely the same question before him which St Paul had, he would have determined just as St Paul did. Their principles were exactly the same, but the questions were diverse; and they had different adversaries to deal with, and opposite extremes to encounter, which is a common case. Faith and obedience its conditions.

"It may be noted, that that faith which is here called a *condition*, is of much wider compass than that particular kind of faith which is precisely the instrument of justification. For faith as a condition means the whole complex of Christian belief, as expressed in the creeds; while faith as an instrument means only the laying hold on grace, and resting in Christ's merits in opposition to our own deservings: though this also, if it is a vital and operative principle (and if it is not, it is nothing worth), must of course draw after it an hearty submission to, and observance of, all the necessary conditions of that covenant of grace wherein we repose our whole trust and confidence. So that St Paul might well say, "Do we then make void the law (the moral law) through faith? God forbid: Yea, we establish the law." * We exempt no man from religious duties; which are duties still, though they do not merit, nor are practicable to such a degree as to be above the need of pardon: they are necessary conditions in their measure of justification, though not sufficient in themselves to justify, nor perfect enough to stand before God or to abide trial: therefore Christ's merits must be taken in to supply their defects: and [illegible] in Christ's atonement by an humble [illegible] our last resort, our anchor of salvation both sure and [illegible]

* Rom. iii. 31.

faſt, after we have otherwiſe done our utmoſt towards the fulfilling of God's ſacred laws, towards the performing of all the conditions required.

"That good works, internal and external, are according as opportunities offer and circumſtances permit, *conditions* properly ſo called, is clear from the whole tenor of Scripture, as hath been often and abundantly proved by our own divines (M), and is admitted by the moſt judicious among the foreign Reformed (N). Yet ſome have been very ſcrupulous as to this innocent name, even while they allow the abſolute neceſſity of good works as indiſpenſable qualifications for future bleſſedneſs. Why not conditions therefore as well as qualifications? Perhaps becauſe that name might appear to ſtrike at abſolute predeſtination, or unconditional election; and there may lie the ſcruple: otherwiſe the difference appears to lie rather in words than in things.

"Some will have them called not conditions, but *fruits* or *conſequents* of juſtification. If they mean by juſtification the ſame as the grace of the Holy Spirit, and the firſt grace of faith ſpringing from it, they ſay true; and then there is nothing more in it than an improper uſe of the word *juſtification*, except that from abuſe of words very frequently ariſes ſome corruption of doctrine. If they mean only, that outward acts of righteouſneſs are fruits of inward habits or diſpoſitions; that alſo is undoubtedly true: but that is no reaſon why internal acts, virtues, graces (good works of the mind), ſhould not be called conditions of juſtification; or why the outward acts ſhould not be juſtly thought conditions of preſerving it. But if they mean that juſtification is ordinarily given to adults, without any preparative or previous conditions of faith and repentance, that indeed is very new doctrine and dangerous, and opens a wide door to carnal ſecurity and to all ungodlineſs."

Such is the doctrine of Chriſtian juſtification as it has been taught by the followers of Calvin, and by ſome of the moſt eminent Arminians who flouriſhed in the end of the laſt and beginning of the preſent century. They appear not, from this view of their opinions, to differ ſo widely as ſome of them have wiſhed the world to believe. It is evident that Dr Waterland, though he rejects ſome of the diſtinguiſhing tenets of Calviniſm, lays greater ſtreſs upon faith in his ſcheme of juſtification than Dr Gill himſelf; and that they both conſider it as the *inſtrument* by which the adult Chriſtian muſt receive the imputed righteouſneſs of Chriſt. The greater part of modern Arminians, however, exclaim againſt the imputation of Chriſt's righteouſneſs, as a doctrine falſe in itſelf, and fraught with the moſt pernicious conſequences; and they would be ready to tell Dr Gill, in his own words, that of his ſcheme every article is wrong. It is not true (ſay they) that God exacts of man, or ever did exact of him, an obedience abſolutely perfect; for under every diſpenſation man was in a ſtate of diſcipline, and had habits of virtue and piety to acquire; and it is probable that his progreſs in piety, virtue, and wiſdom, will continue for ever, as none but God is perfect and ſtationary, and incapable of deviating from the line of rectitude. Moſt of them, after Biſhop Bull, diſlike the uſe of ſuch unſcriptural phraſes as *the inſtrument of juſtification*, applied either to faith or to works; and think, that by conſidering God as the ſole juſtifier of man, upon certain conditions, they can more preciſely aſcertain the diſtinct provinces of faith and obedience in the ſcheme of juſtification, than either their brethren of the old ſchool of Arminius, or their rivals of the ſchool of Calvin.

210 Objections of the more zealous Arminians to this ſtate of the doctrine.

By the very conſtitution of man, piety and virtue are duties which, if he do not ſincerely perform, he muſt of courſe forfeit the favour of his Maker; but the moſt perfect performance of his natural duties would not entitle him to a ſupernatural and eternal reward. Eternal life is the *gift* of God through Jeſus Chriſt; and it is ſurely reaſonable that we ſhould acknowledge it to be ſo, and not claim it as a debt due to our merits. The pious and virtuous man has a natural claim to more happineſs than miſery during the period of his exiſtence, a claim founded on the attributes of that God who called him into being; but he has no natural claim to a future life, and ſtill leſs to a perpetuity of exiſtence. This is a truth not more clearly taught in the holy ſcripture than conſonant to the ſoundeſt philoſophy: and yet, by not attending to it, have St Paul and St James been ſet at variance, and the moſt oppoſite doctrines taught reſpecting the juſtification of Chriſtians.

Because faith in Chriſt cannot entitle a wicked man to eternal *happineſs*, one claſs of divines ſeem to infer that ſuch faith is not neceſſary to Chriſtian *juſtification*, and that "his faith cannot be wrong whoſe life is in the right." They proceed upon the ſuppoſition that man is naturally immortal; that piety and virtue are entitled to reward; and that therefore the pious and virtuous man whatever be his belief, muſt undoubtedly inherit an eternal reward. But this is very fallacious reaſoning. That piety and virtue are through the divine juſtice and benevolence entitled to reward, is indeed a truth incontrovertible; but that man who is of yeſterday is naturally immortal; that a being who began to exiſt by the mere good will of his Maker, has in himſelf a principle of perpetual exiſtence independent of that will—is a direct contradiction. Whatever began to be, can be continued in being only by the power, and according to the pleaſure, of the infinite Creator; but it pleaſed the Creator of his free grace at firſt to promiſe mankind eternal life, on the ſingle condition of their firſt father's obſerving one poſitive precept. That precept was violated, and the free gift loſt: but the covenant was renewed in Chriſt, who "by his death hath aboliſhed death, and by his reſurrection hath brought to light life and immortality." The condition annexed to the gift thus reſtored was faith; for "being juſtified by faith §, we have peace with God through our Lord Jeſus Chriſt; by whom alſo we have acceſs by faith into this grace wherein we ſtand, and rejoice in the hope of the GLORY OF GOD." Faith therefore in the Son of God and Saviour of the world, is not only a condition, but the *ſole* condition, of that juſtification which is peculiarly Chriſtian; for ſince Chriſt, without any co-operation of ours, hath purchaſed for us the free gift of eternal life, we ſhall be guilty of the groſſeſt ingratitude to our Divine Benefactor, and impiouſly claim an independence on God, if we look upon that gift either as a right inherent in our nature, or as a debt due to our meritorious deeds.

21[1] Faith [the] ſole c[ondi]tion [of] the ju[ſtifi]cati[on pe]culiar[ly] Chriſ[tian]. § Ro[m. v.] 1, 2.

But though faith be the condition of Chriſtian juſtification, as that implies the inheritance of *eternal life*, there are other conditions to be performed before a man can be put in poſſeſſion of *eternal felicity*. By a law long prior to the promulgation of the goſpel—a law interwoven with our very being—no man can enjoy the favour of his Maker, who does not make it his conſtant endeavour "to do juſtly, to love mercy, and to walk humbly with his God." This law was in force before man fell; it continues to be in force now that he is redeemed; and it will not be abrogated even at that

21[2] But n[ot] of e[ternal] hap[pineſs].

(M) Bull *Op. Latin.* p. 412, 414, 415, 430, 434, 514, 516, 544, 583, 645, 668. *Edit. ult.*—Stillingfleet's Works, vol. III. p. 367, 380, 393, 398.—Tillotſon's Poſthumous Sermons, vol. II. p. 484, 487.

(N) Voſſius *de Bonis Operibus*, Theſ. x. p. 370.—Op. tom. VI. *Frid. Spanhem. fil.* Op. tom. III. p. 141, 159.

that period when faith shall give place to vision, and hope to enjoyment. By the grace of the Christian covenant, all mankind are rendered immortal in consequence of the death and resurrection of Christ, who is the Lamb slain, in the divine decree, from the foundation of the world; but to obtain immortal *happiness*, they must observe the conditions both of natural and of revealed religion, which are repentance from dead works, and faith in Christ the Redeemer. The former is that condition upon which alone we can retain the Divine favour, and of course enjoy either present or future happiness; the latter is a most equitable acknowledgment required of us, that perpetual conscious existence is neither a right inherent in our nature, nor a debt due to our virtuous obedience, but merely the gift of God through Jesus Christ our Lord.

"To make the distinct provinces of faith and works in the business of justification clear, let us suppose (says bishop Warburton †), that, at the publication of the gospel, all to whom the glad tidings of immortality were offered on the condition of *faith in Jesus* had been moral or virtuous men, and on that account entitled (as natural religion teacheth) to the favour of God and an abundant reward; is it not self-evident, that FAITH ALONE, exclusive of the condition of good works, would, in that case, have been the very thing which *justified* or entitled them to life *everlasting?* But are *good works*, therefore, of no use in the Christian system? So far from it, that those only who serve God in sincerity and in truth are capable of the justification which faith alone embraces; for, to illustrate this matter by a familiar instance, suppose a British monarch to bestow, in *free gift*, a certain portion of his own *demesns*, to which immortality may well be compared, upon such of his subjects as should perform a certain service to which they were not obliged by the laws of the kingdom; it is evident that the performance of this last service ONLY would be the thing which entitled them to the *free gift*. Yet it is obvious that obedience to the laws, which gave them a claim to protection as subjects, in the enjoyment OF THEIR OWN PROPERTY (to which the reward offered by natural religion may be compared), would be a previous and necessary qualification to their enjoyment of their new possession; since it is absurd to suppose that such a *gift* could be intended for rebels and traitors, or indeed for any but good and faithful servants of their king and country." Well therefore might the apostle reprove the ignorance or licentiousness of certain of his converts at Rome, in his question—"Do we then make void the LAW through FAITH? God forbid! yea, we ESTABLISH THE LAW;" obedience to it being the previous qualification of all who are entitled to the fruits of justifying faith—LIFE AND IMMORTALITY.

† Div. Leg. book ix. ch. 3.

Had proper attention been paid to this distinction, which St Paul everywhere makes between such duties as are common to all religions that are true, and those which are peculiar to the Christian revelation, many useless controversies might have been avoided respecting the instrument of justification and the conditions of the Christian covenant. By not attending to it, the divines of one school, who perceive that the mere belief of any truth whatever cannot entitle a man to eternal felicity, have almost dropt faith from their system of Christianity, and taught moral duties like Pagan philosophers; whilst another party, who err almost as far in their interpretations of scripture, finding eternal life represented as the *gift of God*, and faith in Christ as the instrument or means by which that gift must be accepted, have expunged from their system the necessity of good works, forgetting surely that wicked believers, like believing devils, may be doomed to an eternity of torments. But the sum of Christianity, as we are taught by the beloved disciple, is

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comprehended in this one commandment of God, "that we should believe on the name of his Son Jesus Christ, and love one another as he gave us commandment." In perfect harmony with him, the great apostle of the Gentiles, from whose mistaken words much empty noise has been raised about this question, assures us ‡, that "in Christ Jesus nothing can avail to our eternal happiness but faith which WORKETH BY LOVE;" and he informs Titus ||, that it "is a true saying, and what he wills to be constantly affirmed, that they who have believed in God be careful to maintain good works."

The doctrine more peculiarly Christian.

‡ Gal. v. 6.

|| iii. 8.

Indeed no man can have complete faith in Christ, who believes not the promises of the gospel; but all those promises, except the single one of a resurrection from the dead to perpetual conscious existence, are made to us upon the express condition that we obey the law of the gospel; "for God will render to every man according to his deeds: to them that are contentious and do not obey the truth, but obey unrighteousness, indignation and wrath; tribulation and anguish upon every soul of man that doth evil, of the Jew first and also of the Gentile; but glory, honour, and peace to every man that worketh good, to the Jew first and also to the Gentile *."

* Rom. ii. 8, 9.

Such are the notions of justification entertained by those who in the present age have been considered as the leaders † of the sect of Arminians. How far they are just, the reader must decide for himself, as our business is little more than to collect into one point of view the scattered opinions of others; but under every view of this doctrine which we have taken, the Christian covenant appears much more gracious than that into which Adam was admitted in paradise; since it affords room for repentance, even to that man, who may be so unhappy as to be withdrawn for a time into apostacy from the terms of the covenant. Whether the death of Christ therefore was a *direct* atonement for the actual sins of men, or only operated as such *indirectly* by procuring for them repeated opportunities of repentance, it is an undoubted truth, that "if through the offence of one many be dead, much more the grace of God, and the gift by grace, which is by one man, Jesus Christ, hath abounded unto many. And not as it was by one that sinned, so is the gift: for the judgment was of one offence to *condemnation*, but the free gift is of many offences to *justification* ||."

† *Warburton* and *Law*, &c.

217 The Christian covenant more gracious than the paradisiacal.

|| Rom. v. 16, 17.

Thus graciously has the divine goodness displayed itself in the restoration of our lost inheritance. But it stopt not here. The same bountiful Lord of life, for its further security, imparts to every true believer the strength and light of his holy spirit to support faith in working out our own salvation. Our blessed Saviour, "who gave himself for us, that he might redeem us not only from death, but likewise from all iniquity, and purify to himself a peculiar people zealous of good works §," promised, before he left this world, to send to his followers the Holy Ghost or Comforter to abide with them for ever, to guide them into all truth, to bring all things to their remembrance whatsoever he had said unto them, and, as we learn from other passages of scripture, to "work in them both to will and to do of his good pleasure." How amply this promise was fulfilled to the apostles, we have already seen; but we are not to suppose that it was restricted to them. As man is designed for a supernatural state in heaven, he stands in need of supernatural direction to guide him to that state. "No man (says our Saviour) can come to me except the Father draw him; for as no man knoweth the things of a man save the spirit of a man which is in him, even so none knoweth the things of God but the Spirit of God." This omniscient Spirit indeed "searcheth all things, yea even the deep things of God," and revealeth them to the sons of men, to enlighten

§ Titus ii 14.

218 Christians sanctified by the Holy Ghost, who

their

their understandings and purify their hearts. The grace which he sheds abroad is either external and general, or internal and particular. The former has been extended to the whole church of God under the patriarchal, Mosaic, and Christian dispensations, in such a revelation of the divine will as was sufficient to instruct men unto eternal life, whether they had a clear view or not of that stupendous plan of redemption, by which the kingdom of heaven was opened to them after the forfeiture of the terrestrial paradise; for there have been "holy prophets ever since the world began; and prophecy came not at any time by the will of man, but holy men of God spake as they were moved by the Holy Ghost *." Hence it is that all scripture was given by inspiration of God to teach us every thing which it is necessary for us to know and believe; and the scripture is that work of the spirit which is extended to the universal church.

* Luke i. 70. and 2 Peter i. 21.

But the same spirit which thus generally reveals the object of faith to the church, does likewise particularly illuminate the minds of individual believers, working in them an assent to that which is taught them from the written word. It was thus that "the Lord opened the heart of Lydia †, that she attended to the things which were spoken of Paul;" it is thus that "the word preached doth not profit if it be not mixed with faith in them who hear it ‡;" and it is thus that "God deals to every man the measure of faith ||;" for "by grace are we saved through faith, which is not of ourselves; it is the gift of God §." This illumination of the Spirit was conveyed to the apostles "in a sound from heaven as of a rushing mighty wind," because it was meant to testify to the world that they were chosen ministers of the gospel; but the ordinary Christian receives it "in the still small voice," because it is conveyed to him only to "open his understanding that he may understand the scriptures."

† Acts xvi. 14.
‡ Heb. iv. 2.
|| Rom. xii. 3.
§ Eph. ii. 8.

219 Regeneration,

Another operation of the Spirit on the minds of believers is that which in scripture is called REGENERATION; for "according to his mercy God saveth us by the washing of regeneration and renewing of the Holy Ghost *, which he sheds on us abundantly through Jesus Christ our Lord." To those who believe that we derive from Adam a corrupted nature, this particular grace must appear so absolutely necessary, that without it we could have no relish for heaven or heavenly things. "The natural man (we are told) receiveth not the things of the spirit of God; for they are foolishness to him; neither can he know them, because they are spiritually discerned." Indeed whatever be the powers of our moral faculties, when compared with those of our first father, it is so long before they be completely developed, that we should infallibly be lost, if we were not blessed by a supernatural guide, when reason is incapable of directing our conduct. Our passions and appetites are in their full strength before experience has furnished the mind with materials, by means of which motives may be weighed; and therefore it would be impossible, during the giddy period of youth, to keep them in due subjection, or to prevent vicious habits from being formed, were we not influenced by divine grace. So true is it, that "except a man be born again of water and of the Holy Ghost, he cannot enter into the kingdom of God." This change in our dispositions, from an immoderate attachment to earth to a relish for the things of heaven, is in scripture called "a renewing of our minds, a new creation, a new man;" in opposition to our natural disposition, which is called "the old man, corrupted according to the deceitful lusts." The ancient fathers of the church, as well as some very eminent modern divines †, generally speak of baptism as the instrument in God's hand of man's regeneration; and for the truth of their opinion they appeal to John iii. 3, 5. Ephes. v. 25, 26. and 1 Cor. vi. 11. in which great stress is certainly laid upon the washing of water, as well as upon sanctification by the word.

* Titus iii. 5, 6.
† *Clarke and Waterland.*

220 Guides them through life,

A third office of the Holy Spirit is to lead, direct, and govern us through all the periods of our lives. Without such a leader and guide, the temptations with which we are surrounded would certainly overcome us, and we should faint long before we arrive at the end of our journey. By the very constitution of our nature we are subjected in some degree to the influence of sense, of which the objects are present, whilst the enjoyments of heaven are future, and seen, as at a distance, only by the eye of faith; but "the law of the Spirit of life, in Christ Jesus, hath made us free from the law of sin and death;" for God worketh in us both to will and to do of his good pleasure; and as many as are thus led by the spirit of God, they are the sons of God; and while they walk in the Spirit, they do not fulfil the lusts of the flesh." Without the aid of the same Spirit, we could not even make our prayers acceptable; for since "our confidence in God is, that he heareth us only when we ask any thing according to his will; and since we know not what we should pray for as we ought, the Spirit itself maketh the intercession for us with groanings which cannot be uttered *."

* Rom. viii. 26.

221 Unites them to Christ,

A fourth operation of the Holy Ghost, as he is the sanctifier of Christians, is to join them to Christ, and make them members of that one body of which he is the head. "For by one Spirit are we all baptized into one body †; and as the body is one and hath many members, and all the members of that one body being many are one body, so also is Christ." "Hereby we know that God abideth in us, by the Spirit which he hath given us;" and as, in the ordinary course of his dealings with Christians, this Spirit is first given in baptism, so is it continued to the faithful by the instrumentality of the Lord's supper. That ordinance we have elsewhere (see *SUPPER of the Lord*) proved to be a federal rite; and surely no time can be supposed so highly sanctified for the reception of the graces of the Holy Spirit, as that in which we renew our federal union with our Lord and Master in the communion of his body and blood.

† 1 Cor. xii. 12, 13.

It is likewise the office of the Holy Ghost to give us an earnest of our everlasting inheritance, to create in us a sense of the paternal love of God, and thereby to assure us of the adoption of sons. "As many as are led by the Spirit of God, they are the SONS of God; and because we are sons, God hath sent forth the spirit of his Son into our hearts. For we have not received the spirit of bondage again to fear; but we have received the Spirit of adoption, whereby we cry Abba Father; the Spirit itself bearing witness with our spirit, that we are the children of God ‡."

‡ Gal. iv. 6. Rom. viii. 15, 16.

222 And sanctifies the administrations of the ministers of the gospel.

As the gifts of grace are generally annexed to means, to the proper use of the word and sacraments, it is a sixth office of the same Spirit to sanctify such persons as are regularly set apart for the work of the ministry, and ordained to offer up the public prayers of the people; to bless them in the name of God; to teach the doctrines of the gospel; to administer the sacraments instituted by Christ; and to perform all things necessary "for the perfecting of the saints, for the work of the ministry, for the edifying of the body of Christ *." The same Spirit which illuminated the apostles, and endowed them with power from above to perform personally their apostolic functions, fitted them also for sending others, as they were sent by their Divine Master; and for establishing such a constitution of the church as was best adapted for preserving Christians in the unity of the Spirit and bond of peace. They committed a standing power to a successive ministry to be conveyed down to the end of the world; and those who are vested with that power are obliged to "take heed unto themselves, and to

* Eph. iv. 12.

gy, to all the flock over which the HOLY GHOST hath made them overseers, to feed the church of God, and to contend earnestly for the faith which was once delivered unto the saints †." See EPISCOPACY, INDEPENDENTS, PRESBYTERIANS, POPE, and QUAKERS.

By these, and the like means, doth the Spirit of God sanctify the sons of men; and in consequence of this sanctification proceeding immediately from his office, he is called the HOLY Spirit and the COMFORTER. This is such a provision "for renewing us in the spirit of our minds, and enabling us to put on the new man, which, after God, is created in righteousness and true holiness," as, when made known by revelation appears to have been expedient, may be conceived to have been even necessary, and, though reason could hardly have hoped for it, is contradicted by none of our natural notions either of God or of man. Many, however, are the controversies to which it has given rise in the church of God; some contending that it is given only unto the elect, upon whom it operates with resistless efficacy; others affirming that it is offered to all, but in such a manner as that, by the abuse of their free will, it may be "resisted, grieved, and quenched;" and some few, still intoxicated with the pride of PELAGIUS, think it is not necessary, and of course is not bestowed.

The questions concerning *election*, the *efficacy of grace*, and the final *perseverance of the saints*, we have stated elsewhere, and given a summary view of the arguments by which the contending parties maintain their respective opinions (see PREDESTINATION); and the texts of Scripture which we have just quoted, under the different heads of sanctification, show sufficiently that the opinion of Pelagius is directly contrary to the doctrine of the apostles. It may not be improper to inquire whether it be as agreeable to reason and experience as its proud patrons seem to imagine.

If it be unreasonable to expect any assistance from the Spirit of God in carrying on the work of our own salvation, how came so many of the wisest and best of men in all ages to believe, that he who sincerely endeavours to discharge his duty is supported in that endeavour by assistance from heaven? That such was the popular belief of the early Greeks, is evident from the poems of Homer; in which we everywhere find some god calming the passions of the heroes, altering their determinations when improper, and inspiring them with wisdom. Nor was this the sentiment of the poets only. Socrates, it is well known, professed to believe that his own conduct was under the direction of a superior spirit, which he called a *dæmon*; and Plutarch, as we find him quoted by Wollaston, speaks of the gods assisting men, by "exciting the powers or faculties of the soul; by suggesting secret principles, imaginations, or thoughts; or, on the contrary, by diverting or stopping them." Of the same opinion must Cicero have been, when he said, "stabit illud quidem, quod locum hunc continet, de quo agimus, esse Deos, et eorum providentia mundum administrari, eosdemque consulere rebus humanis, nec solum *universis*, verum etiam SINGULIS *;" for it is not conceivable that a particular providence can be administered without the influence of the Deity on the minds of men. That the poets and philosophers of the heathen world derived these notions from primeval tradition, cannot, we think, be questioned; but if they were absurd in themselves, or apparently contradictory to the laws of nature, they would not surely have been so universally embraced; for it will hardly be denied, that Socrates and Cicero were men of as great natural sagacity as Pelagius or any of his followers. It is indeed so far from being incredible that the Father of spirits occasionally directs the thoughts and actions of men, that we believe there are very few who have made observations upon the affairs of others and their own affairs, who have not found, upon reflection, many instances in which their usual judgment and sense of things were over-ruled, they know not how or why; and that the actions which they performed in those circumstances have had consequences very remarkable in their general history. See PROVIDENCE, n° 18, 19.

* Div. sect.

This being the case, why should the pride of Christians make them hesitate to admit, upon the authority of divine revelation, what Socrates, and Plutarch, and Cicero, and all the virtuous and wise men of antiquity, admitted in effect, upon no better evidence than that of oral tradition, supported by their own meditations on their own thoughts, and the principles of their own conduct? Is it that they see not such beneficial effects of Christianity as to induce them to believe the professors of that religion to be indeed "chosen to salvation through the sanctification of the Spirit ‖?" Let them study the practical precepts of the gospel, consider the consequences which they have had on the peace and happiness of society, and compare the general conduct of Christians with that of the Jews, Pagans, and Mahometans (see RELIGION), and they will doubtless find reason to alter their opinion; and let those who embrace the truth, remember, that as they are the temple of God, if the Spirit of God dwell in them, "it is their indispensable duty to cleanse themselves from all filthiness of the flesh and spirit; to follow peace with all men, and holiness, without which no man shall see the Lord; and to work out their own salvation with fear and trembling, since it is God who worketh in them both to will and to do of his good pleasure."

‖ Thess. ii. 3.

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The gospel the last revelation.

From this short view of the several dispensations of revealed religion, it is evident that the gospel is not only the best but the last gift of the kind which man has to expect from his Maker; that the scheme of revelation is completed; and that the pretences of Mahomet and of more modern enthusiasts to divine inspiration are not only false, but fraught with contradictions. All these men admit the divine origin of the Mosaic and Christian religions; but it appears from the scriptures, in which those religions are taught, that the system of revealed truths which constitute the Patriarchal, Mosaic, and Christian revelations, commenced with the fall of man, and that it must therefore necessarily end with his restoration to life and immortality by the sacrifice of Christ upon the cross. A new revelation therefore like that of Mahomet cannot be admitted without rejecting the whole Bible, though the impostor himself everywhere acknowledges the inspiration of Abraham, of Moses, and of Christ. Nor is greater regard due to the claims of Christian enthusiasts. Such of these men as pretend to have been in heaven †, and thence to have brought spiritual discoveries to the earth, have either forgotten or never understood, that in the scriptures of the Old and New Testaments the great scene of Providence appears to be closed in the full completion of its one regular, entire, and eternal purpose; that St Paul has pronounced ‡ a curse upon any man or angel from heaven who shall preach another gospel than what has been already preached by the apostles and evangelists; that in their writings we are taught every thing which it is our duty to believe or to practise in order to our own salvation; and that we have the promise of our blessed Lord himself, that the Spirit of truth shall remain with us to guide us into all necessary truth, till that great day when he shall come again to judge the world in righteousness, and render to every man according to his works.

† *Boehman*, *Swedenbourgh*, and others.

‡ Gal. i. 8.

Theophrasta || Therapeutæ.

THEOPHRASTA, in botany; a genus of plants belonging to the class of *pentandria* and order of *monogynia*. The corolla is campanulated, with divisions and segments obtuse; the capsule unilocular, globular, very large, and many seeded. There is only one species, the *americana*.

THEOPHRASTUS, the philosopher, was born about 371 years before Christ, and was successively the disciple of Plato and of Aristotle. He succeeded Aristotle in the Peripatetic school, and conducted the charge with such high reputation that he had about 2000 scholars. He is highly celebrated for his industry, learning, and eloquence; and for his generosity and public spirit. He is said to have twice freed his country from the oppressor of tyrants. He contributed liberally towards defraying the expence attending the public meetings of philosophers; which were held, not for the sake of show, but for learned and ingenious conversation. In the public schools he commonly appeared, as Aristotle had done, in an elegant dress, and was very attentive to the graces of elocution. He lived to the advanced age of 85: Some say of 107. Towards the close of his life, he grew exceedingly infirm, and was carried to the school on a couch. He expressed great regret on account of the shortness of life; and complained that nature had given long life to stags and crows, to whom it is of so little value, and had denied it to man, who, in a longer duration, might have been able to attain the summit of science; but now, as soon as he arrives within sight of it, is taken away. His last advice to his disciples was, that, since it is the lot of man to die as soon as he begins to live, they would take more pains to enjoy life as it passes, than to acquire posthumous fame. His funeral was attended by a large body of Athenians. He wrote many valuable works, of which all that remain are, several treatises on the Natural History of Plants and Fossils; Of Winds, Of Fire, &c. a rhetorical work intitled "Characters," and a few Metaphysical Fragments.

Enfield's Hist. of Philosophy.

To Theophrastus we are indebted for preserving the works of Aristotle. See ARISTOTLE.

THEOPOMPUS, a celebrated Greek orator and historian, was born in the island Chios, and flourished in the reign of Alexander the Great. He was one of the most famous of all the disciples of Isocrates, and won the prize from all the panegyrists whom Artemisia invited to praise Mausolus. He wrote several works, which are lost.

THEOREM, a proposition which terminates in theory, and which considers the properties of things already made or done; or it is a speculative proposition deduced from comparing together several definitions. A theorem is something to be proved, and a problem something to be done.

THEORETIC, something relating to theory, or that terminates in speculation.

THEORY, in general, denotes any doctrine which terminates in speculation, without considering the practical uses or application thereof.

THEOSOPHISTS, a sect of men who pretend to derive all their knowledge from divine illumination. They boast that, by means of this celestial light, they are not only admitted to the intimate knowledge of God and of all divine truth, but have access to the most sublime secrets of nature. They ascribe it to the singular manifestation of divine benevolence, that they are able to make such a use of the element of fire, in the chemical art, as enables them to discover the essential principles of bodies, and to disclose stupendous mysteries in the physical world. They even pretend to an acquaintance with those celestial beings which form the medium of intercourse between God and man, and to a power of obtaining from them, by the aid of magic, astrology, and other similar arts, various kinds of information and assistance.

Ibid.

To this class belonged Paracelsus, Robert Fludd, Jacob Boehmen, Van Helmont, Peter Poiret, and the Rosicrucians. They are also called *Fire-Philosophers*, which see.

THERAPEUTÆ, a term applied to those that are wholly in the service of religion. This general term has been applied to particular sects of men, concerning whom there have been great disputes among the learned.

THERAPEUTICS, that part of medicine which acquaints us with the rules that are to be observed, and the medicines to be employed, in the cure of diseases.

THERIACA ANDROMACHI, a compound medicine made in the form of an electuary. See PHARMACY, n° 605.

THERMÆ, hot baths or bagnios. Luxury and extravagance were in nothing carried to such heights as in the thermæ of the Roman emperors. Ammianus complains, that they were built to such an extent as to equal whole provinces; from which Valesius would abate, by reading *piscinæ* instead of *provincia*. And yet after all, the remains of some still standing are sufficient testimonies for Ammianus's censure; and the accounts transmitted of their ornaments and furniture, such as being laid with precious stones (Seneca), set round with seats of solid silver (Pliny), with pipes and cisterns of the same metal (Statius), add to, rather than take from, the censure. The most remarkable bagnios were those of Diocletian and Caracalla at Rome, great part of which remains at this day; the lofty arches, stately pillars, variety of foreign marble, curious vaulting of the roofs, great number of spacious apartments, all attract the curiosity of the traveller. They had also their summer and winter baths.

THERMOMETER, an instrument for measuring the degree of heat or cold in any body.

1
Invention of the thermometer.

The thermometer was invented about the beginning of the 17th century; but, like many other useful inventions, it has been found impossible to ascertain to whom the honour of it belongs. Boerhaave * ascribes it to Cornelius Drebbel of Alcmar, his own countryman. Fulgenzio † attributes it to his master Paul Sarpi, the great oracle of the Venetian republic; and Viviani gives the honour of it to Galileo §. But all these are posthumous claims. Sanctorio ‡ claims this honour to himself; and his assertion is corroborated by Borelli § and Malpighi * of the Florentine academy, whose partiality is not to be suspected in favour of a member of the Patavinian school.

* Elementa Chem. † Vita P. Paul. p. 155. ‡ Comm. in Galen. p. 736.—841.

Perhaps the best way to reconcile these different claims would be, to suppose that the thermometer was really invented by different persons about the same time. We know that there are certain periods in the progress of the arts when the stream of human genius runs in the same direction, and moves towards the same object. That part of the current which reaches the object first may possess the title; but the other parts follow so rapidly and arrive so soon after, that it is impossible for a spectator to decide which is first in point of time.

2
The air thermometer described.

The first form of this instrument for measuring the degrees of heat and cold, was the air-thermometer. It is a well known fact that air expands with heat so as to occupy more space than it does when cold, and that it is condensed by cold so as to occupy less space than when warmed, and that this expansion and condensation is greater or less according to the degree of heat or cold applied. The principle then on which the air-thermometer was constructed is very simple. The air was confined in a tube by means of some coloured liquor; the liquor rose or fell according as the air became expanded or condensed. What the first form of the tube was, cannot now perhaps be well known; but the following description of the air-thermometer will fully explain its nature.

The air-thermometer consists of a glass tube BE, connected

Plate DV fig. 1.

Thermometer.

nected at one end with a large glass ball A, and at the other end immersed in an open vessel, or terminating in a ball DE, with a narrow orifice at D; which vessel, or ball, contains any coloured liquor that will not easily freeze. Aquafortis tinged of a fine blue colour with a solution of vitriol or copper, or spirit of wine tinged with cochineal, will answer this purpose. But the ball A must be first moderately warmed so that a part of the air contained in it may be expelled through the orifice D; and then the liquor pressed by the weight of the atmosphere will enter the ball DE, and rise, for example, to the middle of the tube at C, at a mean temperature of the weather; and in this state the liquor by its weight, and the air included in the ball A, &c. by its elasticity, will counterbalance the weight of the atmosphere. As the surrounding air becomes warmer, the air in the ball and upper part of the tube, expanding by heat, will drive the liquor into the lower ball, and consequently its surface will descend; on the contrary, as the ambient air becomes colder, that in the ball is condensed, and the liquor pressed by the weight of the atmosphere will ascend: so that the liquor in the tube will ascend or descend more or less according to the state of the air contiguous to the instrument. To the tube is affixed a scale of the same length, divided upwards and downwards from the middle C into 100 equal parts, by means of which the ascent and descent of the liquor in the tube, and consequently the variations in the cold or heat of the atmosphere, may be observed.

4 Its defects. This instrument was extremely defective; for the air in the tube was not only affected by the heat and cold of the atmosphere but also by its weight.

Spirit of wine thermometer. The air being found improper for measuring with accuracy the variations of heat and cold according to the form of the thermometer which was first adopted, another fluid was proposed about the middle of the 17th century by the Florentine academy. This fluid was spirit of wine, or alcohol, as it is now generally named. The alcohol being coloured, was inclosed in a very fine cylindrical glass tube previously exhausted of its air, having a hollow ball at one end A, and hermetically sealed at the other end D. The ball and tube are filled with rectified spirit of wine to a convenient height, as to C, when the weather is of a mean temperature, which may be done by inverting the tube into a vessel of stagnant coloured spirit, under a receiver of the air-pump, or in any other way. When the thermometer is properly filled, the end D is heated red hot by a lamp, and then hermetically sealed, leaving the included air of about $\frac{1}{3}$ of its natural density, to prevent the air which is in the spirit from dividing it in its expansion. To the tube is applied a scale, divided from the middle, into 100 equal parts, upwards and downwards.

As spirit of wine is capable of a very considerable degree of rarefaction and condensation by heat and cold, when the heat of the atmosphere increases the spirit dilates, and consequently rises in the tube; and when the heat decreases, the spirit descends, and the degree or quantity of the motion is shown by a scale.

5 Its defects. The spirit of wine thermometer was not subject to some of the inconveniences which attended the air thermometer. In particular, it was not affected by variations in the weight of the atmosphere: accordingly it soon came into general use among philosophers. It was, at an early period, introduced into Britain by Mr Boyle. To this instrument, as then used, there are, however, many objections. The liquor was of different degrees of strength, and therefore different tubes filled with it, when exposed to the same degree of heat, would not correspond. There was also another defect: The scale which was adjusted to the thermometer did not commence at any fixed point. The highest term was adjusted to the great sunshine heats of Florence, which are too variable and undetermined; and frequently the workman formed the scale according to his own fancy. While the thermometer laboured under such disadvantages it could not be of general use. (Martine's Essays.)

6 Different fixed points proposed by philosophers. To obtain some fixed unalterable point by which a determined scale might be discovered, to which all thermometers might be accurately adjusted, was the subject which next drew the attention of philosophers. Mr Boyle, who seems at an early period to have studied this subject with much anxiety, proposed the freezing of the essential oil of anniseeds as a convenient point for graduating thermometers; but this opinion he soon laid aside. Dr Halley next proposed that thermometers should be graduated in a deep pit under ground, where the temperature both in winter and summer is pretty uniform; and that the point to which the spirit of wine should rise in such a subterraneous place should be the point from which the scale should commence. But this proposal was evidently attended with such inconveniences that it was soon abandoned. He made experiments on the boiling point of water, of mercury, and of spirit of wine; and he seems rather to give a preference to the spirit of wine *. He objected to the freezing of water as a fixed point, because he thought that it admitted considerable latitude.

* Phil. Trans. Abr. II. 34.

7 Newton's thermometer. It seems to have been reserved to the all-conquering genius of Sir Isaac Newton to determine this important point, on which the accuracy and value of the thermometer depends. He chose, as fixed, those points at which water freezes and boils; the very points which the experiments of succeeding philosophers have determined to be the most fixed and convenient. Sensible of the disadvantages of spirit of wine, he tried another liquor which was homogeneous enough, capable of a considerable rarefaction, about 15 times greater than spirit of wine. This was linseed oil. It has not been observed to freeze even in very great colds, and it bears a heat about four times that of water before it boils. With these advantages it was made use of by Sir Isaac Newton, who discovered by it the comparative degree of heat for boiling water, melting wax, boiling spirit of wine, and melting tin; beyond which it does not appear that this thermometer was applied. The method he used for adjusting the scale of this oil thermometer was as follows: Supposing the bulb, when immerged in thawing snow, to contain 10,000 parts, he found the oil expand by the heat of the human body so as to take up $\frac{1}{39}$th more space, or 10,256 such parts; and by the heat of water boiling strongly 10,725; and by the heat of melting tin 11,516. So that reckoning the freezing point as a common limit between heat and cold, he began his scale there, marking it 0, and the heat of the human body he made 12°; and consequently, the degrees of heat being proportional to the degrees of rarefaction, or 256 : 725 : : 12 : 34, this number 34 will express the heat of boiling water; and by the same rule, 72 that of melting tin †. This thermometer was constructed in 1701.

† Phil. Trans. No 270. or Abr. iv. part 2.

8 Its imperfections. To the application of oil as a measure of heat and cold, there are insuperable objections. It is so viscid, that it adheres too strongly to the sides of the tube. On this account it ascends and descends too slowly in case of a sudden heat or cold. In a sudden cold, so great a portion remains adhering to the sides of the tube after the rest has subsided, that the surface appears lower than the correspondent temperature of the air requires. An oil thermometer is therefore not a proper measure of heat and cold.

9 Reaumur's spirit of wine thermometer. All the thermometers hitherto proposed were liable to many inconveniences, and could not be considered as exact standards for pointing out the various degrees of temperature. This led Reaumur to attempt a new one, an account of which was published in the year 1730 in the Memoirs

Thermometer.

moirs of the Academy of Sciences. This thermometer was made with ſpirit of wine. He took a large ball and tube, the dimenſions and capacities of which were known; he then graduated the tube, ſo that the ſpace from one diviſion to another might contain 1000th part of the liquor; the liquor containing 1000 parts when it ſtood at the freezing point. He adjuſted the thermometer to the freezing point by an artificial congelation of water: then putting the ball of his thermometer and part of the tube into boiling water, he obſerved whether it roſe 80 diviſions: if it exceeded these, he changed his liquor, and by adding water lowered it, till upon trial it ſhould juſt riſe 80 diviſions; or if the liquor, being too low, fell ſhort of 80 diviſions, he raiſed it by adding rectified ſpirit to it. The liquor thus prepared ſuited his purpoſe, and ſerved for making a thermometer of any ſize, whoſe ſcale would agree with his ſtandard.

10 Its defects.

This thermometer was far from being perfect. As the bulbs were three or four inches in diameter, the ſurrounding ice would be melted before its temperature could be propagated to the whole ſpirits in the bulb, and conſequently the freezing point would be marked higher than it ſhould be. Dr Martine accordingly found, that inſtead of coinciding with the 32d degree of Fahrenheit, it correſponded with the 34th, or a point a little above it. Reaumur committed a miſtake alſo reſpecting the boiling point; for he thought that the ſpirit of wine, whether weak or ſtrong, when immerged in boiling water, received the ſame degree of heat with the boiling water. But it is well known that highly rectified ſpirit of wine cannot be heated much beyond the 175th degree of Fahrenheit, while boiling water raiſes the quickſilver 37 degrees higher. There is another thermometer that goes by the name of *Reaumur's*, which ſhall be afterwards deſcribed.

11 Mercurial thermometers.

At length a different fluid was propoſed, by which thermometers could be made free from moſt of the defects hitherto mentioned. This fluid was mercury, and ſeems firſt to have occurred to Dr Halley in the laſt century; but was not adopted by him on account of its having a ſmaller degree of expanſibility than the other fluids uſed at that time *. Boerhaave ſays that the mercurial thermometer was firſt conſtructed by Olaus Roemer; but the honour of this invention is generally given to Fahrenheit of Amſterdam, who preſented an account of it to the Royal Society of London in 1724.

* Phil. Tranſ. vol. xvii. or Abr. vol. ii

That we may judge the more accurately of the propriety of employing mercury, we will compare its qualities with thoſe of the fluids already mentioned, air, alcohol, and oil.

12 Properties of air, alcohol, and oil.

Air is the moſt expanſible fluid, but it does not receive nor part with its heat ſo quickly as mercury. Alcohol does not expand much by heat. In its ordinary ſtate it does not bear a much greater heat than 175° of Fahrenheit; but when highly rectified it can bear a greater degree of cold than any other liquor hitherto employed as a meaſure of temperature. At Hudſon's Bay, Mr Macnab, by a mixture of vitriolic acid and ſnow, made it to deſcend to 69 below 0 of Fahrenheit. There is an inconvenience, however, attending the uſe of this liquor; it is not poſſible to get it always of the ſame degree of ſtrength. As to oil, its expanſion is about 15 times greater than that of alcohol; it ſuſtains a heat of 600°, and its freezing point is ſo low that it has not been determined; but its viſcoſity renders it uſeleſs.

13 Thermometrical properties of mercury.

Mercury is far ſuperior to alcohol and oil, and is much more manageable than air. 1. As far as the experiments already made can determine, it is of all the fluids hitherto employed in the conſtruction of thermometers, that which meaſures moſt exactly equal differences of heat by equal differences of its bulk: its dilatations are in fact very nearly proportional to the augmentations of heat applied to it (A). 2. Of all liquids it is the moſt eaſily freed from air. 3. It is fitted to meaſure high degrees of heat and cold. It ſuſtains a heat of 600° of Fahrenheit's ſcale, and does not congeal till it fall 39 or 40 degrees below 0. 4. It is the moſt ſenſible of any fluid to heat and cold, even air not excepted. † Sir Benjamin Thompſon, now Count Rumford, found that mercury was heated from the freezing to the boiling point in 58 ſeconds, while water took two minutes 13 ſeconds, and common air 10 minutes and 17 ſeconds. 5. Mercury is a homogeneous fluid, and every portion of it is equally dilated or contracted by equal variations of heat. Any one thermometer made of pure mercury is, *cæteris paribus*, poſſeſſed of the ſame properties with every other thermometer made of pure mercury. Its power of expanſion is indeed about ſix times leſs than that of ſpirit of wine, but it is great enough to anſwer moſt of the purpoſes for which a thermometer is wanted.

Recherches ſur les Modif. de l'Atmoſphère.

† Phil. Tranſ. for 1786.

14 Fixed points.

The fixed points which are now univerſally choſen for adjuſting

(A) We have affirmed that the expanſions of the bulk of quickſilver by heat are nearly (for they are not ſtrictly ſo) in a regular arithmetical progreſſion, according to the quantity of heat it is expoſed to; and ſuch ſeems to be the caſe according to the Table publiſhed by Mr de Luc, at page 309. of his firſt volume on the Modifications of the Atmoſphere. The following extract of this table ſhows theſe variations: and the firſt and ſecond differences are added, in order to render theſe irregularities more ſenſible. They are ſuch as can hardly be conceived from the nature of any ſubſtance, without the influence of extraneous and accidental cauſes, which may have eſcaped the attention of the obſerver; neither have they been found exactly true by Dr Crawford. Mr de Luc ſuppoſes the whole heat from melting ice to that of boiling water to be divided into 80 parts; by the fractional ſubdiviſions of which he expreſſes the abſolute quantities of heat, anſwering to each 5, or 10 degrees of Reaumur's thermometer (= 22,5 of Fahrenheit's ſcale); ſo that the whole ſum of theſe fractions amounts exactly to the aſſumed number 80. They are as follow:

Cronſtedt's Mineralogy vol. ii.

Reaumur's Thermometer.	Fahrenheit's Thermometer.	Quantities of heat.	First differences.	Second differences.
Degrees 80	212			
70	189,5	9,44		
60	167	9,60	,16	+ ,06
50	144,5	9,70	,10	— ,06
40	122	9,86	,16	— ,06
30	99,5	10,08	,22	+ ,10
20	77	10,20	,12	— ,06
10	54,5	10,38	,18	— ,18
0	32	10,74	,56	

adjusting thermometers to a scale, and to one another, are the boiling and freezing water points. The boiling water point, it is well known, is not an invariable point, but varies some degrees according to the weight and temperature of the atmosphere. In an exhausted receiver, water will boil with a heat of 95° or 100°; whereas in Papin's digester it will acquire a heat of 412. Hence it appears that water will boil at a lower point, according to its height in the atmosphere, or to the weight of the column of air which presses upon it. In order to ensure uniformity therefore in the construction of thermometers, it is now agreed that the bulb of the tube be plunged in the water when it boils violently, the barometer standing at 30 English inches (which is its mean height round London), and the temperature of the atmosphere 55°. A thermometer made in this way, with its boiling point at 212°, is called by Dr Horsley *Bird's Fahrenheit*, because Mr Bird was the first person who attended to the state of the barometer in constructing thermometers.

As artists may be often obliged to adjust thermometers under very different pressures of the atmosphere, philosophers have been at pains to discover a general rule which might be applied on all occasions. M. de Luc, in his *Recherches sur les Mod. de l'Atmosphere* from a series of experiments, has given an equation for the allowance on account of this difference, in Paris measure, which has been verified by Sir George Schuckburgh ‡; also Dr Horsley, Dr Maskelyne, and Sir George Schuckburgh, have adapted the equation and rules to English measures, and have reduced the allowances into tables for the use of the artist. Dr Horsley's rule, deduced from De Luc's, is this:

$$\frac{99}{8990000} \log. z - 92{\cdot}804 = h.$$

where h denotes the height of a thermometer plunged in boiling water, above the point of melting ice, in degrees of Bird's Fahrenheit, and z the height of the barometer in 10ths of an inch. From this rule he has computed the following table, for finding the heights, to which a good Bird's Fahrenheit will rise when plunged in boiling water, in all states of the barometer, from 27 to 31 English inches; which will serve, among other uses, to direct instrument-makers in making a true allowance for the effect of the variation of the barometer, if they should be obliged to finish a thermometer at a time when the barometer is above or below 30 inches; though it is best to fix the boiling point when the barometer is at that height.

Equation of the Boiling Point.

Barometer.	Equation.	Difference.
31·0	+ 1·57	0·78
30·5	+ 0·79	0·79
30·0	0·00	0·80
29·5	— 0·80	0·82
29·0	— 1·62	0·83
28·5	— 2·45	0·85
28·0	— 3·31	0·86
27·5	— 4·16	0·88
27·0	— 5·04	

The numbers in the first column of this table express heights of the quicksilver in the barometer in English inches and decimal parts: the second column shows the equation to be applied, according to the sign prefixed, to 212° of Bird's Fahrenheit, to find the true boiling point for every such state of the barometer. The boiling point for all intermediate states of the barometer may be had with sufficient accuracy, by taking proportional parts, by means of the third column of differences of the equation. See *Phil. Trans.* lxiv. art. 30.; also Dr Maskelyne's *Paper*, vol. lxiv. art. 20.

In the following table we have the result of 15 different observations made by Sir George Schuckburgh compared with the result of M. de Luc's rules. 17 Sir George Schuckburgh's observations compared with De Luc's rules.

Heights of the Barometer reduced to the temperature of 50.	Mean boiling Point by Observation.	Boiling Point by De Luc's Rules.	Height of Barometer.	Boiling Point by Observation.	Boiling Point by De Luc's Rules.
Inch.	°	°	Inch.	°	°
26,495	207,07	208,54	30,00?	213,22	213,47
27,241	208,64	209,04	30,207	213,58	213,79
27,954	209,87	210,03	30,45?	214,15	214,23
28,377	210,50	210,81	30,763	214,37	214,66
28,699	211,27	211,34	30,847	214,53	214,79
28,898	211,50	211,67	30,957	214,9?	214,96
28,999	211,62	211,85			
29,447	212,55	212,74			
29,?25	212,95	213,15			

Sir George Schuckburgh has also subjoined the following general table for the use of artists in constructing the thermometer, both according to his own observations and those of M. de Luc.

Height of the Barometer.	Correct. of the boiling point	Difference	Correct accord. to M. de Luc	Difference
	°		°	
26,0	— 7,09	,91	— 6,83	,90
26,5	— 6,18	,91	— 5,93	,89
27,0	— 5,27	,90	— 5,04	,88
27,5	— 4,37	,89	— 4,16	,87
28,0	— 3,48	,89	— 3,31	,86
28,5	— 2,59	,87	— 2,45	,83
29,0	— 1,72	,87	— 1,62	,82
29,5	— 0,85	,85	— 0,80	,80
30,0	0,00	,85	0,00	,79
30,5	+ 0,85	,84	+ 0,79	,78
31,0	+ 1,69		+ 1,57	

18 Observations made by a committee of the Royal Society for adjusting the fixed points.

The Royal Society, fully apprized of the importance of adjusting the fixed points of thermometers, appointed a committee of seven gentlemen to consider of the best method for this purpose; and their report is published in the Phil. Trans. vol. lxvii. part ii. art. 37.

They observed, that though the boiling point be placed so much higher on some of the thermometers now made than on others, yet this does not produce any considerable error in the observations of the weather, at least in this climate; for an error of $1\frac{0}{4}$ in the position of the boiling point, will make an error only of half a degree in the position of 92°, and of not more than a quarter of a degree in the point of 62°. It is only in nice experiments, or in trying the heat of hot liquors, that this error in the boiling point can be of much importance.

In adjusting the freezing as well as the boiling point, the quicksilver in the tube ought to be kept of the same heat as that in the ball. When the freezing point is placed at a considerable distance from the ball, the pounded ice should be piled to such a height above the ball, that the error which can arise from the quicksilver in the remaining part of the tube not being heated equally with that in the ball, shall be very small, or the observed point must be corrected on that account according to the following table:

Heat

Thermometer.

19
Table for correcting the freezing point.

Heat of the Air.	Correction.
42°	,00087
52	,00174
62	,00261
72	,00348
82	,00435

The correction in this table is expreſſed in 1000th parts of the diſtance between the freezing point and the ſurface of the ice: *e. g.* if the freezing point ſtands ſeven inches above the ſurface of the ice, and the heat of the room is 62, the point of 32° ſhould be placed 7 X 00261, or ,018 of an inch lower than the obſerved point. A diagonal ſcale will facilitate this correction.

20
The quickſilver in the tube ought to be heated to the ſame degree as that in the ball.

The committee obſerve, that in trying the heat of liquors, care ſhould be taken that the quickſilver in the tube of the thermometer be heated to the ſame degree as that in the ball; or if this cannot be done conveniently, the obſerved heat ſhould be corrected on that account; for the manner of doing which, and a table calculated for this purpoſe, we muſt refer to their excellent report in the Phil. Tranſ. vol. lxvii. part ii. art. 37.

21
The tubes ought to be cylindrical and capillary.

† *Leçons de Phyſique*, tom. iv. p. 380.

With regard to the choice of tubes, they ought to be exactly cylindrical. But though the diameter ſhould vary a little, it is eaſy to manage that matter in the manner propoſed by the Abbé Nollet †, by making a ſmall portion of the quickſilver, *e. g.* as much as fills up an inch or half an inch, ſlide backward and forward in the tube; and thus to find the proportions of all its inequalities, and from thence to adjuſt the diviſions to a ſcale of the moſt perfect equality. The capillary tubes are preferable to others, becauſe they require ſmaller bulbs, and they are alſo more ſenſible, and leſs brittle. The moſt convenient ſize for common experiments has the internal diameter about the 40th or 50th of an inch, about 9 inches long, and made of thin glaſs, that the riſe and fall of the mercury may be better ſeen.

22
The number of degrees into which the ſcale ought to be divided.

The next thing to be conſidered, is of what number of degrees or diviſions the ſcale ought to conſiſt, and from what point it ought to commence. As the number of the diviſions of the ſcale is an arbitrary matter, the ſcales which have been employed differ much from one another in this circumſtance. Fahrenheit has made 180 degrees between the freezing and boiling water point. Amonton's made 73, and Sir Iſaac Newton only 34. There is, however, one general maxim, which ought to be obſerved: *That ſuch an arithmetical number ſhould be choſen as can eaſily be divided and ſubdivided, and that the number of diviſions ſhould be ſo great that there ſhall ſeldom be occaſion for fractions.* The number 80 choſen by Reaumur anſwers extremely well in this reſpect, becauſe it can be divided by ſeveral figures without leaving a remainder; but it is too ſmall a number: the conſequence of which is, that the degrees are placed at too great a diſtance from one another, and fractions muſt therefore be often employed. We think, therefore, that 160 would have been a more convenient number. Fahrenheit's number 180 is large enough, but when divided its quotient ſoon becomes an odd number.

23
At what point the ſcale ought to commence.

As to the point at which the ſcale ought to commence, various opinions have been entertained. If we knew the beginning or loweſt degree of heat, all philoſophers would agree, that the loweſt point of the thermometer ought to be fixed there; but we know neither the loweſt nor the higheſt degrees of heat; we obſerve only the intermediate parts. All that we can do, then, is to begin it at ſome invariable point, to which thermometers made in different places may eaſily be adjuſted. If poſſible too, it ought to be a point at which a natural well known body receives ſome remarkable change from the effects of heat or cold. Fahrenheit began his ſcale at the point at which ſnow and ſalt congeal. Kirwan propoſes the freezing point of mercury. Sir Iſaac Newton, Hales, and Reaumur adopted the freezing point of water. The objection to Fahrenheit's loweſt point is, that it commences at an artificial cold never known in nature, and to which we cannot refer our feelings, for it is what few can ever experience. There would be ſeveral great advantages gained, we allow, by adopting the freezing point of mercury. It is the loweſt degree of cold to which mercury can be applied as a meaſure; and it would render unneceſſary the uſe of the ſigns plus and minus, and the extenſion of the ſcale below 0. But we object to it, that it is not a point well known; for few, comparatively ſpeaking, who uſe thermometers, can have an opportunity of ſeeing mercury congealed. As to the other advantage to be gained by adopting the freezing point of mercury, namely, the abolition of negative numbers, we do not think it would counterbalance the advantage to be enjoyed by uſing a well-known point. Beſides, it may be aſked, Is there not a propriety in uſing negative numbers to expreſs the degree of cold, which is a negative thing? Heat and cold we can only judge of by our feelings: the point then at which the ſcale ſhould commence, ought to be a point which can form to us a ſtandard of heat and cold; a point familiar to us from being one of the moſt remarkable that occurs in nature, and therefore a point to which we can with moſt clearneſs and preciſion refer to in our minds on all occaſions. This is the freezing point of water choſen by Sir Iſaac Newton, which of all the general changes produced in nature by cold is the moſt remarkable. It is therefore the moſt convenient point for the thermometers to be uſed in the temperate and frigid zones; we may ſay over the globe, for even in the hotteſt countries of the torrid zone many of the mountains are perpetually covered with ſnow.

24
Only four thermometers generally used.

Having now explained the principles of the thermometer as fully as appears neceſſary, in order to make it properly underſtood, we will now ſubjoin an account of thoſe thermometers which are at preſent in moſt general uſe. There are Fahrenheit's, De l'Iſle's, Reaumur's, and Celſius's. Fahrenheit's is uſed in Britain, De l'Iſle's in Ruſſia, Reaumur's in France, and Celſius's in Sweden. They are all mercurial thermometers.

25
Fahrenheit's deſcribed.

Fahrenheit's thermometer conſiſts of a ſlender cylindrical tube and a ſmall longitudinal bulb. To the ſide of the tube is annexed a ſcale which Fahrenheit divided into 600 parts, beginning with that of the ſevere cold which he had obſerved in Iceland in 1709, or that produced by ſurrounding the bulb of the thermometer with a mixture of ſnow or beaten ice and ſal ammoniac or ſea ſalt. This he apprehended to be the greateſt degree of cold, and accordingly he marked it, as the beginning of his ſcale, with 0; the point at which mercury begins to boil, he conceived to ſhow the greateſt degree of heat, and this he made the limit of his ſcale. The diſtance between theſe two points he divided into 600 equal parts or degrees; and by trials, he found that the mercury ſtood at 32 of theſe diviſions, when water juſt begins to freeze, or ſnow or ice juſt begins to thaw; it was therefore called the degree of the freezing point When the tube was immerſed in boiling water, the mercury roſe to 212, which therefore is the boiling point, and is juſt 180 degrees above the former or freezing point. But the preſent method of making the ſcale of theſe thermometers, which is the ſort in moſt common uſe, is firſt to immerge the bulb of the thermometer in ice or ſnow

snow just beginning to thaw, and mark the place where the mercury stands with a 32; then immerge it in boiling water, and again mark the place where the mercury stands in the tube, which mark with the num. 212, exceeding the former by 180; dividing therefore the intermediate space into 180 equal parts, will give the scale of the thermometer, and which may afterwards be continued upwards and downwards at pleasure.

Other thermometers of a similar construction have been accommodated to common use, having but a portion of the above scale. They have been made of a small size and portable form, and adapted with appendages to particular purposes; and the tube with its annexed scale has often been enclosed in another thicker glass tube, also hermetically sealed, to preserve the thermometer from injury. And all these are called *Fahrenheit's thermometers.*

In 1733, M. De l'Isle of Petersburgh constructed a mercurial thermometer on the principles of Reaumur's spirit thermometer. In his thermometer, the whole bulk of quicksilver, when immerged in boiling water, is conceived to be divided into 100,000 parts; and from this one fixed point the various degrees of heat, either above or below it, are marked in these parts on the tube or scale, by the various expansion or contraction of the quicksilver, in all imaginable varieties of heat.—Dr Martine apprehends it would have been better if De l'Isle had made the integer 100,000 parts, or fixed point, at freezing water, and from thence computed the dilatations or condensations of the quicksilver in those parts; as all the common observations of the weather, &c. would have been expressed by numbers increasing as the heat increased, instead of decreasing, or counting the contrary way. However, in practice it will not be very easy to determine exactly all the divisions from the alteration of the bulk of the contained fluid. And besides, as glass itself is dilated by heat, though in a less proportion than quicksilver, it is only the excess of the dilatation of the contained fluid above that of the glass that is observed; and therefore if different kinds of glass be differently affected by a given degree of heat, this will make a seeming difference in the dilatations of the quicksilver in the thermometers constructed in the Newtonian method, either by Reaumur's rules or De l'Isle's. Accordingly it has been found, that the quicksilver in De l'Isle's thermometers has stood at different degrees of the scale when immerged in thawing snow: having stood in some at 154°, while in others it has been at 156° or even 158°.

The thermometer presently used in France is called *Reaumur's;* but it is very different from the one originally invented by Reaumur in 1730, and described in the Memoirs of the Academy of Sciences. The one invented by Reaumur was filled with spirit of wine; and tho' its scale was divided by the author into 80 parts, of which 0 was the freezing point and 80 the boiling water point, yet in fact 80 was only the boiling point of the spirit of wine that he employed, which, as Dr Martine computes, corresponded with 180 of Fahrenheit. But the thermometer now in use in France is filled with mercury; and the boiling water point, which is at 80, corresponds with the 212th degree of Fahrenheit. The scale indeed commences at the freezing point, as the old one did. The new thermometer ought more properly to be called *De Luc's thermometer*, for it was first made by De Luc; and is in fact as different from Reaumur's as it is from Sir Isaac Newton's. When De Luc had fixed the scale, and finished an account of it, he showed the manuscript to M. De la Condamine. Condamine advised him to change the number 80; remarking, that such was the inattention of physicians, that they would probably confound it with Reaumur's. De Luc's modesty, as well as a predilection for the number 80, founded, as he thought, on philosophical reasons, made him decline following this advice. But he found by experience that the prediction of Condamine was too well founded.

28 Celsius's thermometer.

The thermometer of Celsius, which is used in Sweden, has a scale of 100 degrees from the freezing to the boiling water point.

29 How to compare these together.

These are the principal thermometers now used in Europe; and the temperatures indicated by any of them may be reduced into the corresponding degrees on any of the others by means of the following simple canons; in which R signifies the degrees on the scale of Reaumur, F those of Fahrenheit, and S those of the Swedish thermometer.

1. To convert the degrees of Reaumur into those of Fahrenheit; $\frac{R \times 9}{4} + 32 = F$.

2. To convert the degrees of Fahrenheit into those of Reaumur; $\frac{F - 32 \times 4}{9} = R$.

3. To convert the Swedish degrees into those of Fahrenheit; $\frac{S \times 9}{5} + 32 = F$.

4. To convert Fahrenheit's into Swedish; $\frac{F - 32 \times 5}{9} = S$.

5. To convert Swedish degrees into those of Reaumur; $\frac{S \times 4}{5} = R$.

6. To convert Reaumur's degrees into Swedish; $\frac{R \times 5}{4} = S$.

To such readers as are unacquainted with the algebraic expression of arithmetical formulæ, it will be sufficient to express one or two of these in words to explain their use.—1. Multiply the degree of Reaumur by 9, divide the product by 4, and to the quotient add 32, the sum expresses the degree on the scale of Fahrenheit.—2. From the degree of Fahrenheit subtract 32, multiply the remainder by 4, and divide the product by 9, the quotient is the degree according to the scale of Reaumur, &c.

As many other thermometers have been used besides these, and consequently observations taken by them, it is of importance to have them placed in such a point of view that they may be easily compared with any of these four now in general use. We therefore give them in Plate DVII. in the same order as they were arranged by Dr Martine in his valuable Essay on the Construction and Graduation of Thermometers, and at the same time adding those of Celsius and De Luc. We call it by the name of De Luc for the sake of distinguishing it from Reaumur's spirit of wine thermometer, which may be seen in the same Plate.

It is unnecessary to describe any of these more minutely, as they are no longer used. Those who wish to read a more particular account of them may consult Dr Martine's Essays.

30 Account of self-registering thermometers.

As in meteorological observations it is necessary to attend to the greatest rise and fall of the thermometer, attempts have been made to construct a thermometer which might register the greatest degree of heat, or greatest degree of cold, which took place during the absence of the observer. In 1757 Lord Charles Cavendish presented to the Royal Society of London a thermometer in two different forms; the one contrived to mark the greatest degree of heat, and the other the greatest degree of cold.

31 Lord Charles Cavendish's thermometer.

Plate DVI. Fig. 3.

The first consists of a glass tube AB, with a cylindrical bulb B at the lower end, and capillary at the top, over which there is fixed a glass ball C. The bulb and part of the tube are filled with mercury, the top of which shows the

Thermometer.

degrees of heat as usual. The upper part of the tube above the mercury is filled with spirit of wine; the ball C is also filled with the same liquor almost to the top of the capillary tube. When the mercury rises the spirit of wine is also raised, and falls into the ball C, which is so made that the liquor cannot return into the tube when the mercury sinks; consequently the height of the spirit of wine in the ball, added to that in the tube, will give the greatest degree of heat to which the thermometer has pointed since last observation. When a new observation is to be made, the instrument must be inclined till the liquor in the ball cover the end of the capillary tube.

In this thermometer it is evident that the mercury must be affected by the weight and elasticity of the spirit of wine, and therefore it will not correspond to any of the common mercurial thermometers.

The thermometer for showing the greatest degree of cold is represented in fig. 4. by the crooked tube ABCD. This instrument is filled with spirit of wine, with the addition of as much mercury as is sufficient to fill both legs of the syphon, and about a fourth or fifth part of the hollow ball C. We are not told what the proportion of mercury was to that of spirit of wine. The degrees of heat are shown by the rise or fall of the mercury in the leg AB. The thermometer marks the greatest fall by means of the hollow ball C. When the mercury in the longer leg sinks by cold, that in the shorter will rise and run over into the ball C, from which it cannot return when the mercury subsides in the shorter and rises in the longer leg. The upper part of the shorter leg will therefore be filled with a column of spirits of a length proportional to the increase of heat; the bottom or lower surface of which, by means of a proper scale, will show how much the mercury has been lower than it is; which being subtracted from the present height will give the lowest point to which the mercury has fallen. That the thermometer may be fitted for a new observation, the mercury must be made to run back from the ball into the shorter leg, by inclining the tube and heating the ball.

32 Mr Six's thermometer. Fig. 5.

In 1782 Mr Six proposed another self-registering thermometer. It is properly a spirit of wine thermometer, though mercury is also employed for supporting an index. *ab* is a thin tube of glass 16 inches long, and $\frac{1}{13}$ths of an inch caliber: *cde* and *fgh* are smaller tubes about $\frac{1}{16}$th of an inch caliber. These three tubes are filled with highly rectified spirit of wine, except the space between *d* and *g*, which is filled with mercury. As the spirit of wine contracts or expands in the middle tube, the mercury falls or rises in the outside tubes. An index, such as that represented in fig. 6. is placed on the surface, within each of these tubes, so light as to float upon it. *k* is a small glass tube $\frac{1}{2}$ths of an inch long, hermetically sealed at each end, and inclosing a piece of steel wire nearly of its own length. At each end *l*, *m*, of this small tube, a short tube of black glass is fixed, of such a diameter as to pass freely up and down within either of the outside tubes of the thermometer *ce* or *fh*. From the upper end of the index is drawn a spring of glass to the fineness of a hair, and about $\frac{4}{7}$ths of an inch long; which being placed a little oblique, presses lightly against the inner surface of the tube, and prevents the index from descending when the mercury descends. These indexes being inserted one into each of the outside tubes, it is easy to understand how they point out the greatest heat or cold that has happened in the observer's absence. When the spirit of wine in the middle tube expands, it presses down the mercury in the tube *bf*, and consequently raises it in the tube *ec*; consequently the index on the left hand tube is left behind and marks the greatest cold, and the index in the right hand tube rises and marks the greatest heat.

33 Rutherford's thermometer.

In 1790 a paper was given into the Royal Society of Edinburgh, describing two thermometers, newly invented, by Dr John Rutherford of Middle Bailish; the one for registering the highest and the other for registering the lowest degree of heat to which the thermometer has risen or fallen during the absence of the observer. An account of them may be found in the third volume of the Transactions of the Society.

34 Mr Keith's thermometer.

A new self-registering thermometer has more lately been invented by Mr Keith of Ravelstone, which we consider as the most ingenious, simple, and perfect, of any which has hitherto appeared. Its simplicity is so great, that it requires only a very short description to make it intelligible.

Fig.

AB is a thin glass tube about 14 inches long and $\frac{1}{2}$ths of an inch caliber, close or hermetically sealed at top. To the lower end, which is open, there is joined the crooked glass tube BE, seven inches long, and $\frac{4}{10}$ths of an inch caliber, and open at top. The tube AB is filled with the strongest spirit of wine, and the tube BE with mercury. This is properly a spirit of wine thermometer, and the mercury is used merely to support a piece of ivory or glass, to which is affixed a wire for raising one index or depressing another, according as the mercury rises or falls. E is a small conical piece of ivory or glass, of such a weight as to float on the surface of the mercury. To the float is joined a wire called the *float-wire*, which reaches upwards to H, where it terminates in a knee bent at right angles. The float-wire, by means of an eye at *a*, moves easily along the small harpsichord wire GK. LL are two indexes made of thin black oiled silk, which slide upwards or downwards with a force not more than two grains. The one placed above the knee points out the greatest rise, and the one placed below it points out the greatest fall, of the thermometer.

When the instrument is to be prepared for an observation, both indexes are to be brought close to the knee H. It is evident, that when the mercury rises, the float and float wire, which can be moved with the smallest force, will be pushed upwards till the mercury become stationary. As the knee of the float-wire moves upwards it will carry along with it the upper index L. When the mercury again subsides, it leaves the index at the highest point to which it was raised, for it will not descend by its own weight: As the mercury falls the float-wire does the same; it therefore brings along with it the lower index L, and continues to depress it till it again become stationary or ascend in the tube; in which case it leaves the lower index behind it as it had formerly left the upper. The scale to which the indexes point is placed parallel to the slender harpsichord wire. It may be seen more distinctly in fig. 8. That the scale and indexes may not be injured by the wind and rain, a cylindrical glass cover, close at top, and made so as to exactly fit the part FG, is placed over it.

The ingenious inventor has another improvement in contemplation, which, if upon trial it be found to answer, will make this thermometer as perfect as can be desired, provided there do not arise some errors from the variable pressure of the atmosphere. He proposes to adopt clock-work to this thermometer, in such a way as to register with the utmost precision the degrees of heat and cold for every month, day, and minute in the year. The principles on which this clockwork is to be formed we shall forbear to describe, hoping that the author himself, after his experiment has met with the success which we ardently wish, will favour the world with his own account of it.

The fame ingenious gentleman has invented a felf-regiftering barometer, upon the fame principles with his felf-regiftering thermometer. We have had the pleafure of feeing both; and are convinced that they will fully gratify the wifhes of all who are engaged in meteorological ftudies. He is alfo in expectation of being foon able to produce an air thermometer free from the defects of thofe which were formerly made, as he has found out a way of preventing it from being affected by the preffure of the atmofphere.

M. De Luc has defcribed the beft method of conftructing a thermometer, fit for determining the temperature of the air, in the menfuration of heights by the barometer. He has alfo fhown how to divide the fcale of a thermometer, fo as to adapt it for aftronomical purpofes in the obfervation of refractions.

Mr Cavallo, in 1781, propofed the conftruction of a thermometrical barometer, which, by means of boiling water, might indicate the various gravity of the atmofphere, or the height of the barometer. But as he does not fay that the inftrument has been tried with the defired fuccefs, we forbear to defcribe it. Thofe who wifh to know his ideas refpecting it may confult the Philofophical Tranfactions, vol. lxxi. p. 524.

The thermometers hitherto defcribed are very limited in their extent; they indeed point out to us the loweft degrees of heat which are commonly obferved even in cold climates, but they by no means reach to thofe degrees of heat which are very familiar to us. The mercurial thermometer extends no farther than to 600 of Fahrenheit's fcale, the heat of boiling mercury; but we are fure that the heat of folid bodies, when heated to ignition, or till they emit light, far exceeds the heat of boiling mercury.

In order to remedy this defect, Sir Ifaac Newton, whofe genius overcame thofe obftacles which ordinary minds could not approach, attempted by an ingenious experiment to extend the fcale to any degree required. Having heated a mafs of iron red-hot, and expofed it to the cold air, he obferved the time which elapfed till it became cold, or of the fame temperature with the air; and when the heat fo far decreafed that he could apply fome known meafure (as a thermometer) to it, he obferved the degrees of heat loft in given times; and thence drew the general conclufion, that the quantities of heat loft in given fmall fpaces are always proportional to the heat remaining in the body, reckoning the heat to be the excefs by which it is warmer than the ambient air. So that taking the number of minutes which it took to cool after it came to a determined point in an arithmetical progreffion, the decrements of the heat of the iron would be continually proportional. Having by this proportion found out the decrements of heat in a given time after it came to a known point, it was eafy, by carrying upwards the fame proportion to the beginning of its cooling, to determine the greateft heat which the body had acquired. This proportion of Sir Ifaac's was found by Dr Martine to be fomewhat inaccurate. The heat of a cooling body does not decreafe exactly in proportion to that which the body retains. As the refult of many obfervations, he found that two kinds of proportion took place, an arithmetical as well as the geometrical proportion which Sir Ifaac Newton had adopted; namely, that the decrements of heat were partly proportional to the times (that is, that quantities of heat are loft in equal times), as well as partly in proportion to the remaining heat; and that if thefe two are added together the rule will be fufficiently accurate. By the geometrical proportion which Sir Ifaac Newton adopted he difcovered the heat of metals red-hot or in fufion.

This method, fo fuccefsfully purfued by Sir Ifaac, was fufficient to form a fcale of high degrees of heat, but was not convenient for practical purpofes. Accordingly the ingenious Mr Jofiah Wedgwood, who is well known for his great improvement in the art of pottery, applied himfelf in order to difcover a thermometer which might be eafily managed. After many experiments recorded in the Philofophical Tranfactions, but which it is unneceffary to detail in this place, he has invented a thermometer which marks with much precifion the different degrees of ignition from a dull red heat vifible in the dark to the heat of an air-furnace. This thermometer is extremely fimple. It confifts of two rulers fixed upon a fmooth flat plate, a little farther afunder at the one end than at the other, leaving an open longitudinal fpace between them. Small pieces of alum and clay mixed together are made of fuch a fize as juft to enter at the wide end; they are then heated in the fire along with the body whofe heat we wifh to determine. The fire, according to the degree of heat it contains, diminifhes or contracts the earthy body, fo that when applied to the wide end of the gage, it will flide on towards the narrow end, lefs or more according to the degree of heat to which it has been expofed. 39 Wedgwood's thermometer for meafuring high degrees of heat

That this inftrument may be perfectly underftood, we have given a reprefentation of it in Plate DVI. fig. 9. ABCD is a fmooth flat plate; and EF and GH two rulers or flat pieces, a quarter of an inch thick, fixed flat upon the plate, with the fides that are towards one another made perfectly true, a little farther afunder at one end EG than at the other end FH: thus they include between them a long converging canal, which is divided on one fide into a number of fmall equal parts, and which may be confidered as performing the offices both of the tube and fcale of the common thermometer. It is obvious, that if a body, fo adjufted as to fit exactly at the wider end of this canal, be afterwards diminifhed in its bulk by fire, as the thermometer pieces are, it will then pafs further in the canal, and more and more fo according as the diminution is greater; and converfely, that if a body, fo adjufted as to pafs on to the narrow end, be afterwards expanded by fire, as is the cafe with metals, and applied in that expanded ftate to the fcale, it will not pafs fo far; and that the divifions on the fide will be the meafures of the expanfions of the one, as of the contractions of the other, reckoning in both cafes from that point to which the body was adjufted at firft. 40 Defcribed. *Philofophical Tranfactions*, vol. lxxiv.

I is the body whofe alteration of bulk is thus to be meafured. This is to be gently pufhed or flid along towards the end FH, till it is ftopped by the converging fides of the canal.

Mr Wedgwood at firft ufed clay for his thermometer pieces; but he foon found it impoffible to procure frefh fupplies of the fame quality. He therefore had recourfe to an artificial preparation. As the earth of alum is the pure argillaceous earth to which all clays owe their property of diminifhing in the fire, he mixed fome of this earth with the clay, and found it to anfwer his wifhes completely, both in procuring the neceffary degree of diminution and of increafing its unvitrefcibility. The only way of afcertaining the proportion of alum earth to be added is by repeated trials. Mr Wedgwood found that 10 hundred weight of the poreclain clay of Cornwall required all the earth that was afforded by five hundred weight of alum. But as the clay or alum differs in quality, the proportion will alfo differ. There can now, however, be no difficulty in making thermometers of this kind, as common clay anfwers the purpofe very well, and alum-earth can eafily be procured. Thofe who wifh to fee a more particular account of this fubject may perufe Mr Wedgwood's 41 Thermometer pieces, of what compofed.

 papers

Thermometer

papers in the Philosophical Transactions for 1782, 1784, and 1786.

As Mr Wedgwood's thermometer begins at the lowest degree of ignition, and Fahrenheit's goes no higher than the boiling point of mercury, Mr Wedgwood continued to fill up the interval of the scale by using a piece of silver instead of his common thermometer pieces; and in this way he has found out that 130 degrees of Fahrenheit are equal to one of his. He has accordingly, by obferving this proportion, continued Fahrenheit's fcale to the top of his own. We are now therefore enabled to give a fcale of heat from the higheft degree of heat produced by an air-furnace to the greateft degree of cold hitherto known, which was produced at Hudfon's Bay in December 1784 by a mixture of vitriolic acid and fnow. Of the remarkable degrees between thefe extreme points we fhall now lay before our readers a lift.

	Fahrenheit's fcale.	Wedgwood's fcale.
Extremity of Wedgwood's fcale	32277°	240°
Greateft heat of his fmall air-furnace	21877	160
Caft iron melts - -	17977	130
Greateft heat of a common fmith's forge	17327	125
Welding heat of iron, greateft	13427	95
——— ——— least -	12777	90
Fine gold melts - -	5237	32
Fine filver melts - -	4717	28
Swedifh copper melts -	4587	27
Brafs melts - -	3807	21
Heat by which his enamel colours are burnt on - -	1857	6
Red heat fully vifible in day-light	1077	0
Red-heat fully vifible in the dark	947	1
MERCURY BOILS, alfo lintfeed and other expreffed oils - -	600	
Oil of turpentine boils -	560	
Sulphuric acid boils - -	546	
Lead melts - - -	540	
Bifmuth melts - -	460	
Tin melts - -	408	
Sulphur melts - -	244	
Nitrous acid boils - -	242	
Cows milk boils - -	213	
WATER BOILS - -	212	
Human urine boils - -	206	
Brandy boils - -	190	
Alcohol boils - -	174	
Serum of blood and white of eggs harden	156	
Bees wax melts - -	142	
Heat of the air near Senegal fometimes	111	
Hens hatch eggs about - -	108	
Heat of birds from - -	103 to 111	
Heat of domeftic quadrupeds from	100 to 103	
Heat of the human body -	92 to 99	
Heat of a fwarm of bees -	97	
Heat of the ocean under the equator	80	
Butter melts - -	74	
Vitriolic acid of the fpecific gravity of 1780 freezes at - -	45	
Oil of olives begins to congeal -	43	
Heat of hedgehogs and marmots in a torpid ftate - - -	59½	
WATER FREEZES and fnow melts	32	
Milk freezes - -	30	
Urine and common vinegar freezes	28	
Human blood freezes - -	25	
Strong wines freeze - -	20	

	Fahrenheit's fcale.
A mixture of one part of alcohol and three parts of water freezes -	7
A mixture of fnow and falt freezes	0 to 4
Brandy, or a mixture of equal parts of alcohol and water, freezes - -	— 7
Spirit of wine in Reaumur's thermometer froze at Torneo - -	— 34
MERCURY FREEZES - -	— 39 or 40
Cold produced by Mr Macnab at Hudfon's Bay by a mixture of vitriolic acid and fnow - - -	— 69

Thermopylæ || Thefeus

THERMOPYLÆ, (anc. geog.); a narrow pafs or defile, between the wafh of the Sinus Maliacus; on the eaft and fteep mountains, reaching to Oeta, made dreadful by unpaffable woods; on the weft, leading from Theffaly to Locris and Bœotia. Thefe mountains divide Greece in the middle, in the fame manner as the Apennine does Italy; forming one continued ridge from Leucate on the weft to the fea on the eaft, with thickets and rocks interfperfed; that perfons even prepared for travelling, much lefs an army encumbered with baggage, cannot eafily find a commodious paffage. In the valley verging towards the Sinus Maliacus, the road is only fixty paces broad; the only military way for an army to pafs, if not obftructed by an enemy; and therefore the place is called *Pylæ*, and by others, on account of its hot water, *Thermopylæ*. Ennobled by the brave ftand made by Leonidas and three hundred Spartans againft the whole army of Perfia; and by the bold refolution of blind Euthycus, choofing rather to fall there in fight, than return to Sparta, and efcape the common danger. Famous alfo for the Amphyctiones, the common council or ftates general of Greece, affembling there twice a-year, fpring and autumn. For an account of the battle of Thermopylæ at which Leonidas with a handful of men engaged the Perfian army, fee SPARTA.

THESEA, in antiquity, feafts celebrated by the Athenians in honour of Thefeus, confifting of fports and games, with mirth and banquets; fuch as were poor and unable to contribute to them were entertained at the public expence

THESEUS, a famous hero of antiquity ranked among the demi-gods, whofe hiftory is fabulous. He was the reputed fon of Ægeus king of Athens. He threw Sciron, a cruel robber, down a precipice; faftened Procruftes tyrant of Attica to a bending pine, which being let loofe tore him afunder; killed the Minotaur kept in the labyrinth by king Minos, in Crete; and by the affiftance of that prince's daughter, Ariadne, who gave him a clue, efcaped out of that labyrinth, and failed with his deliverer to the ifle of Naxos, where he had the ingratitude to leave her.

Thefeus afterwards overcame the Centaurs, fubdued the Thebans, and defeated the Amazons. He affifted his friend Pirithous in his expedition to the infernal regions to carry off Proferpine; but was imprifoned by Pluto, till he was releafed by Hercules. He is alfo faid to have eftablifhed the Ifthmean games, in honour of Neptune; to have united the twelve cities of Attica; and to have founded a republic there, 1236 B. C. Some time after, taking a voyage into Epirus, he was feized by Aidonius king of the Moloffians; meanwhile Mneftheus rendered himfelf mafter of Athens. But at length Thefeus being releafed from prifon, retired to Scyros, where king Lycomedes caufed him to be thrown from the top of a rock. Thefeus had feveral wives, the firft of whom was Helena the daughter of Tyndarus; the fecond, Hypolita queen of the Amazons; and the laft, Phedra fifter to Ariadne, who punifhed him for

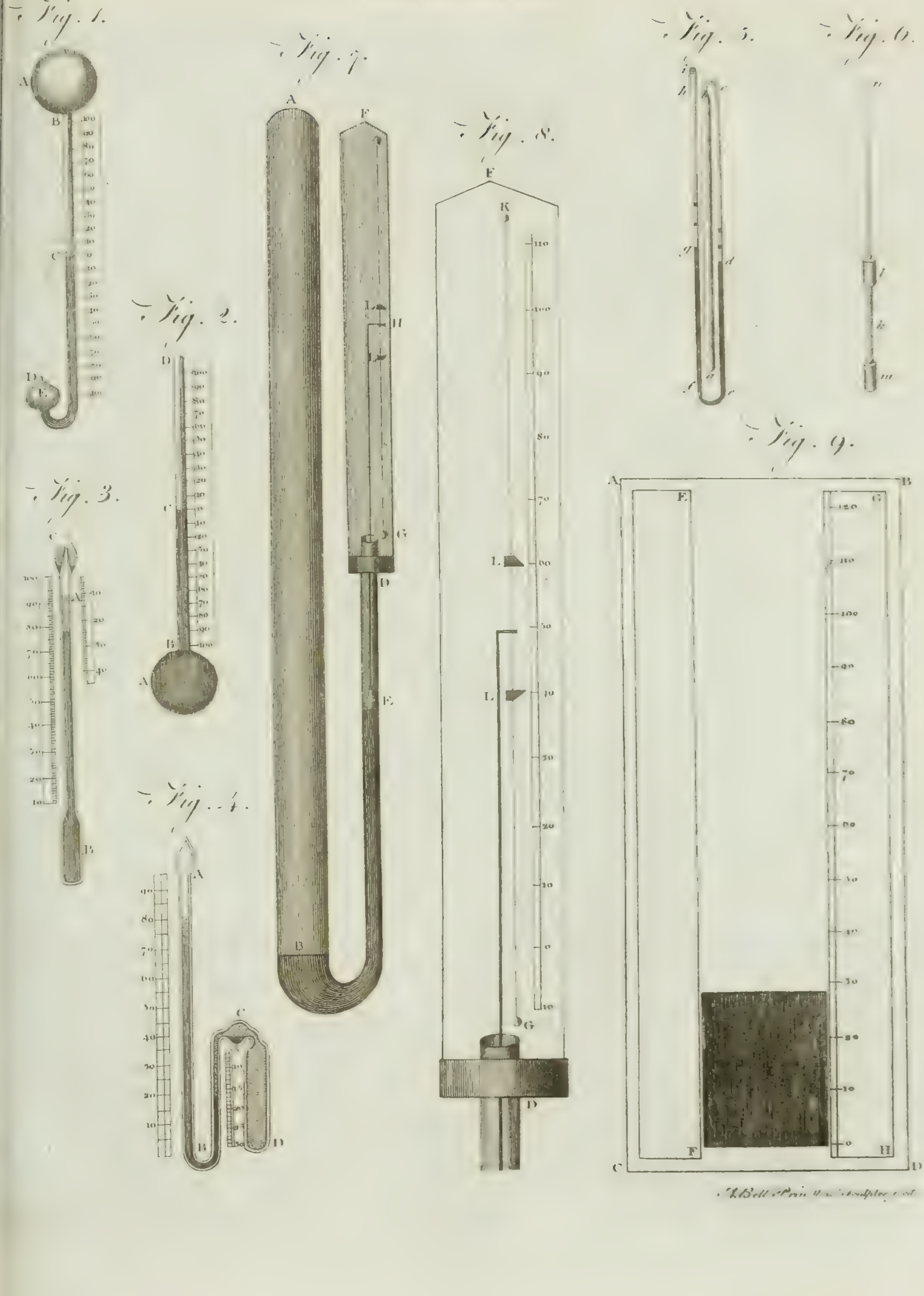
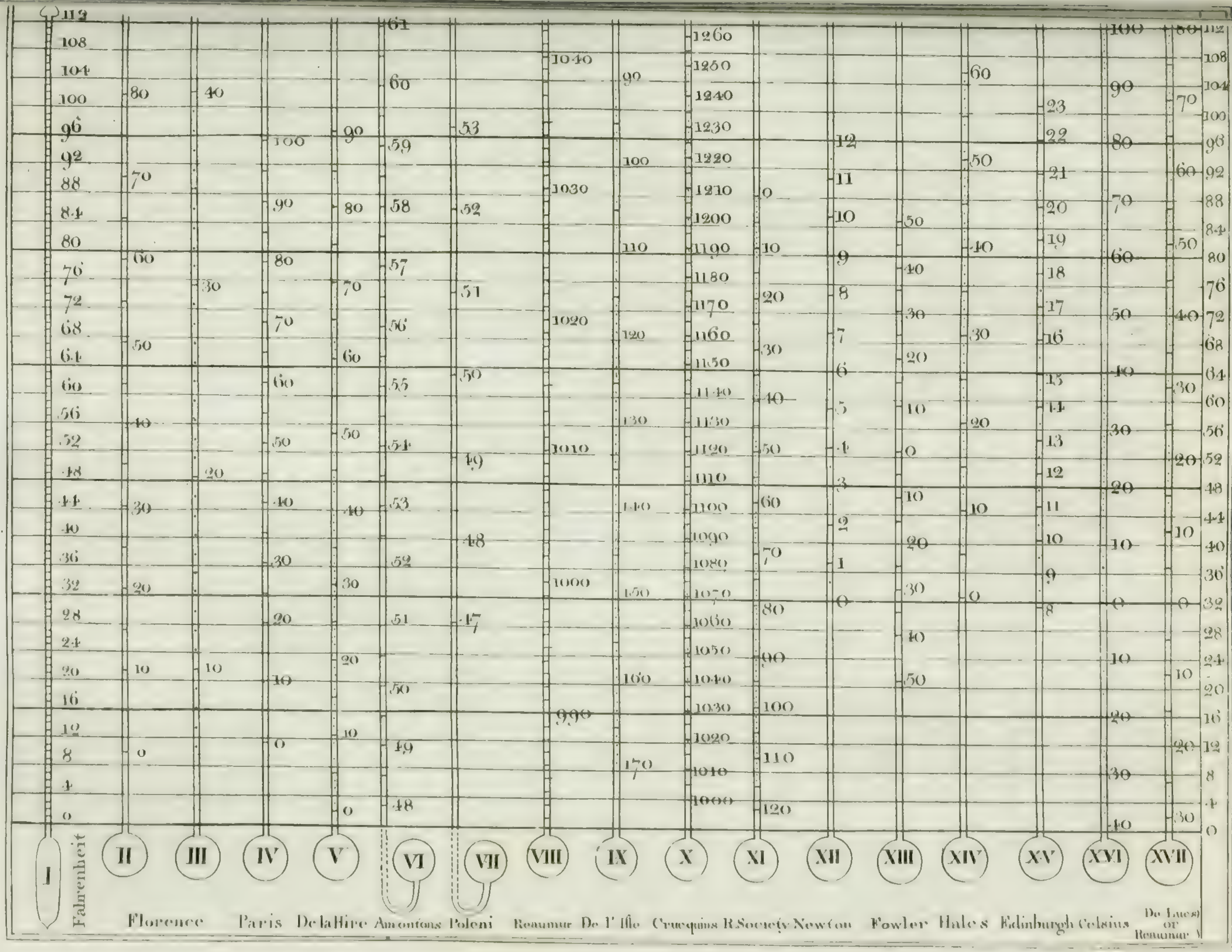


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.


I
Fahrenheit
II
Florence
III
IV
Paris
V
De la Hire
VI
Amontons
VII
Poleni
VIII
Reaumur
IX
De l'Isle
X
Cruquius
XI
R. Society
XII
Newton
XIII
Fowler
XIV
Hale's
XV
Edinburgh
XVI
Celsius
XVII
De Luc's or Reaumur's

for his infidelity to her sister, by her incestuous passion for his son Hippolitus.

THESIS, a general position which a person advances, and offers to maintain. In taking degrees in universities, the candidates are generally obliged to write a thesis, which they must afterwards defend.

THESIUM, BASE FLUELLIN, in botany; a genus of plants belonging to the class of *pentandria*, and order of *monogynia*. The calyx is monophyllous, with the stamina inserted into it: there is only one seed, which is inferior. There are 17 species; one of which is a British plant, the *linophyllum* or bastard toad-flax. It has a foliaceous panicle with linear leaves, and flowers in June and July.

THESPIS, a famous Greek tragic poet, and the first representer of tragedy at Athens. He carried his troop from village to village in a waggon, from which they performed their pieces. Alcestis was the first tragedy they performed at Athens, 536 B. C. See THEATRE.

THESSALIAN Chair, so called from Thessaly, where chairs of this figure were most in use; it is recommended by Hippocrates * in place of a machine for reducing a recent luxation of the shoulder bone. The back of this chair is perpendicular to the seat, as Galen tells us; by which construction it is distinguished and accommodated to the operation.

THESSALY, a country of Greece, whose boundaries have been different at different periods. Properly speaking, Thessaly was bounded on the south by the southern parts of Greece, or Græcia Propria; east, by the Ægean; north, by Macedonia and Mygdonia; and west, by Illyricum and Epirus. It was generally divided into four separate provinces, Thessaliotis, Pelasgiotis, Istiæotis, and Phthiotis, to which some add Magnesia. It has been severally called *Æmonia*, *Pelasgicum*, *Argos*, *Hellas*, *Argeia*, *Dryopis*, *Pelasgia*, *Pyrrhæa*, &c. The name of Thessaly is derived from Thessalus, one of its monarchs. Thessaly is famous for a deluge which happened there in the age of Deucalion. Its mountains and cities are also celebrated, such as Olympus, Pelion, Ossa, Larissa, &c. The Argonauts were partly natives of Thessaly. The inhabitants of the country passed for a treacherous nation, so that false money was called *Thessalian coin*, and a perfidious action a *Thessalian deceit*. Thessaly was originally governed by kings, till it became subject to the Macedonian monarchs. The cavalry was universally esteemed, and the people were superstitious and addicted to the study of magic and incantations. See *Lucan*. 6. v. 438, &c.; *Dionys.* 219; *Curt.* 3. c. 2; *Ælian*, *V. H.* 3. c. 1; *Paus.* 4. c. 36. l. 10. c. 1; *Mela.* 2. c. 3; *Justin* 7. c. 6; *Diod.* 4

Thessaly is now called *Janna*, a province of European Turkey, bounded by Macedonia on the north, by the Archipelago on the east, by Achaia or Livadia on the south, and by Epirus on the west.

THETIS, in Pagan mythology, the wife of Oceanus, and the mother of Nereus and Doris, who were married to each other; and from this marriage sprung the nymphs of the earth and sea. Among these nymphs there was one named *Thetis the Younger*, who excelled all the rest in beauty, and for whom Jupiter conceived such a passion, that he resolved to espouse her: but being informed by the Destinies that she would bring forth a son who would rise above his father, he married her to Peleus. To their nuptials all the gods and goddesses were invited except Discord, who, to be revenged for this contempt, threw a golden apple into the assembly, on which was engraven, *Detur pulchriori*. Juno, Pallas, and Venus, disputed for this apple; but Paris being chosen to decide the difference, adjudged it to Venus. From this marriage of Thetis and Peleus sprung Achilles.

THEURGY, θεουργια, a name which the ancients gave to that sacred part of magic which we sometimes call *white magic*, or the *white art*.

The word is formed from Θεος, "God," and εργον "work;" *q. d.* the art of doing divine things, or things which God alone can do: or the power of working extraordinary and supernatural things, by invoking the names of God, saints, angels, &c. Accordingly, those who have written of magic in general, divide it into three parts: the first whereof is called *theurgy*, as operating by divine or celestial means; the second, ***natural magic***, performed by the powers of nature; and the third, comprehending ***necromancy***, ***sorcery***, and *witchcraft or magic*, performed by the assistance of demons or departed men. See MAGIC.

THIBET. See TIBET.

THIGH, in anatomy. See ANATOMY, nº 58.

THINKING, a general name for any act or operation of the mind. See METAPHYSICS.

THIRLAGE. See LAW, nº clxx. 12—18.

THIRST, an uneasy sensation arising from a deficiency of the saliva to moisten the inward parts of the mouth. Hence arises a strong desire for drink; and thirst is a symptom generally attending fevers of all kinds.—Thirst is best allayed by acids; water kept a while in the mouth, then spit out, and repeated as required; a bit of bread chewed with a little water, which latter may be gradually swallowed; if the person is very hot, brandy is the best for holding in the mouth, but should be spit out again: except in fevers, large draughts of cold water are hurtful.

Preservation against Hunger and THIRST. See HUNGER.

THISTLE, a well known weed in corn fields. In Britain there are eight species of thistles according to the vulgar arrangement; the carduus lanceolatus or spear-thistle, the nutans or musk-thistle, the palustris or marsh thistle, the marianus or milk-thistle, acanthoides or welted-thistle, crispus or curled-thistle, onopordum acanthium or cotton-thistle, serratula arvensis or corn-thistle. All these, except the last, are annual or biennial, and therefore may be easily destroyed by cutting them down before their seed ripens; but the serratula arvensis is perennial, continues in the earth increasing and throwing up new shoots every year. Mr Curtis ascertained the annual increase of its root, by planting in a garden a piece of the root two inches long and about the thickness of a goose's quill, and a small head of leaves. By the 2d of November the root had extended itself eight feet, and when dug and washed it weighed four pounds.

As to the uses of the thistle, they are not well known. The corn-thistle is eaten by the ass, and formerly was pulled with great care by the farmers in some parts of Scotland as food for their horses. For a botanical description of the different kinds of thistle, see CARDUUS, CACTUS, DIPSAUS, ONOPORDUM, SERRATULA, SONCHUS.

Order of the THISTLE, or of St Andrew, a military order of knighthood in Scotland, the rise and institution of which is variously related by different authors. Lesley bishop of Ross reports, that the night before the battle between Athelstan king of Northumberland and Hungus king of the Picts, a bright cross, in form of that whereon St Andrew the tutelar saint of Scotland suffered martyrdom, appeared to Hungus; who having gained the victory, ever after bore the figure of that cross on his banners. Others affirm, that Achaius king of Scotland first instituted this order, after having made the famous league offensive and defensive with Charlemagne king of France. But though the thistle had been acknowledged as the symbol of the kingdom of Scotland from the reign of Achaius, yet

Thistle. Thomas. some refer the beginning of this order to Charles VII. of France. Others place the foundation of it as low as the year 1500.

The chief and principal ensign is a gold collar composed of thistles and sprigs of rue interlinked with amulets of gold, having pendent thereto the image of St Andrew with his cross, and the motto, NEMO ME IMPUNE LACESSIT. "No body shall provoke me with impunity."

The ordinary or common ensign worn by the knights is a star of four silver points, and over them a green circle, bordered and lettered with gold, containing the said motto, and in the centre is a thistle; all which is embroidered on their left breast, and worn with the collar, with a green riband over the left shoulder, and brought under the right arm; pendent thereto is the image of St Andrew, with his cross, in a purple robe, within an oval of gold enamelled vert, with the former motto; but sometimes they wear, encircled in the same manner, a thistle crowned.

About the time of the Reformation, this order was dropped, till James II. of Great Britain resumed it, by creating eight knights. The Revolution unsettled it again; and it lay neglected, till queen Anne, in 1703, restored it to the primitive design, of twelve knights of St Andrew.

THLASPI, BASTARD-CRESS, or *mithridate-mustard*, in botany: A genus of plants belonging to the class of *tetradynamia*, and order of *siliculosa*; and in the natural system ranging under the 39th order, *Siliquosa*. The pod is emarginated, obcordate, and polyspermous; the valves are boat-shaped and marginato-carinated. There are 12 species; of which six only are natives of Britain, the *arvense*, *hirtum*, *campestre*, *montanum*, *perfoliatum*, and *bursa pastoris*.

1. The *arvense*, treacle-mustard or penny-cress, has orbiculate pods, and leaves oblong, smooth, and scalloped. It smells like garlic, and has a white flower. 2. The *hirtum*, or perennial mithridate-mustard, has roundish hairy pods; the cauline leaves are sagittate and villous. 3. The *campestre*, or mithridate-mustard, has roundish pods, sagittate leaves, dentated and hairy. 4. *Montanum*, or mountain mithridate mustard, has obcordate pods, smooth leaves; the radical leaves somewhat fleshy, obovate and entire; the cauline embracing the stalk, and the corolla being larger than the calyx. 5. The *perfoliatum*, or perfoliate treacle-mustard, has obcordate pods; the cauline leaves are smooth and subdentate; the petals of the length of the calyx, and the stalk branchy. 6. The *bursa pastoris*, or shepherd's purse, has obcordate pods; the radical leaves are pinnatifid.

The seeds of some of these species have an acrid biting taste, approaching to that of the common mustard; with which they agree nearly in their pharmaceutic properties. They are rarely made use of any otherwise than as ingredients in the compositions whose names they bear; though some recommend them in different disorders, preferably to the common mustard. *Lewis's Materia Medica*, vol. ii. p. 429.

THOLOUSE. See TOULOUSE.

THOMÆANS, THOMISTS. See *CHRISTIANS of St Thomas*.

THOMAS AQUINAS. See AQUINAS.

St Thomas's Day, a festival of the Christian church, observed on December 21. in commemoration of St Thomas the apostle.

St Thomas of Canterbury's Day, a festival of the Romish church, observed on December 29. in memory of Thomas Becket archbishop of Canterbury, who was murdered, or, as the Romanists say, martyred, in the reign of king Henry II.

Thomas the Rhymour, called also *Thomas Lermont*, and *Thomas of Erceldon*, was born at Erceldon, a village near Melrose in Tweedale, in what year is uncertain; but he was an old man when Edward I. was carrying on war in Scotland.

The character of Lermont as a prophet, and which was common to him with Linus, Orpheus, and other early poets in many countries, arose, if we may believe Mackenyie in his Lives of Scottish Writers, from his having conferences with Eliza, a nun and prophetess at Haddington. Lermont put her predictions into verse, and thus came in for his share of the prophetic spirit. None of these ancient prophecies now remain; but the following, which pretends to be one of them, is given from a manuscript of the time of Edward I. or II. The countess of Dunbar is the lady famous for the defence of her castle against the English. Her proper title was *Countess of March*; but it was common in these times to style a nobleman from his chief residence. Thus Gilbert Strongbow, earl of Pembroke, is called *Earl of Striguil*, from his residence at Striguil castle, near Chepstow, Monmouthshire, &c. Pinkerton's Ancient Scotish Poems.

La Countesse de Donbar demande a Thomas de Essedoune, quant la guere d'Escoce prendreit fyn. E yl l'a repoundy, et dyt.

When man as mad a kyng of a capped mon.
When mon is levere other mons thyng than is owen.
When londe thouys forest, and forest ys felde.
When hares kendles othe herston.
When Wyt and Wille werres togedere.
When mon makes stables of kyrkes; and steles castles wyth styes.
When Rokesbourh nys no burgh; ant market is at Forwyleye.
When the alde is gan, and the newe is come that doue noht.
When Bambourne ys donged with dede men.
When men ledes men in ropes to buyen ant to sellen.
When a quarter of whaty whete is chaunged for a colt of ten markes.
When prude prikes, ant pees is leyd in prisoun.
When a Scot ne may hym hude ase hare in forme, that the Englysh ne shal hym fynde.
When ryht ant wrong astente the togedere.
When laddes weddeth lovedies.
When Scottes flen so faste, that for faute of ship, hy drouneth hemselve.
When shal this be?
Nouther in thine tyme, ne in myne.
Ah comen, ant gone,
Withinne twenty wynter ant on.

In fact, the prophecies of Lermont appear to have been merely traditional; nay, it seems doubtful if he ever pretended to such folly, notwithstanding Mackenyie's story of Eliza. The reverence of the people for a learned and respectable character seems to have been the sole foundation of Thomas's claim to prophecy. But, in the 16th century, prophecies were made, and ascribed to him, as well as others given to Bede, Merlin, &c. (A). They were printed at Edinburgh, 1615, reprinted 1680, and 1742.

THOMISM. See AQUINAS.

THOMSON

(A) Sibilla and Banister Anglicus are mentioned in the time of Edward IV. (MSS Cot. Dom. A IX.) A long Latin prophecy of Bridlington is there given. Waldhave and Eltraine seem also English prophets. In the whole collection, therefore, Thomas is the only Scottish one.

Thomſon.

THOMSON (James), an excellent Britiſh poet, the ſon of a Scotch divine, was born in the ſhire of Roxburgh in 1700, and was educated in the univerſity of Edinburgh with a view to the miniſtry. But his genius inclining him to the ſtudy of poetry, which he ſoon found would be incompatible with that of theology, or at leaſt might prevent his being provided for in that way in his own country, he relinquiſhed his views of engaging in the ſacred function, and repaired to London in conſequence of ſome encouragement which he had received from a lady of quality there, a friend of his mother.

The reception he met with wherever he was introduced, emboldened him to riſk the publication of his excellent poem on Winter.—This piece was publiſhed in 1726; and from the univerſal applauſe it met with, Mr Thomſon's acquaintance was courted by people of the firſt taſte and faſhion. But the chief advantage which it procured him was the acquaintance of Dr Rundle, afterward biſhop of Derry, who introduced him to the late lord chancellor Talbot; and ſome years after, when the eldeſt ſon of that nobleman was to make his tour on the continent, Mr Thomſon was choſen as a proper companion for him. The expectations which his Winter had raiſed, were fully ſatisfied by the ſucceſſive publications of the other ſeaſons; of Summer, in the year 1727; of Spring, in the following year; and of Autumn, in a quarto edition of his works, in 1730. Beſide the Seaſons, and his tragedy of Sophoniſba, written and acted with applauſe in the year 1729, he had, in 1727, publiſhed his poem to the memory of Sir Iſaac Newton, with an account of his chief diſcoveries; in which he was aſſiſted by his friend Mr Gray, a gentleman well verſed in the Newtonian philoſophy. That ſame year the reſentment of our merchants, for the interruption of their trade by the Spaniards in America, running very high, Mr Thomſon zealouſly took part in it, and wrote his Britannia, to rouſe the nation to revenge.

With the Honourable Charles Talbot, our author viſited moſt of the courts in Europe, and returned with his views greatly enlarged; not only of exterior nature and the works of art, but of human life and manners, and of the conſtitution and policy of the ſeveral ſtates, their connections, and their religious inſtitutions. How particular and judicious his obſervations were, we ſee in his poem on Liberty, begun ſoon after his return to England. We ſee at the ſame time to what a high pitch his care of his country was raiſed, by the compariſons he had all along been making of our happy government with thoſe of other nations. To inſpire his fellow-ſubjects with the like ſentiments, and ſhow them by what means the precious freedom we enjoy may be preſerved, and how it may be abuſed or loſt, he employed two years in compoſing that noble work, upon which he valued himſelf more than upon all his other writings. On his return to England with Mr Talbot (who ſoon after died), the chancellor made him his ſecretary of briefs; a place of little attendance, ſuiting his retired indolent way of life, and equal to all his wants. From this office he was removed, when death, not long after, deprived him of his noble patron. He then found himſelf reduced to a ſtate of precarious dependence. In this ſituation, having created ſome few debts, and his creditors finding that he had no longer any certain ſupport, became inexorable; and imagined by confinement to force that from his friends, which his modeſty would not permit him to aſk. One of theſe occaſions furniſhed Quin, the celebrated actor, with an opportunity of diſplaying the natural goodneſs of his heart, and the diſintereſtedneſs of his friendſhip. Hearing that Thomſon was confined in a ſpunging houſe for a debt of about 70l. he repaired to the place; and, having inquired for him, was introduced to the bard. Thomſon was a good deal diſconcerted at ſeeing Quin, as he had always taken pains to conceal his wants; and the more ſo, as Quin told him he was come to ſup with him. His anxiety upon this head was however removed, upon Quin's informing him, that, as he ſuppoſed it would have been inconvenient to have had the ſupper dreſſed in the place they were in, he had ordered it from an adjacent tavern; and, as a prelude, half a dozen of claret was introduced. Supper being over, and the bottle circulating pretty briſkly, Quin ſaid, "It is time now we ſhould balance accounts." This aſtoniſhed Thomſon, who imagined he had ſome demand upon him; but Quin perceiving it, continued, "Mr Thomſon, the pleaſure I have had in peruſing your works I cannot eſtimate at leſs than a hundred pounds, and I inſiſt upon now acquitting the debt." On ſaying this, he put down a note of that value, and took his leave, without waiting for a reply.

The profits ariſing from his works were not inconſiderable; his tragedy of Agamemnon, acted in 1738, yielded a good ſum. But his chief dependence was upon the prince of Wales, who ſettled on him a handſome allowance, and honoured him with many marks of particular favour. Notwithſtanding this, however, he was refuſed a licence for his tragedy of Edward and Eleanora, which he had prepared for the ſtage in the year 1736, for ſome political reaſons. Mr Thomſon's next performance was the Maſque of Alfred, written in the year 1740 jointly with Mr Mallet, by the command of the prince of Wales, for the entertainment of his royal highneſs's court at Cliſden, his ſummer reſidence.

Mr Thomſon's poem, entitled the Caſtle of Indolence, was his laſt work publiſhed by himſelf; his tragedy of Coriolanus being only prepared for the theatre, when a fatal accident robbed the world of one of the beſt of men and beſt of poets. He would commonly walk the diſtance between London and Richmond (where he lived) with any acquaintance that offered, with whom he might chat and reſt himſelf, or perhaps dine by the way. One ſummer evening being alone in his walk from town to Hammerſmith, he had over-heated himſelf, and in that condition imprudently took a boat to carry him to Kew; apprehending no bad conſequence from the chill air on the river, which his walk to his houſe, towards the upper end of Kew-lane, had always hitherto prevented. But now the cold had ſo ſeized him, that the next day he was in a high fever. This, however, by the uſe of proper medicines, was removed, ſo that he was thought out of danger; till the fine weather having tempted him to expoſe himſelf once more to the evening dews, his fever returned with violence, and with ſuch ſymptoms as left no hopes of a cure. His death happened on the 27th of Auguſt 1748.

Mr Thomſon had improved his taſte upon the fineſt originals, ancient and modern. The autumn was his favourite ſeaſon for poetical compoſition, and the deep ſilence of the night he commonly choſe for his ſtudies. The amuſement of his leiſure-hours were civil and natural hiſtory, voyages, and the beſt relations of travellers. Though he performed on no inſtrument, he was paſſionately fond of muſic, and would ſometimes liſten a full hour at his window to the nightingales in Richmond gardens; nor was his taſte leſs exquiſite in the arts of painting, ſculpture, and architecture. As for the more diſtinguiſhing qualities of his mind and heart, they beſt appear in his writings. There his devotion to the Supreme Being, his love of mankind, of his country, and friends, ſhine out in every page; his tenderneſs of heart was ſo unbounded, that it took in even the brute creation. It is not known, that through his whole life he ever gave any perſon a moment's pain, either by his writings

writings or otherwise. He took no part in the political squabbles of his time, and was therefore respected and left unmolested by both sides. These amiable virtues did not fail of their due reward; the applause of the public attended all his productions, and his friends loved him with an enthusiastic ardour.

"As a writer (says Dr Johnson), he is intitled to one praise of the highest kind; his mode of thinking, and of expressing his thoughts, is original. His blank verse is no more the blank verse of Milton, or of any other poet, than the rhymes of Prior are the rhymes of Cowley. His numbers, his pauses, his diction, are of his own growth, without transcription, without imitation. He thinks in a peculiar train, and he thinks always as a man of genius; he looks round on Nature and on life with the eye which Nature bestows only on a poet; the eye that distinguishes, in every thing presented to its view, whatever there is on which imagination can delight to be detained, and with a mind that at once comprehends the vast, and attends to the minute. The reader of the Seasons wonders that he never saw before what Thomson shews him, and that he never yet has felt what Thomson impresses."

His testamentary executors were the lord Lyttelton, whose care of our poet's fortune and fame ceased not with his life; and Mr Mitchell, a gentleman equally noted for the truth and constancy of his private friendship, and for his address and spirit as a public minister. By their united interests, the orphan play of Coriolanus was brought on the stage to the best advantage; from the profits of which, and the sale of manuscripts and other effects, a handsome sum was remitted to his sisters. His remains were deposited in the church of Richmond, under a plain stone, without any inscription. A handsome monument was erected to him in Westminster abbey in the year 1762, the charge of which was defrayed by the profits arising from a splendid edition of all his works in 4to; Mr Millar the bookseller, who had purchased all Mr Thomson's copies, giving up his property on this grateful occasion. A monument has also been erected to him at the place of his birth.

THOR, the eldest and bravest of the sons of Odin and Frea, was, after his parents, the greatest god of the Saxons and Danes while they continued heathens. They believed, that Thor reigned over all the aerial regions, which composed his immense palace, consisting of 540 halls; that he launched the thunder, pointed the lightening, and directed the meteors, winds, and storms. To him they addressed their prayers for favourable winds, refreshing rains, and fruitful seasons; and to him the fifth day of the week, which still bears his name, was consecrated.

Henry's History of Great Britain, part 4.

THORAX. See Anatomy.

White or Haw THORN. See Cratægus.

Thorn, a town of Poland, in Regal Prussia, and in the palatinate of Culm. It was formerly a Hanseatic town, and still enjoys great privileges; is large and well fortified; but part of the fortifications, and a great number of houses, were ruined by the Swedes in 1703. It is seated on the Vistula, and contains 10,000 inhabitants. E. Long. 18. 42. N. Lat. 53. 6.

THORNBACK, in ichthyology. See Raia.

THORNHILL (Sir James), an eminent English painter, was born in Dorsetshire in 1676, of an ancient family; but was constrained to apply to some profession by the distresses of his father, who had been reduced to the necessity of selling his family estate. His inclination directed him to the art of painting: and on his arrival at London he applied to his uncle, the famous Dr Sydenham, who enabled him to proceed in the study of the art under the direction of a painter who was not very eminent. However, the genius of Thornhill made ample amends for the insufficiency of his instructor, and by an happy application of his talents he made so great a progress, that he gradually rose to the highest reputation.

Dictionary of Painters.

His genius was well adapted to historical and allegorical compositions; he possessed a fertile and fine invention; and he sketched his thoughts with great ease, freedom, and spirit. He excelled also equally in portrait, perspective, and architecture; shewed an excellent taste for design, and had a free and firm pencil. Had he been so fortunate as to have studied at Rome and Venice, to acquire greater correctness at the one, and a more exact knowledge of the perfection of colouring at the other, no artist among the moderns might perhaps have been his superior. Nevertheless, he was so eminent in many parts of his profession, that he must for ever be ranked among the best painters of his time; and his performances in the dome of St Paul's church at London, in the hospital at Greenwich, and at Hampton-court, are such public proofs of his merit as will convey his name to posterity with great honour.

This painter lived in general esteem; he enriched himself by the excellence of his works; was appointed state-painter to Queen Anne, from whom he received the honour of knighthood; had the singular satisfaction to repurchase his family estate; and was so much distinguished as to be elected one of the members of parliament. He died in 1732.

THOROUGH-wax, in botany. See Bupleurum.

THOTH, or Theut, (called by the Phœnicians *Taaut*, by the Greeks *Hermes*, and by the Romans *Mercury*), was a Phœnician of very superior talents, and one of the civilizers of mankind. He was prime minister to Osiris, whom, after his death, he deified; and he was himself deified by his countrymen the Egyptians, for the benefits that he had rendered to the human race. See Mercury, Mythology, n° 34, and Polytheism, n° 18.

THOUGHT, a general name for all the ideas consequent on the operations of the mind, and even on the operations themselves. See Metaphysics.

Thought, in composition. See Oratory, Part I. and II.

THOUINIA, in botany; a genus of plants belonging to the class of *diandria*, and order of *monogynia*. The corolla is quadripetalous; the calyx quadripartite, and the antheræ sessile. There is only one species discovered, the *nutans*.

THRACE, a country very frequently mentioned by the Greek and Latin writers, deriving its name, according to Josephus, from Tiras one of the sons of Japhet. It was bounded on the north by mount Hæmus; on the south, by the Ægean Sea; on the west, by Macedon and the river Strymon; and on the east, by the Euxine Sea, the Hellespont, and the Propontis.—The Thracian Chersonesus is a peninsula inclosed on the south by the Ægean Sea, on the west by the gulf of Melas, and on the east by the Hellespont; being joined on the north to the continent by a neck of land about 37 furlongs broad. The inland parts of Thrace are very cold and barren, the snow lying on the mountains the greatest part of the year; but the maritime provinces are productive of all sorts of grain and necessaries for life; and withal so pleasant, that Mela compares them to the most fruitful and agreeable countries of Asia.

The ancient Thracians were deemed a brave and warlike nation, but of a cruel and savage temper; being, according to the Greek writers, strangers to all humanity and good-nature. It was to the Thracians, however, that the Greeks were chiefly indebted for the polite arts that flourished among them; for Orphæus, Linus, Musæus, Thamyris, and Eumolpus, all Thracians, were the first, as Eustathius informs us, who charmed the inhabitants of Greece with their

eloquence

[…]shing eloquence and melody, and persuaded them to exchange their fierceness for a sociable life and peaceful manners; nay, great part of Greece was anciently peopled by Thracians. Tereus, a Thracian, governed at Daulis in Phocis, where the tragical story of Philomela and Progne was acted. From thence a body of Thracians passed over to Eubœa, and possessed themselves of that island. Of the same nation were the Aones, Tembices, and Hyanthians, who made themselves masters of Bœotia; and great part of Attica itself was inhabited by Thracians, under the command of the celebrated Eumolpus. It is not therefore without the utmost ingratitude and injustice that the Greeks style them *Barbarians*, since to them chiefly they were indebted both for the peopling and polishing of their country.

Thrace was anciently divided into a number of petty states, which were first subdued by Philip of Macedon. On the decline of the Macedonian empire, the country fell under the power of the Romans. It continued under subjection to them till the irruption of the Turks, in whose hands it still remains.

THRASHING, in agriculture, the operation by which corn is separated from the straw. This operation is performed in a variety of ways, sometimes by the feet of animals, sometimes by a flail, and sometimes by a machine.

The most ancient method of separating the corn from the straw was by the hoofs of cattle or horses. This was practised by the Israelites, as we find from the books of Moses; it was also common among the Greeks and Romans *. Flails and thrashing machines were also not uncommon among these nations †. The flail which was used by the Romans, called *baculus*, *fustis*, or *pertica*, was probably nothing more than a cudgel or pole. The thrashing machine, which was called *tribula* or *tribulum*, and sometimes *traha*, was a kind of sledge made of boards joined together, and loaded with stone or iron. Horses were yoked to this machine, and a man was seated upon it to drive them over the sheaves of corn.

[…]liny, l. 30. […]gil, […]rg. iii. […]Col. i. Tibull. 21. […]iah i. 27. […]ner, Il. 495.

Different methods are employed in different countries for separating the corn from the stalk. In the greatest part of France the flail is used; but in the southern districts it is generally performed by the feet of animals: animals are also used for the same purpose in Spain, in Italy, in the Morea, in the Canaries, in China, and in the vicinity of Canton, where the flail is also sometimes used. It appears that in hot climates the grains do not adhere so firmly to the stalk as in cold countries, and therefore may be more easily separated. This will explain the reason why animals are so frequently employed in hot countries for treading out the corn; whereas in cold climates we know they are seldom tried, and have no reason to suppose that they would answer the purpose. In the Isle of France in Africa, rice and wheat are thrashed with poles, and maize with sticks; for it has not been possible to teach the negroes the use of the flail.

The animals used for treading out corn are, oxen, cows, horses, mules, and even asses when the quantity is not great. The operation is performed in this manner: The sheaves, after being opened, are spread in such a manner that the ears of the corn are laid as much uppermost as possible, and a man, standing in the centre, holds the halters of the cattle, which are made to trot round as in a manege; whilst other men with forks shake the straw up from time to time, and the cattle are trotted over it again and again till they have beaten out all the grain. This method is expeditious enough; but besides bruising a considerable quantity of corn, it requires a great many cattle, and injures the legs of the horses and m[…], which are preferred before cows and oxen for this work.

The flail is undoubtedly a much better instrument for thrashing corn than the feet of animals, for it separates the grain from the straw and husks both more effectually and more expeditiously; yet it is liable to many objections. It is a very laborious employment, too severe indeed even for a strong man; and as it is usually the interest of the thrasher rather to thrash much than to thrash clean, a good deal of corn will generally be left upon the straw. It is therefore an object of great importance in husbandry to procure a proper machine for separating the corn from the straw.

Thrashing.

The first thrashing machine attempted in modern times, of which we have received any account, was invented in Edinburgh by Mr Michael Menzies about the year 1732. It consisted of a number of instruments like flails, fixed in a moveable beam, and inclined to it at an angle of ten degrees. On each side of the beam in which the flails were fixed, floors or benches were placed for spreading the sheaves on. The flails were moved backwards and forwards upon the benches by means of a crank fixed on the end of an axle, which made about 30 revolutions in a minute.

The second thrashing machine was invented by Mr Michael Stirling, a farmer in the parish of Dunblane, Perthshire. Of this discovery we have received a very accurate and authentic account from his son, the Reverend Mr Robert Stirling minister of Crieff.

It is an old proverb, that necessity is the mother of invention. This was verified on the present occasion. Besides his ordinary domestic servants, Mr M. Stirling had occasion sometimes to hire an additional number to thrash out his grain, and frequently found it difficult to procure so many as he needed. This naturally led him to reflect whether the operation of thrashing could not easily be performed by machinery. Accordingly, so early as the year 1753, under the pretence of joining in the amusements of his children, he formed in miniature a water mill, in which two iron springs, made to rise and fall alternately, represented the motion of two flails, by which a few stalks of corn put under them might be speedily thrashed. This plan he executed on a scale sufficiently large within two years after, making the springs about ten feet long, each of which had one end firmly screwed into a solid plank, and the other terminated in a round batoon of solid iron, two feet long and above an inch in diameter. Under these the sheaves were conveyed gradually forward in a narrow channel or trough, by passing between two indented horizontal cylinders, similar to those now used in most of the thrashing mills in that part of the country, and called *feeders*. In this manner the thrashing was executed completely, and with considerable rapidity; but as the operation was performed on a low floor, and no method contrived for carrying off the straw, the accumulation of it produced such confusion, and the removal of it was attended with such danger, that this scheme was very soon entirely abandoned. The mortification arising from disappointment, and especially the scoffs of his neighbours, for what was universally accounted an absurd and ridiculous attempt, served only to stimulate the exertions of the inventor to accomplish his designs on another plan.

Laying aside therefore the iron springs with the feeders, and all the apparatus adapted to them, he retained only an outer or water wheel, with an inner or cog wheel moving on the same axle; to this inner wheel, which had 48 teeth or cogs, he applied a vertical trundle or pinion, with seven notches, the axle of which passed through a floor above the wheel, and having its upper pivot secured in a beam six feet above that floor. At the distance of three feet three inches above the floor two straight pieces of squared wood, each four feet long, passed through the axle of the trundle at right angles, forming four arms, to be moved round horizontally. To the extremities of these arms were fixed

 four

Thrashing. four iron plates, each 20 inches long, and eight broad at the end next the arms but tapering towards a point at the other end. This large horizontal fly, constituting four thrashers, was inclosed within a wooden cylindrical box three and an half feet high and eight in diameter. On the top of the box was an opening or port (two or three ports were made at first, but one was found sufficient) eight inches wide, and extending from the circumference a foot and an half towards its centre, through which the corn sheaves descended, being first opened and laid one by one on a board with two ledges gently declining towards the port; on which board they were moderately pressed down with a boy's hand, to prevent them from being too hastily drawn in by the repeated strokes of the thrashers. Within the box was an inclined plane, along which the straw and grain fell down into a wide wire riddle two feet square, placed immediately under a hole of nearly the same size. The riddle received a jerk at every revolution of the spindle from a knob placed on the side of it, and was instantly thrust backward by a small spring pressing it in the opposite direction. The short straw, with the grain and chaff which passed through the wide riddle, fell immediately into an oblong strait riddle, which hung with one end raised and the other depressed, and was moved by a contrivance equally simple as the other; and having no ledge at the lower end, the long chaff which could not pass through the riddle dropped from thence to the ground; while the grain and most of the chaff falling through the riddle into a pair of common barn-fanners that stood under it on the ground floor, the strong grain, the weak, and the chaff, were all separated with great exactness. The fanners were moved by a rope or band running circuitously in a shallow niche cut on the circumference of the cog-wheel. The straw collected gradually in the bottom of the box over the wide riddle, and through an opening two and an half feet wide, and as much in height, left in that side of the box nearest the brink of the upper floor, was drawn down to the ground with a rake by the person or persons employed to form it into sheaves or rolls.

Such was the thrashing mill invented by Mr Michael Stirling, which, after various alterations and improvements, he completed in the form now described, A. D. 1758. By experiment it was found that four bolls of oats, Linlithgow measure, could be thrashed by it in 25 minutes. From that period he never used a common flail in thrashing, except for humbling or bearding barley. In every other kind of grain he performed the whole operation of thrashing with the mill; and continued always to use it till 1772, when he retired from business, and his thrashing mill became the property of his second son, who continues to use it with equal advantage and satisfaction. Several machines were constructed on the same plan, particularly one near Stirling, under Mr Stirling's direction, for Mr Moir of Leckie, in 1765, which, we understand, has been used ever since, and gives complete satisfaction to the proprietor. There was another erected in 1778 by Mr Thomas Keir (in the parish of Muthil and county of Perth), who has contrived a method of bearding barley with it: and by the addition of a small spindle with short arms contiguous to the front of the box, and moved by a band common to it and the great spindle to which it is parallel, the straw is shaken and whirled out of the box to the ground. That this machine did not come immediately into general use, was owing partly to the smallness of the farms in that part of the country, whose crops could easily be thrashed by the few hands necessarily retained on them for other purposes; and chiefly to an apprehension that the machine could only be moved by water; an apprehension which experience proves to be entirely groundless. The machine however, was, ingenious, and did great credit to the worthy inventor, and certainly deserved a better fate than it was destined to undergo.

A third threshing mill was invented in 1772, by two persons nearly about the same time, and upon the same principles. The inventors were, Mr Alderton who lived near Alnwick, and Mr Smart at Wark in Northumberland. The operation was performed by rubbing. The sheaves were carried round between an indented drum of about six feet diameter, and a number of indented rollers arranged round the circumference of the drum, and attached to it by means of springs; so that while the drum revolved, the fluted rollers rubbed the corn off from the straw by rubbing against the flutings of the drum. But as a considerable quantity of the grain was bruised in passing between the rollers, the machine was soon laid aside.

In 1776 an attempt was made by Mr Andrew Meikle, an ingenious millwright in the parish of Tyningham, East Lothian, to construct a new machine upon the principles which had been adopted by Mr Menzies already mentioned. This consisted in making joints in the flails, which Mr Menzies had formed without any. But this machine, after much labour and expence, was soon laid aside, on account of the difficulty of keeping it in repair, and the small quantity of work performed, which did not exceed one boll or six Winchester bushels of barley *per* hour.

Some time after this, Mr Francis Kinloch, then junior of Gilmerton, having visited the machine invented in Northumberland, attempted an improvement upon it. He inclosed the drum in a fluted cover; and instead of making the drum itself fluted, he fixed upon the outside of it four fluted pieces of wood, which by means of springs could be raised a little above the circumference of the drum, so as to press against the fluted covering, and thus rub off the ears of corn as the sheaves passed round between the drum and the fluted covering. But not finding this machine to answer his expectation (for it bruised the grain in the same manner as the Northumberland machine did), he sent it to Mr Meikle, that he might, if possible, rectify its errors.

Mr Meikle, who had long directed his thoughts to this subject, applied himself with much ardour and perseverance to the improvement and correction of this machine; and after spending a good deal of time upon it, found it was constructed upon principles so erroneous, that to improve it was impracticable.

At length, however, Mr Meikle's own genius invented a model, different in principle from the machines which had already been constructed. This model was made in the year 1785; and in the following year the first thrashing machine, on the same principles was erected in the neighbourhood of Alloa, in the county of Stirling, by Mr George Meikle the son of the inventor. This machine answered completely the wishes of Mr Stein, the gentleman for whom it was erected, who gave the most ample testimony of his satisfaction both to the inventor and to the public. The fame of this discovery soon spread over the whole country, and a great many farmers immediately applied to Mr Meikle, desiring to have thrashing mills erected on their farms. The discovery, it appeared, would be profitable, and it was reasonable that the inventor should enjoy the profits of his invention. He accordingly applied for a patent; which, after considerable expence, arising from the opposition of some persons, who claimed a share in the discovery, was granted.—These machines are now becoming very common in many parts of Scotland, and are increasing very considerably in number every year over all the united kingdom.

We will now endeavour to describe this machine in its most improved state; which is so simple, that with the assistance

Thrashing. ance of a plate, exhibiting the plan of elevation, n° 1. the ground plan, n° 2. and the 3d showing its essential parts in a distinct manner, we hope it will be easily understood by all our readers who have not had an opportunity of seeing it. The power employed for turning that part of the machine which separates the corn from the straw is produced by four wheels (when moved by horses), the teeth of which move in one another and turn the drum, on which four scutchers are fixed. The sheaves are introduced between two fluted rollers, which hold them firm, and draw them in gradually, while the scutchers strike off the grain from the straw as it passes through. This will suffice for a general idea of this machine. We will now be more particular.

Plate VIII.

The large spur-wheel A, n° 1. and 2. which has 276 cogs, is horizontal, and moves the pinion B, which has 14 teeth. The pinion B moves the crown wheel C, which has 84 teeth; the wheel C moves a second pinion D, which has 16 teeth; and the pinion D moves the drum HIKL. The drum is a hollow cylinder three feet and an half diameter, and placed horizontally; on the outside of which the scutchers are fixed by strong screw bolts. The scutchers consist of four pieces of wood, faced on one side with a thin plate of iron, placed at an equal distance from each other, and at right angles to the axis of the drum.

The sheaves are spread on an inclined board F, n° 3. from which they are introduced between two fluted rollers GG made of cast iron, about three inches and an half in diameter, and making about 35 revolutions in a minute. As these rollers are only about three quarters of an inch distant from the scutchers or leaves of the drum HIKL, they serve to hold the sheaves fast, while the scutchers *a*, *b*, *c*, *d*, moving with prodigious velocity, separate the grain completely from the straw, and at the same time throw out both grain and straw upon the concave rack M, lying horizontally with slender parallel ribs, so that the corn passes through them into a hopper N placed below. From the hopper it passes through a harp or riddle O into a pair of fanners P, from which, in the most improved machines, it comes out clean and fit for the market. The straw, after being thrown by the scutchers *a*, *b*, *c*, *d*, into the rack, is removed from it by a rake QRST into a place contiguous V. The rake consists of four thin pieces of wood or leaves; on the end of each of these leaves is ranged a row of teeth *e*, *f*, *g*, *h* five inches long. The rake moves in a circular manner in the concave rack, while the teeth catch hold of the straw, and throw it out of the rack. These are all the essential parts of the machine; the rest may be easily understood by the references to the Plate. W is the horse-course, n° 1, which is 27 feet diameter. X is the pillar for supporting the beams on which the axle of the spur-wheel is fixed. YYY are three spindles for moving the two fluted rollers, the rake, and fanners. To the description now given we have only to add, that the drum has a covering of wood Z at a small distance above it, for the purpose of keeping the sheaves close to the scutchers.

The advantages of this machine are many. As the drum makes 300 revolutions in a minute, the four scutchers together make 1200 strokes in the same space of time. From such power and velocity, it is evident that much work must be performed. When the horses go at the rate of two and one third miles *per* hour, from three to six bolls will be thrashed; but as the quantity thrashed will be less when the straw is long than when it is short, we shall take the average at four bolls. One gentleman, whose veracity and accuracy we can depend on, assures us, that his mill thrashed 63 bolls in a day; by which, we suppose, he meant 10 hours. To prove the superior advantage of this machine to the common method of thrashing with flails, a gentleman ordered two equal quantities of oats to be thrashed by the mill and by flails. When the corn was cleaned and measured, he obtained $\frac{1}{18}$th more from the sheaves thrashed by the mill than from those thrashed by the flail. We are also informed by another gentleman who has studied this machine with much attention, and calculated its advantages with care, that, independently of having the corn much cleaner separated from the straw than is usually done by flails, there is a saving of 30 or 40 *per cent.* in the expence of thrashing. Thrashing || Thread.

The number of persons requisite for attending the mill when working is six: One person drives the horses; a second hands the sheaves to a third, who unties them, while a fourth spreads them on the inclined boards and presses them gently between the rollers; a fifth person is necessary to riddle the corn as it falls from the fanners, and a sixth to remove the straw (A).

This machine can be moved equally well by water, wind, or horses. Mr Meikle has made such improvements on the wind mill as to render it much more manageable and convenient than formerly; and we are informed many wind-mills are now erecting in different parts of the country. As to the comparative expence of these different machines, the erection of the horse machine is least; but then the expence of employing horses must be taken into consideration. One of this kind may be erected for L. 70. A water mill will cost L. 10 more on account of the expence of the water-wheel. A wind-mill will cost from L. 200 to L. 300 Sterling.

THRAVE *of* CORN, an expression denoting 24 sheaves, or four shocks of six sheaves to the shock; though in some countries they only reckon 12 sheaves to the thrave.

THRASYBULUS, a renowned Athenian general and patriot, the deliverer of his country from the yoke of the 30 tyrants, lived about 294 B. C*.

* See *Athens*, n° 199—174.

THRASYMENUS LACUS (anc. geog.), a lake of Etruria, near Perusia, and not far from the Tiber, fatal to the Romans in the Punic war. Now *Il Lago de Perugia* on the Ecclesiastical State.

THREAD, a small line made up of a number of fine fibres of any vegetable or animal substance, such as flax, cotton, or silk; from which it takes its name of linen, cotton, or silk thread.

Dyeing THREAD *Black*. Linen and cotton thread may be dyed of a durable and deep black by solution of iron in sour beer, in which the linen is to be steeped for some time, and afterwards boiled in madder. See the article DYEING, n° 87.

Thread may be easily bleached by the oxygenated muriatic acid discovered by Mr Scheele. This acid whitens cloth remarkably well, but it is still more advantageous for bleaching thread. M. Welter has formed at Lisle, with two partners, an establishment for bleaching thread with great success, and he has already begun some others. He has

(A) We add, on the authority of an experienced farmer, that of the six persons necessary to attend the thrashing machine, only two can in justice be charged to the account of the machine; namely, the person who manages the horses, and the one who feeds the machine: For in the usual mode of thrashing by the flail, it requires the same number of persons as the thrashing machine does to clear an equal quantity of corn from the chaff in the same time.

has found that 10 or 12 leys and as many immerſions are required for ſome ſorts of thread; and that the thread may be ſurrounded with the liquor, it is neceſſary to place it, quite looſely, in a baſket, which permits the liquor to penetrate to all its ſurfaces: when the liquor is much weakened, it is ſtill fit to be uſed for the bleaching of cotton.

Thoſe who wiſh more information upon the powerful effects of the oxygenated muriatic acid in bleaching, as well as on the cheapeſt method of preparing it, may conſult a Paper written by M. Berthollet, and publiſhed in the *Annales de Chimie*, a tranſlation of which is given in the *Repert. of Arts*, vol. i.

THREATENING LETTERS. Knowingly to ſend any letter without a name, or with a fictitious name, demanding money, or any other valuable thing, or threatening (without any demand) to kill or fire the houſe of any perſon, is made felony without benefit of clergy. And ſending letters, threatening to accuſe any perſon of a crime puniſhable with death, tranſportation, pillory, or other infamous puniſhment, with a view to extort from him any money or other valuable chattels, is puniſhable by ſtatute 30 Geo. II. c. 24. at the diſcretion of the court, with fine, impriſonment, pillory, whipping, or tranſportation for ſeven years.

THRESHING. See THRASHING.

THRIFT, in botany. See STATICE.

THRINAX, SMALL JAMAICA FAN-PALM, in botany; a genus of plants belonging to the natural claſs of *palmæ*, and order of *flabellifoliæ*. The calyx is ſexdentate; there is no corolla; there are ſix ſtamina; the ſtigma is emarginate, and the berry monoſpermous. This plant was brought from Jamaica to Kew garden by Dr William Wright.

THRIPS, a genus of inſects belonging to the order of *hemiptera*. The roſtrum is obſcure, or ſo ſmall as to be ſcarce perceptible. The antennæ are filiform, and as long as the thorax. The body is ſlender, and of equal thickneſs in its whole length. The abdomen is reflexible, or bent upwards. The four wings are extended, incumbent upon the back of the inſect, narrow in proportion to their length, and croſs one another at ſome diſtance from their baſe. The tarſi of the feet are compoſed of only two articulations.

There are eleven ſpecies mentioned by Gmelin; of which three are natives of Britain; the phyſapus, juneperina, and faſciata.

THROAT, the anterior part of an animal, between the head and the ſhoulders.

THROAT-WORT. See CAMPANULA.

THRONE, a royal ſeat or chair of ſtate, enriched with ornaments of architecture and ſculpture, raiſed on one or more ſteps, and covered with a kind of canopy. Such are the thrones in the rooms of audience of kings and other ſovereigns.

THROSTLE, in ornithology. See TURDUS.

THRUSH, in ornithology. See TURDUS.

THRUSH, or *Aphtha*. See MEDICINE, n° 233.

THRYALLIS, in botany; a genus of plants belonging to the claſs of *decandria*, and order of *monogynia*; and in the natural ſyſtem ranging under the 38th order, *Tricoccæ*. The calyx is quinquepartite; there are five petals, and the capſule is tricoccous. There is only one ſpecies known, the *braſilienſis*.

THUANUS (Jacobus Auguſtus), youngeſt ſon of the preſident de Thou, was famous for the depth and erudition of his works. He was born in 1553; and having finiſhed his ſtudies and travels, was made preſident a-Mortier, and took poſſeſſion thereof in 1595. He was employed in ſeveral important offices of ſtate, and in reforming the univerſity of Paris; which he diſcharged with ſo much prudence, that he was eſteemed the Cato of his age, and the ornament of France. He wrote the hiſtory of his own time in Latin, from the year 1543 to 1608, in 138 books; a work, both for ſubject and ſtyle, worthy of the ancients. He alſo left memoirs of his own life, beſides poems; and died at Paris, 1617.

THUCYDIDES, a celebrated Greek hiſtorian, was born at Athens 471 B. C. He was the ſon of Olorus, and grandſon of Miltiades, who is thought to have been deſcended from Miltiades the famous Athenian general, and to have married the king of Thrace's daughter. He was educated in a manner ſuitable to his quality, that is, in the ſtudy of philoſophy and eloquence. His maſter in the former was Anaxagoras, in the latter Antiphon; one, by his deſcription in the eighth book of his Hiſtory, for power of ſpeech almoſt a miracle, and feared by the people on that account. Suidas and Photius relate, that when Herodotus recited his hiſtory in public, a faſhion in uſe then and many ages after, Thucydides felt ſo great a ſting of emulation, that it drew tears from him; inſomuch that Herodotus himſelf took notice of it, and congratulated his father on having a ſon who ſhowed ſo wonderful an affection to the Muſes. Herodotus was then 29 years of age, Thucydides about 16.

When the Peloponeſian war began to break out, Thucydides conjectured truly, that it would prove a ſubject worthy of his labour; and it no ſooner commenced than he began to keep a journal. This explains the reaſon why he has attended more to chronological order than to unity of deſign. During the ſame war he was commiſſioned by his countrymen to relieve Amphipolis; but the quick march of Braſidas the Lacedæmonian general defeated his operations; and Thucydides, unſucceſsful in his expedition, was baniſhed from Athens. This happened in the eighth year of this celebrated war; and in the place of his baniſhment the general began to write an impartial hiſtory of the important events which had happened during his adminiſtration, *Lempriere's Dictionary.* and which ſtill continued to agitate the ſeveral ſtates of Greece. This famous hiſtory is continued only to the 21ſt year of the war, and the remaining part of the time till the demolition of the walls of Athens was deſcribed by the pen of Theopompus and Xenophon. Thucydides wrote in the Attic dialect, as being poſſeſſed of moſt vigour, purity, elegance, and energy. He ſpared neither time nor money to procure authentic materials; and the Athenians, as well as their enemies, furniſhed him with many valuable communications, which contributed to throw great light on the different tranſactions of the war. His hiſtory has been divided into eight books; the laſt of which is imperfect, and ſuppoſed to have been written by his daughter.

The hiſtorian of Halicarnaſſus has often been compared with the ſon of Olorus, but each has his peculiar excellence. Sweetneſs of ſtyle, grace and elegance of expreſſion, may be called the characteriſtics of the former; while Thucydides ſtands unequalled for the fire of his deſcriptions, the conciſeneſs, and at the ſame time the ſtrong and energetic manner of his narratives. His relations are authentic, as he himſelf was intereſted in the events he mentions; his impartiality is undubitable, as he nowhere betrays the leaſt reſentment againſt his countrymen, and the factious partizans of Cleon, who had baniſhed him from Athens. The hiſtory of Thucydides was ſo admired by Demoſthenes, that he tranſcribed it eight different times, and read it with ſuch attention, that he could almoſt repeat it by heart. Thucydides died at Athens, where he had been recalled from his exile about 411 years before Chriſt.

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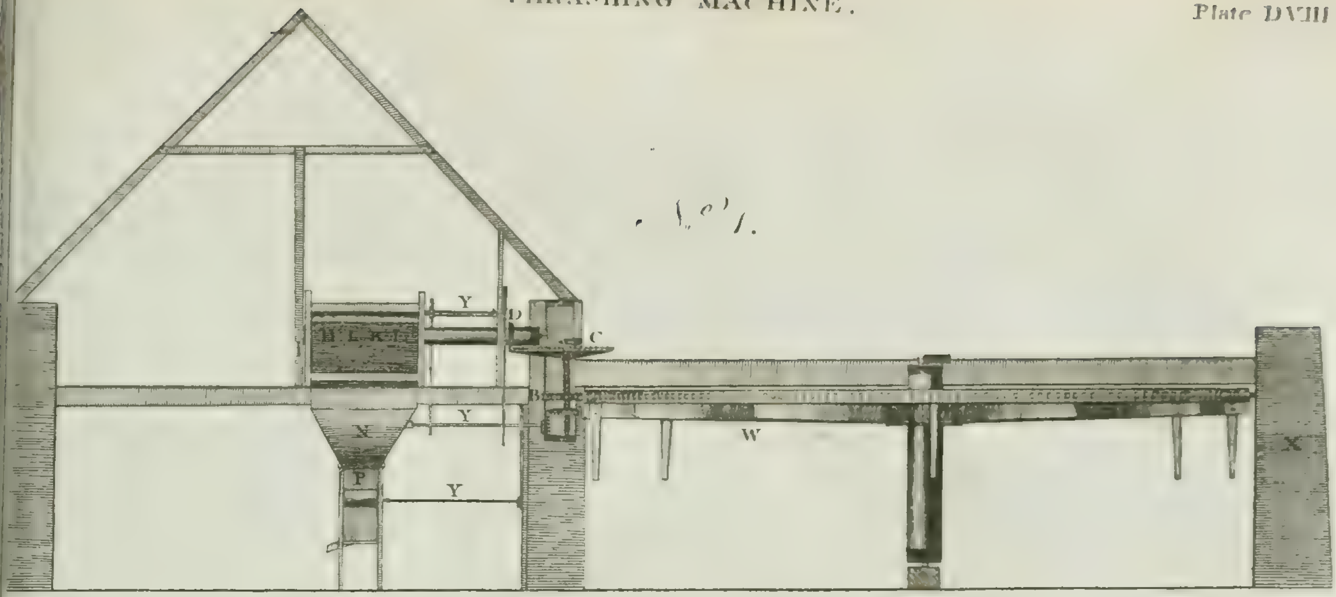

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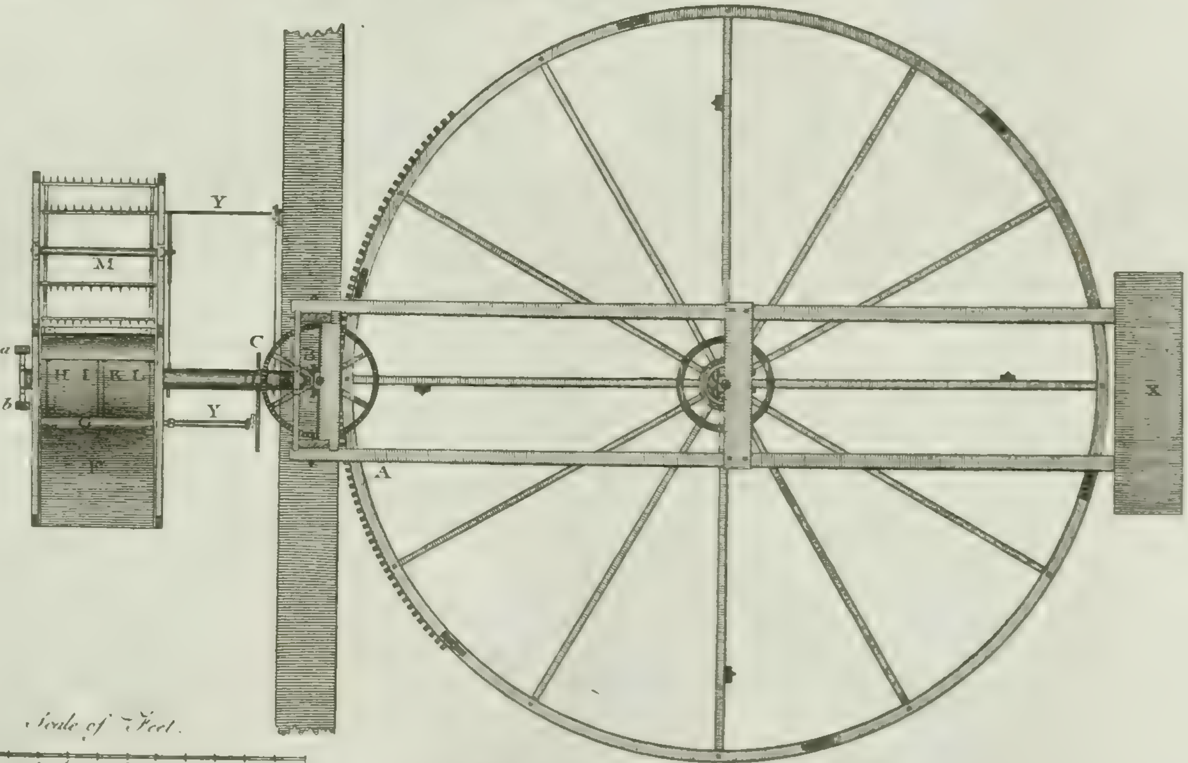

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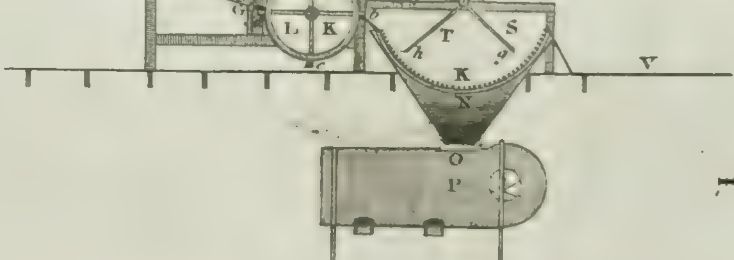

Scale of Feet.

A. Bell Prin. Pal. Sculptor fecit

The beſt edition of Thucydides is that of Oxford, publiſhed in 1696, folio, and that of Duker, publiſhed at Amſterdam in 1731, folio.

THUJA, the ARBOR VITÆ, in botany: A genus of plants belonging to the claſs of *monodelphia*, and order of *monœcia*; and in the natural ſyſtem ranging under the 51ſt order, *Coniferæ*. There are four ſpecies known; the orientalis, occidentalis, apylla, and dolabrata; of which the two firſt are moſt remarkable.

The *occidentalis*, or common arbor vitæ, grows naturally in Canada, Siberia, and other northern countries. In ſome of the Engliſh gardens a few of theſe trees are to be met with of a large ſize: it has a ſtrong woody trunk, which riſes to the height of 40 feet or more. The bark, while young, is ſmooth, and of a dark brown colour; but as the trees advance, the bark becomes cracked, and leſs ſmooth. The branches are produced irregularly on every ſide, ſtanding almoſt horizontal, and the young ſlender ſhoots frequently hang downward, thinly garniſhed with leaves; ſo that when the trees are grown large they make but an indifferent appearance. The young branches are flat, and their ſmall leaves lie imbricated over each other like the ſcales of a fiſh; the flowers are produced from the ſide of the young branches pretty near to the foot-ſtalk; the male flowers grow in oblong catkins, and between theſe the female flowers are collected in form of cones. When the former have ſhed their farina, they ſoon after drop off; but the female flowers are ſucceeded by oblong cones, having obtuſe ſmooth ſcales, containing one or two oblong ſeeds. The leaves of this tree have a rank oily ſcent when bruiſed.

2. The *orientalis*, or China arbor vitæ, grows naturally in the northern parts of China, where it riſes to a conſiderable height; but this has not been long enough in Europe to have any trees of large ſize. The ſeeds of this ſort were firſt ſent to Paris by ſome of the miſſionaries; and there are ſome of the trees growing in the gardens of the curious there, which are more than 20 feet high. The branches of this ſort grow cloſer together, and are much better adorned with leaves, which are of a brighter green colour, ſo make a much better appearance than the other, and being very hardy, it is eſteemed preferable to moſt of the evergreen trees with ſmall leaves, for ornament in gardens. The branches of this tree croſs each other at right angles: the leaves are flat; but the ſingle diviſions of the leaves are ſlender, and the ſcales are ſmaller and lie cloſer over each other than thoſe of the firſt ſort. The cones are alſo much larger, and of a beautiful grey colour; their ſcales end in acute reflexed points.

Theſe trees are propagated by ſeeds, layers, or cuttings.

THULE, or THYLÆ, (anc. geog.), an iſland in the moſt northern parts of the German Ocean. Its ſituation was never accurately aſcertained by the ancients, hence its preſent name is unknown by modern hiſtorians. Some ſuppoſe that it is the iſland now called Iceland, or part of Greenland, and others that it was *Foula*. See FOULA.

THUMB, in anatomy, one of the extremities of the hand.

THUMB-Cap, an iſland in the South Sea, lies about ſeven leagues north-weſt of Lagoon-iſland; it is a low, woody iſland, of a circular form, and not much above a mile in compaſs. There was no appearance of inhabitants; the land was covered with verdure of many hues.

THUMMIM. See URIM.

THUNBERGIA, in botany; a genus of plants belonging to the claſs of *didynamia*, and order of *angioſpermia*. The calyx is double; the exterior one is diphyllous, and the interior one multipartite. The capſule is globoſe, beaked, and bilocular. There is only one ſpecies known, the *capenſis*.

THUNDER, the noiſe occaſioned by the exploſion of a flaſh of lightning echoed back from the inequalities on the ſurface of the earth, in like manner as the noiſe of a cannon is echoed, and in particular circumſtances forms a rolling lengthened ſound.

Although *thunder*, properly ſpeaking, is only a mere ſound, capable of producing very little effect, yet the word is generally ſuppoſed to include the phenomena of lightning alſo; and electrified clouds are by univerſal conſent called *thunder-clouds*, and the exploſions of many flaſhes of lightning proceeding from them are generally called *thunder-ſtorms*. Though the phenomena of lightning, therefore, have been at a great length explained and accounted for under the articles ELECTRICITY and LIGHTNING, and though the immediate cauſe of electrical exploſions from clouds is explained under the article RAIN; yet the ultimate cauſe remains ſtill to be ſhown, and properly belongs to the preſent article.

It is univerſally allowed, that the variation of the electricity in different parts of the atmoſphere is the cauſe of thunder. Under the article ELECTRICITY, it has been ſhown why lightning explodes after the thunder-clouds are charged. Under the article LIGHTNING, it is ſhown why that meteor puts on the various forms in which we ſee it, why it ſometimes ſtrikes houſes or animals, and ſometimes not, &c.; and under the article RAIN, why the atmoſphere in ſome caſes parts with the vapours which at other times it ſo obſtinately retains. It remains therefore only to mention the theory by which ſome philoſophers explain the reaſon why rains are ſometimes attended with thunder, and ſometimes not; which, to thoſe who attentively peruſe the articles above-mentioned, may be done in few words.

In this part of Great Britain, and for a conſiderable way along the eaſtern coaſt, although thunder may happen at any time of the year, yet the month of July is that in which it may almoſt certainly be expected. Its duration is of very uncertain continuance; ſometimes only a few peals will be heard at any particular place during the whole ſeaſon; at other times the ſtorm will return at the interval of three or four days for a month, ſix weeks, or even longer; not that we have violent thunder in this country directly vertical in any one place ſo frequently in any year, but in many ſeaſons it will be perceptible that thunder-clouds are formed in the neighbourhood even at theſe ſhort intervals. Hence it appears, that during this particular period there muſt be ſome natural cauſe operating for the production of this phenomenon, which does not take place at other times. This cannot be the mere heat of the weather, for we have often a long tract of hot weather without any thunder; and beſides, though not common, thunder is ſometimes heard in the winter alſo. As therefore the heat of the weather is common to the whole ſummer, whether there be thunder or not, we muſt look for the cauſes of it in thoſe phenomena, whatever they are, which are peculiar to the months of July, Auguſt, and the beginning of September. Now it is generally obſerved, in the tract of country of which we now ſpeak, that from the month of April an eaſt or ſouth-eaſt wind generally takes place, and continues with little interruption till towards the end of June. At that time, ſometimes ſooner and ſometimes later, a weſterly wind takes place; but as the cauſes producing the eaſt wind are not removed, the latter oppoſes the weſt wind with its whole force. At the place of meeting, there is naturally a moſt vehement preſſure of the atmoſphere, and friction of its parts againſt one another; a calm enſues, and the vapours brought by both winds begin to collect and form dark clouds, which

Thunder.

can have little motion either way, because they are pressed almost equally on all sides. For the most part, however, the west wind prevails, and what little motion the clouds have is towards the east: whence the common remark in this country, that "thunder-clouds move against the wind." But this is by no means universally true: for if the west wind happens to be excited by any temporary cause before its natural period when it should take place, the east wind will very frequently get the better of it; and the clouds, even although thunder is produced, will move westward. Yet in either case the motion is so slow, that the most superficial observers cannot help taking notice of a considerable resistance in the atmosphere.

That when two streams of air are thus driven against each other, the space where they meet must become highly electrified, is as plain as that an electric globe must be excited when friction is applied. It is true, as the substances here to be excited are both electrics *per se*, it may be objected, that no electricity could be produced; for we cannot excite one electric by rubbing it with another. Yet it is observed, that glass may be electrified by blowing strongly upon it, or by the explosion of cannon; and even when glass is strongly pressed upon glass, both pieces become electrified as soon as they are separated. When glass is rubbed upon glass, no attraction nor repulsion can be perceived, nor is any sign of electricity observed on bodies brought near to it; yet a very bright electric light always appears on the glasses, and a phosphoreal smell is felt; which shows, that though the electricity does not fly out through the air in the usual way, yet the fluid within the glass is agitated; and there is little reason to doubt that any conducting body inclosed within the substance of the glass would be electrified also. The vapours therefore, which are the conducting substances in the atmosphere, become immediately electrified in consequence of the pressure above-mentioned, and all the phenomena described under the various articles already referred to take place.

In like manner, by the struggle of two other winds as well as those of the east and west, may a thunder-storm be produced; but it is always necessary that the resistance of the air to the motion of the clouds should be very great, and nearly equal all round. For if the vapour should get off to a side, no thunder would take place; the electricity would then be carried off as fast as it was collected, and rain would only be the consequence, by reason of the electrified vapours parting with their latent heat, as is explained under the article Rain. In fact, we very often observe, that in the time of rain the clouds evidently move across the wind, and the nearer their motion is to a direct opposition, the heavier will the rain be; while, on the other hand, if they move briskly before the wind, let the direction be what it will, the atmosphere soon clears up.

That rattling in the noise of thunder which makes it seem as if it passed thro' arches, or were variously broken, is probably owing to the sound being excited among clouds hanging over one another, and the agitated air passing irregularly between them. The explosion, if high in the air, and remote from us, will do no mischief; but when near, it may destroy trees, animals, &c. This proximity or small distance may be estimated nearly by the interval of time between seeing the flash of lightning and hearing the report of the thunder, estimating the distance after the rate of 1142 feet *per* second of time, or three two-third seconds to the mile. Dr Wallis observes, that commonly the difference between the two is about seven seconds, which, at the rate above-mentioned, gives the distance almost two miles. But sometimes it comes in a second or two, which argues the explosion very near us, and even among us. And in such cases, the Doctor assures us, he has sometimes foretold the mischiefs that happened.

Thunderbolt.

The noise of thunder and the flame of lightning are easily made by art. If a mixture of oil or spirit of vitriol be made with water, and some filings of steel added to it, there will immediately arise a thick smoke or vapour out of the mouth of the vessel; and if a lighted candle be applied to this, it will take fire, and the flame will immediately descend into the vessel, which will be burst to pieces with a noise like that of a cannon.

Thur

This is so far analogous to thunder and lightning, that a great explosion and fire are occasioned by it; but in this they differ, that this matter when once fired is destroyed, and can give no more explosions; whereas, in the heavens, one clap of thunder usually follows another, and there is a continued succession of them for a long time. Mr Homberg explained this by the lightness of the air above us in comparison of that near, which therefore would not suffer all the matter so kindled to be dissipated at once, but keeps it for several returns.

Respecting the phenomena of thunder, we have many observations to communicate; some of which, we flatter ourselves, are new, and all of them valuable; but our bounds oblige us, though with great reluctance, to pass them over.

THUNDERBOLT. When lightning acts with extraordinary violence, and breaks or shatters any thing, it is called a *thunderbolt*, which the vulgar, to fit it for such effects, suppose to be a hard body, and even a stone. But that we need not have recourse to a hard solid body to account for the effects commonly attributed to the thunderbolt, will be evident to any one who considers those of the pulvis fulminans and of gunpowder; but more especially the astonishing powers of electricity, when only collected and employed by human art, and much more when directed and exercised in the course of nature.

When we consider the known effects of electrical explosions, and those produced by lightning, we shall be at no loss to account for the extraordinary operations vulgarly ascribed to thunderbolts. As stones and bricks struck by lightning are often found in a vitrified state, we may reasonably suppose, with Beccaria, that some stones in the earth having been struck in this manner, gave occasion to the vulgar opinion of the thunderbolt.

Thunder-House. See Electricity, p. 474.

THURINGIA, a division of the circle of Upper Saxony in Germany. It is a fruitful tract, abounding in corn, especially wheat; in black cattle, sheep, and horses. It is about 73 miles in length, and as much in breadth. It contains 47 towns, 14 boroughs, betwixt 700 and 800 villages, 300 noble estates, 7 superintendencies, and 5 under-consistories. Thuringia, the country of the ancient Thuringi, or Catti, a branch of the Vandals, mentioned by Tacitus, was formerly a kingdom. afterwards a county, then a landgravate, and was governed by its own princes for many ages, till 1124, when it devolved to the marquis of Misnia, and, with that country, afterwards to the duke of Saxony. But the modern Thuringia is only a part of the ancient, nay, but a part of the ancient South Thuringia, which comprehends besides, a large share of the modern Franconia, Hesse, &c. On the extinction of the male line of the ancient landgraves in 1247, it came to the margraves of Meissen, ancestors to the present electoral family. The elector has no voice in the diet, on account of his share in the landgravate or circle of Thuringia. Erfurt is the capital.

THURLOE (John), an English statesman under Oliver Cromwell, was born at Abots Roding in Essex in 1616, of which parish his father was rector, and was educated to the

y the ſtudy of the law. In 1648 he was made receiver or clerk of the curſitor fines; and though his attachments were entirely on the ſide of the parliament, he declares himſelf totally unconcerned in all counſels relative to the death of the king: however, on that event, and on the eſtabliſhment of the commonwealth, he was diverted from proſecuting his employments in the law by engaging in public buſineſs. When Cromwell aſſumed the protectorſhip, he became ſecretary of ſtate; in 1655, he had the care and charge both of foreign and inland poſtage committed to him by the protector; and was afterward ſworn one of his privy-council, according to "The humble petition and advice." He was continued in the ſame capacities under Richard Cromwell, and until meaſures were taken for the Reſtoration; when he made an offer of his ſervices to that end, which, however, were not accepted. May 15th 1660, he was committed to the cuſtody of the ſerjeant at arms on a charge of high treaſon; but being ſoon releaſed, he retired to Great Milton in Oxfordſhire: and though he was afterward often ſolicited by Charles II. to engage in the adminiſtration of public buſineſs, he thought proper to decline the offers. He died in 1668: and was a man of an amiable private character, who in the higheſt of his power exerciſed all poſſible moderation towards perſons of every party. The moſt authentic teſtimony of his abilities is that vaſt collection of ſtate-papers, ſeven volumes folio, now in the hands of the public; which place the affairs of Great Britain, and of Europe in general, during that remarkable period in the cleareſt light.

THURSDAY, the fifth day of the Chriſtian week, but the ſixth of that of the Jews.

THUS, Frankincense, a ſolid brittle reſin, brought to us in little globes or maſſes, of a browniſh or yellowiſh colour on the outſide, internally whitiſh or variegated with whitiſh ſpecks. It is ſuppoſed to be the produce of the pine that yields the common turpentine, and to concrete upon the ſurface of the terebinthinate juice ſoon after it has iſſued from the tree. See Incense.

THUYA. See Thuja.

THYMUS, Thyme, in botany: A genus of plants belonging to the claſs of *didynamia*, and order of *gymnoſpermia*; and in the natural ſyſtem ranging under the 42d order, *Verticillatæ*. The calyx is bilabiate, and its throat cloſed with ſoft hairs. There are 11 ſpecies; of which two only are natives of Britain, the *ſerpyllum* and *acinos*.

1. The *ſerpyllum*, or mother of thyme, has pale red flowers growing on round heads, terminal; the ſtalks are procumbent, and the leaves plane, obtuſe, and ciliated at the baſe. 2. The *acinos*, or wild baſil, has flowers growing in whirls on ſingle footſtalks; the ſtalks are erect and branched; the leaves acute and ſerrated. The *thymus vulgaris*, or garden thyme, is a native of France, Spain, and Italy.—The attachment of bees to this and other aromatic plants is well known. In the experiments made at Upſal, ſheep and goats were obſerved to eat it, and ſwine to refuſe it.

Thymus, in anatomy. See Anatomy, n° 114.

THYRSUS, in antiquity, the ſceptre which the poets put into the hand of Bacchus, and wherewith they furniſhed the menades in their Bacchanalia.

Thyrsus, in botany, a mode of flowering reſembling the cone of a pine. It is, ſays Linnæus, a panicle contracted into an oval or egg-ſhaped form. The lower footſtalks, which are longer, extend horizontally, whilſt the upper ones are ſhorter and mount vertically. Lilac and butter-bur furniſh examples.

TIARA, an ornament or habit wherewith the ancient Perſians covered their head; and with which the Armenians and kings of Pontus are repreſented on medals; these laſt, becauſe they were deſcended from the Perſians. Latin authors call it indifferently *tiara* and *cidaris*. Strabo ſays, the tiara was in form of a tower; and the ſcholiaſt on Ariſtophanes's comedy, [illegible] act 1. ſcene 2. affirms, that it was adorned with peacock's feathers.

Tiara is alſo the name of the pope's triple crown. The tiara and keys are the badges of the papal dignity; the tiara of his civil rank, and the keys of his juriſdiction: for as ſoon as the pope is dead, his arms are repreſented with the tiara alone, without the keys. The ancient tiara was a round high cap. John XXIII. firſt encompaſſed it with a crown. Boniface VIII. added a ſecond crown; and Benedict XII. a third.

TIARELLA, in botany: A genus of plants belonging to the claſs of *decandria*, and order of *digynia*; and in the natural ſyſtem ranging under the 13th order, *Succulentæ*. The calyx is quinquepartite; the corolla pentapetalous, and inſerted into the calyx; the petals are entire; the capſule is unilocular and bivalve, the one valve being leſs than the other. There are two ſpecies, the *cordifolia* and *trifoliata*.

TIBER, a great river of Italy, which runs through the pope's territories, paſſing by Perugia and Orvietto; and having viſited Rome, falls into the Tuſcan ſea at Oſtia, fifteen miles below that city.

TIBET, called by the Tartars *Barantola*, *Bootan*, or *Tangout*, and by the Chineſe *Tſang*, is ſituated between 26° and 39° north latitude; and, according to Abbé Groſier, is reckoned to be 640 leagues from eaſt to weſt, and 650 from north to ſouth. It is bounded on the north by the country of the Mongols and the deſert of Kobi; on the eaſt by China; on the weſt by Hindoſtan, and on the ſouth by the ſame country and the kingdom of Ava. In the valleys lying between the lower mountains are many tribes of Indian people; and a diſpute happening between the heirs of one of the rajahs or petty princes, one party called to their aſſiſtance the Boutaners, and the other the Britiſh. The latter prevailed; and the fame of Britiſh valour being carried to the court of Tibet, the Teeſhoo-Lama, who ruled the ſtate under the Delai-Lama, at that time in his minority, ſent a deputation to Bengal, deſiring peace for the prince who had been engaged in war with the Britiſh. This was readily granted by the governor; and Mr Bogle was ſent ambaſſador to the court of Tibet, where he reſided ſeveral months; and after an abſence of a year and a quarter, returned to Calcutta. The account of this gentleman's expedition hath not been publiſhed by himſelf; but from Mr Stewart's letter to Sir John Pringle, publiſhed in the Philoſophical Tranſactions, vol. 67. we learn the following particulars, collected from his papers.

"Mr Bogle divides the territories of the Delai Lama into two different parts. That which lies immediately contiguous to Bengal, and which is called by the inhabitants *Dropo*, he diſtinguiſhes by the name of *Bootan*; and the other, which extends to the northward as far as the frontiers of Tartary, called by the natives *Pu*, he ſtyles *Tibet*. Bootan is ruled by the Dah Terriah, or Deb Rajah. It is a country of ſteep and inacceſſible mountains, whoſe ſummits are crowned with eternal ſnow; they are interſected with deep valleys, through which pour numberleſs torrents that increaſe in their courſe, and at laſt, gaining the plains, loſe themſelves in the great rivers of Bengal. These mountains are covered down their ſides with foreſts of ſtately trees of various ſorts; ſome (ſuch as pines, &c.) which are known in Europe; others, ſuch as are peculiar to the country and climate. The valleys and ſides of the hills which admit of cultivation are not unfruitful, but produce crops of wheat, barley, and rice. The inhabitants are a ſtout and warlike people, of a copper complexion, in ſize rather

Tibet. above the middle European stature, hasty and quarrelsome in their temper, and addicted to the use of spirituous liquors; but honest in their dealings, robbery by violence being almost unknown among them. The chief city is Tassey Seddein situated on the Patchoo. Tibet begins properly from the top of the great ridge of the Caucasus, and extends from thence in breadth to the confines of Great Tartary, and perhaps to some of the dominions of the Russian empire. The woods, which everywhere cover the mountains in Bootan, are here totally unknown; and, except a few straggling trees near the villages, nothing of the sort to be seen. The climate is extremely severe and rude. At Chamnanning, where he wintered, although it be in latitude 31° 39', only 8° to the northward of Calcutta, he often found the thermometer in his room at 29° by Fahrenheit's scale; and in the middle of April the standing waters were all frozen, and heavy showers of snow perpetually fell. This, no doubt, must be owing to the great elevation of the country, and to the vast frozen space over which the north wind blows uninterruptedly from the pole, through the vast deserts of Siberia and Tartary, till it is stopped by this formidable wall

"The Tibetians are of a smaller size than their southern neighbours, and of a less robust make. Their complexions are also fairer, and many of them have even a ruddiness in their countenances unknown in the other climates of the east. Those whom Mr Bogle saw at Calcutta appeared to have quite the Tartar face. They are of a mild and cheerful temper; the higher ranks are polite and entertaining in conversation, in which they never mix either strained compliments or flattery. The common people, both in Bootan and Tibet, are clothed in coarse woollen stuffs of their own manufacture, lined with such skins as they can procure; but the better orders of men are dressed in European cloth, or China silk, lined with the finest Siberian furs. The use of linen is totally unknown among them. The chief food of the inhabitants is the milk of their cattle, prepared into cheese, butter, or mixed with the flour of a coarse barley or of pease, the only grain which their soil produces; and even these articles are in a scanty proportion: but they are furnished with rice and wheat from Bengal and other countries in their neighbourhood. They also are supplied with fish from the rivers in their own and the neighbouring provinces, salted and sent into the anterior parts. They have no want of animal food from the cattle, sheep, and hogs, which are raised on their hills; and are not destitute of game. They have a singular method of preparing their mutton, by exposing the carcase entire, after the bowels are taken out, to the sun and bleak northern winds which blow in the months of August and September, without frost, and so dry up the juices and parch the skin, that the meat will keep uncorrupted for the year round. This they generally eat raw, without any other preparation.

"The religion and political constitution of this country, which are intimately blended together, would make a considerable chapter in its history. It suffices to say, that at present, and ever since the expulsion of the Eluth Tartars, the kingdom of Tibet is regarded as depending on the empire of China, which they call *Cathay;* and there actually reside two mandarines, with a garrison of a thousand Chinese, at Lahassa the capital, to support the government; but their power does not extend far: and in fact the Lama, whose empire is founded on the surest grounds, personal affection and religious reverence, governs every thing internally with unbounded authority. Every body knows that the Delai Lama is the great object of adoration for the various tribes of heathen Tartars, who roam through the vast tract of continent which stretches from the banks of the Volga to Corree on the sea of Japan, the most extensive religious dominion, perhaps, on the face of the globe. See Lama.

Tibet. "It is an old notion, that the religion of Tibet is a corrupted Christianity: and even Father Disederii, a Jesuit (but not of the Chinese mission) who visited the country about the beginning of this century, thinks he can resolve all their mysteries into ours; and asserts, with a truly mystical penetration, that they have certainly a good notion of the Trinity, since in their address to the Deity, they say as often *konciok-oik* in the plural as *konciok* in the singular, and with their rosaries pronounce these words, *om, ha, hum.* The truth is, that the religion of Tibet, from whatever source it sprung, is pure and simple in its source, conveying very exalted notions of the Deity, with no contemptible system of morality: but in its progress it has been greatly altered and corrupted by the inventions of worldly men; a fate we can hardly regret in a system of error, since we know that that of truth has been subject to the same. Polygamy, at least in the sense we commonly receive the word, is not in practice among them; but it exists in a manner still more repugnant to European ideas; for there is a plurality of husbands, which is firmly established and highly respected there. In a country where the means of subsisting a family are not easily found, it seems not impolitic to allow a set of brothers to agree in raising one, which is to be maintained by their joint efforts In short, it is usual in Tibet for the brothers in the family to have a wife in common, and they generally live in great harmony and comfort with her; not but sometimes little dissensions will arise (as may happen in families constituted upon different principles), an instance of which Mr Bogle mentions in the case of a modest and virtuous lady, the wife of half a dozen of the Teeshoo Lama's nephews, who complained to the uncle that the two youngest of her husbands did not furnish that share of love and benevolence to the common stock which duty and religion required of them. In short, however strange this custom may appear to us, it is an undoubted fact that it prevails in Tibet.

"The manner of bestowing their dead is also singular: they neither put them in the ground like the Europeans, nor burn them like the Hindoos; but expose them on the bleak pinnacle of some neighbouring mountain, to be devoured by wild beasts and birds of prey, or wasted away by time and the vicissitudes of the weather in which they lie. The mangled carcases and bleached bones lie scattered about; and amidst this scene of horror, some miserable old wretch, man or woman, lost to all feelings but those of superstition, generally sets up an abode, to perform the dismal office of receiving the bodies, assigning each a place, and gathering up the remains when too widely dispersed."

To the account of Tibet which we have given from the communications of Mr Bogle, we may add the information which we have obtained from a later traveller, Mr Saunders* surgeon at Boglepoer in Bengal, who made a journey into Tibet in the year 1783. His observations chiefly respect the natural productions and diseases of the country.

* *Paper in the Phil. Transf.* LXXI.

The plants which Mr Saunders found were almost all European plants, a great number of them being natives of Britain. From the appearance of the hills he concludes that they must contain many ores of metal and pyrites. There are inexhaustible quantities of Tincal (see that article), and rock-salt is plentiful; gold-dust is found in great quantities in the beds of rivers, and sometimes in large masses, lumps, and irregular veins; lead, cinnabar containing a large proportion of quicksilver, copper, and iron, he thinks, might easily be procured. But the inhabitants of Tibet have no better fuel than the dung of animals. A coal

mine would be a valuable discovery. We are told, that in some parts of China bordering on Tibet coal is found and used as fuel.

It is remarkable that the same disease prevails at the foot of the mountains of Tibet as in Switzerland at the foot of the Alps, a glandular swelling in the throat commonly called *goure*. This disease has been ascribed to the use of snow-water, which flows down in streams from the mountains in both countries. But in many countries where snow-water is abundant it does not prevail, and in other places far remote from snow it is not unfrequent, as in Sumatra. Mr Saunders thinks that it arises from the air peculiar to the vicinity of certain mountains; and finding the vegetable productions of the mountains of Tibet the same with those of the Alps, that they also may have their influence. An analysis of the water where this disease prevails might throw some light on the subject. We have heard it attributed to the impregnation of water with *tufa*. This very extraordinary disease has been little attended to, from obvious reasons; it is unaccompanied with pain, seldom fatal, and generally confined to the poorer sort of people. The tumor is unsightly, and grows to a troublesome size, being often as large as a person's head. It is certainly not exaggerating to say, that one in six of the Rungpore district, and country of Bootan, has the disease.

As those who labour most, and are the least protected from the changes of weather, are most subject to the disease, we universally find it in Bootan more common with the women than men. It generally appears in Bootan at the age of thirteen or fourteen, and in Bengal at the age of eleven or twelve: so that in both countries the disease shows itself about the age of puberty. I do not believe this disease has ever been removed, though a mercurial course seemed to check its progress, but did not prevent its advance after intermitting the use of mercury. An attention to the primary cause will first lead to a proper method of treating the disease; a change of situation for a short while, at that particular period when it appears, might be the means of preventing it.

The venereal disease is not uncommon in Tibet; and what will perhaps surprize the physician, the inhabitants are acquainted with the effects of mercury, and with a method of preparing it so as to render it a safe and efficacious remedy. They know how to deprive it of its metallic form by mixing it with alum, nitre, and vermilion, and exposing it to a certain degree of heat, which they judge of by weighing the fuel.

The language spoken in Tibet is different from that of the Tartars. The astronomers are acquainted with the motion of the heavenly bodies, and able to calculate eclipses: but the lamas are generally ignorant; few of them can read, much less understand their ancient books.

TIBULLUS (Aulus Albius), a Roman knight, and a celebrated Latin poet, was born at Rome 43 B. C. He was the friend of Horace, Ovid, Macer, and other great men in the reign of Augustus. He accompanied Messala Corvinus in his expedition against the island of Corcyra: but falling sick, and being unable to support the fatigues of war on account of the weakness of his constitution, he quitted the profession of arms, and returned to Rome, where he died before the year 17; when Ovid showed his grief for his death by writing a fine elegy upon him. Tibullus wrote four books of elegies, which are still extant: they are written in a tender and agreeable style, and in very elegant Latin. Muret and Joseph Scaliger have written learned and curious commentaries on the works of this poet. The best edition of Tibullus is that of Janus Broeckhusius, published at Amsterdam in 1708, in one volume quarto. We have an English poetical version by Mr Grainger.

TIBUR, (anc. geog.) a town of Latium, pleasantly situated on the Anio. Here Horace had his villa and home; and here he wished to end his days. Here Adrian built an extraordinary villa called *Tiburtina*, inscribed with the names of the provinces and of the most celebrated places, (Spartian); near which Zenobia had a house called *Zenobia*, (Trebellius, Pollio). Hither Augustus often retreated on account of its salubrity, (Suetonius): for which it is greatly commended, (Martial). Anciently, when the Romans had far extended their territory, it was the utmost place of banishment, (Ovid). It had a temple of Hercules; and therefore called *Herculeum*. In the temple was a library, (A. Gellius). Now *Tivoli* in the Campagna di Roma on the Teverone.

TICINUS, (anc. geog.) a river in Insubria, rising in mount Adula, traversing the Lacus Verbanus southwards, and falling into the Po near Ticinum. Between this river and the Po Hannibal gained his first victory over the Romans under P. Scipio. The general himself escaped with the utmost difficulty, and that by the bravery of his son the first Scipio Africanus. Now the *Tesino*, rising in mount Godard, running south through the Lago Maggiore and Milan, by Pavia, into the Po.

TICK, in zoology. See Acarus.

TICKELL (Thomas), an excellent English poet, was the son of the Reverend Richard Tickell, and was born in 1686, at Bridekirk in Cumberland. He was educated at Queen's college, Oxford, of which he was made fellow; and while he continued at that university, he addressed to Mr Addison a complimentary copy of verses on his Opera of Rosamond, which introduced him to an acquaintance with that gentleman, who discovering his merit, became his sincere friend. On Mr Addison's being made secretary of state, he appointed Mr Tickell his under-secretary; and on his being obliged to resign that office on account of his ill health, he recommended him so effectually to Mr Craggs his successor, that he was continued in his post till that gentleman's death. In 1724 Mr Tickell was appointed secretary to the lords justices in Ireland, and enjoyed that place as long as he lived. He wrote some poems, which, when separately published, met with a favourable reception, and passed through several editions: they are now printed in the second volume of The Minor Poets. After Mr Addison's death Mr Tickell had the care of the edition of his works printed in 4 vols 4to; to which he prefixed an account of Mr Addison's life, and a poem on his death. Mr Tickell died in the year 1740.

TICKERA, a considerable article of merchandise in Fezzan in Africa; it is valued by travellers as a portable and highly salubrious food. It is a preparation of pounded dates, and the meal of Indian corn, formed into a paste, and highly dried in an oven.

TICKSEED, Sunflower. See Coreopsis.

TICUNAS. See Poison, p. 266.

TIDE, is a word which expresses that rising and falling of the waters which are observed on all maritime coasts.

There is a certain depth of the waters of the ocean which would obtain if all were at rest: but observation shows that they are continually varying from this level, and that some of these variations are regular and periodical.

1*st*, It is observed, that on the shores of the ocean, and in bays, creeks, and harbours, which communicate freely with the ocean, the waters rise up above this mean height twice a-day, and as often sink below it, forming what is called a flood and an ebb, a high and a low water. The whole interval between high and low water is called a tide: the

Tide.

the water is faid to FLOW and to EBB; and the rifing is called the FLOOD-TIDE, and the falling is called the EBB TIDE.

2*d*, It is obferved, that this rife and fall of the waters is variable in quantity. At Plymouth, for inftance, it is fometimes 21 feet between the greateft and leaft depth of the water in one day, and fometimes only 12 feet.

Thefe different heights of tide are obferved to fucceed each other in a regular feries, diminifhing from the greateft to the leaft, and then increafing from the leaft to the greateft. The greateft is called a SPRING TIDE, and the leaft is called a NEAP TIDE.

3*d*, This feries is completed in about 15 days. More careful obfervation fhows that two feriefes are completed in the exact time of a lunation. For the fpring tide in any place is obferved to happen precifely at a certain interval of time (generally between two and three days) after new or full moon, and the neap tide at a certain interval after half moon; or, more accurately fpeaking, it is obferved that the fpring tide always happens when the moon has got a certain number of degrees eaftward of the line of conjunction and oppofition, and the neap tide happens when fhe is a certain number of degrees from her firft or laft quadrature. Thus the whole feries of tides appears to be regulated by the moon.

4*th*, It is obferved that high water happens at new and full moon when the moon has a certain determined pofition with refpect to the meridian of the place of obfervation, preceding or following the moon's fouthing a certain interval of time; which is conftant with refpect to that place, but very different in different places.

5*th*, The time of high water in any place appears to be regulated by the moon; for the interval between the time of high water and the moon's fouthing never changes above three quarters of an hour, whereas the interval between the time of high water and noon changes fix hours in the courfe of a fortnight.

6*th*, The interval between two fucceeding high waters is variable. It is leaft of all about new and full moon, and greateft when the moon is in her quadratures. As two high waters happen every day, we may call the double of their interval a TIDE DAY, as we call the diurnal revolution of the moon a *lunar day*. The tide day is fhorteft about new and full moon, being then about $24^h\ 37'$; about the time of the moon's quadratures it is $25^h\ 27'$. Thefe values are taken from a mean of many obfervations made at Barbadoes by Dr Mafkelyne.

7*th*, The tides in fimilar circumftances are greateft when the moon is at her fmalleft diftance from the earth, or in her perigee, and, gradually diminifhing, are fmalleft when fhe is in her apogee.

8*th*, The fame remark is made with refpect to the fun's diftance, and the greateft tides are obferved during the winter months of Europe.

9*th*, The tides in any part of the ocean increafe as the moon, by changing her declination, approaches the zenith of that place.

10*th*, The tides which happen while the moon is above the horizon are greater than the tides of the fame day when the moon is below the horizon.

Such are the regular phenomena of the tides. They are important to all commercial nations, and have therefore been much attended to. It is of the tides, in all probability, that the Bible fpeaks, when God is faid to fet bounds to the fea, and to fay "this far fhall it go, and no farther."

Homer is the earlieft profane author who fpeaks of the tides. Indeed it is not very clear that it is of them that he fpeaks (in the XIIth book of the Odyffey) when he fpeaks of Charybdis, which rifes and retires thrice in every day. Herodotus and Diodorus Siculus fpeak more diftinctly of the tides in the Red Sea. Pytheas of Marfeilles is the firft who fays any thing of their caufe. According to Strabo he had been in Britain, where he muft have obferved the tides of the ocean. Plutarch fays exprefsly that Pytheas afcribed them to the moon. It is fomewhat wonderful that Ariftotle fays fo little about the tides. The army of Alexander, his pupil, were ftartled at their firft appearance to them near the Perfian Gulph; and we fhould have thought that Ariftotle would be well informed of all that had been obferved there. But there are only three paffages concerning them in all Ariftotle's writings, and they are very trivial. In one place he fpeaks of great tides obferved in the north of Europe; in another, he mentions their having been afcribed by fome to the moon; and in a third, he fays, that the tide in a great fea exceeds that in a fmall one.

The Greeks had little opportunity of obferving the tides. The conquefts and the commerce of the Romans gave them more acquaintance with them. Cæfar fpeaks of them in the 4th book of his Gallic War. Strabo, after Pofidonius, claffes the phenomena into daily, monthly, and annual. He obferves, that the fea rifes as the moon gets near the meridian, whether above or below the horizon and falls again as fhe rifes or falls; alfo, that the tides increafe at the time of new and full moon, and are greateft at the fummer folftice. Pliny explains the phenomena at fome length; and fays, that both the fun and moon are their caufe, dragging the waters along with them (B. II. c. 97). Seneca (*Nat. Quest.* III. 28.) fpeaks of the tides with correctnefs; and Macrobius (*Somn. Scip.* I. 6.) gives a very accurate defcription of their motions.

It is impoffible that fuch phenomena fhould not exercife human curiofity as to their caufe. Plutarch (*Plaut. Phil.* III. 17), Galileo (*Syft. Mund.* Dial. 4.), Riccioli in his *Almagest*, ii. p. 374, and Gaffendi, ii. p. 27. have collected moft of the notions of their predeceffors on the fubject; but they are of fo little importance, that they do not deferve our notice. Kepler fpeaks more like a philofopher (*De Stella Martis*, and *Epit. Aftron.* p. 555). He fays that all bodies attract each other, and that the waters of the ocean would all go to the moon were they not retained by the attraction of the earth; and then goes on to explain their elevation under the moon and on the oppofite fide, becaufe the earth is lefs attracted by the moon than the nearer waters, but more than the waters which are more remote.

The honour of a complete explanation of the tides was referved for Sir Ifaac Newton. He laid hold of this clafs of phenomena as the moft inconteftable proof of univerfal gravitation, and has given a moft beautiful and fynoptical view of the whole fubject; contenting himfelf, however, with merely exhibiting the chief confequences of the general principle, and applying it to the phenomena with fingular addrefs. But the wide fteps taken by this great philofopher in his inveftigation leave ordinary readers frequently at fault: many of his affumptions require the greateft mathematical knowledge to fatisfy us of their truth. The academy of Paris therefore propofed to illuftrate this among other parts of the principles of natural philofophy, and publifhed the theory of the tides as a prize problem. This produced three excellent differtations, by M'Laurin, Dan. Bernoulli, and Euler. Aided by thefe, and chiefly by the fecond, we fhall here give a phyfical theory, and accommodate it to the purpofes of navigation by giving the rules of calculation. We have demonftrated in our differtations on the phyfical principles of the celeftial motions, that it is an unexcepted fact, that every particle of matter in the folar fyftem is actually deflected toward every other particle; and

that

Tide. that the deflection of a particle of matter toward any distant sphere is proportional to the quantity of matter in that sphere directly, and to the square of the distance of the particle from the centre of that sphere inversely: and having found that the heavineſs of a piece of terreſtrial matter is nothing but the ſuppoſed opponent to the force which we exert in carrying this piece of matter, we conceive it as poſſeſſing a property, that is, diſtinguiſhing quality, manifeſted by its being *gravis* or heavy. This is heavineſs, *gravitas*, gravity; and the manifeſtation of this quality, or the event in which it is ſeen, whether it be directly falling, or deflecting in a parabolic curve, or ſtretching a coiled ſpring, or breaking a rope, or ſimply preſſing on its ſupport, is *gravitatio*, gravitation; and the body is ſaid to gravitate. When all obſtacles are removed from the body, as when we cut the ſtring by which a ſtone is hung, it moves directly downwards, *tendit ad terram. Si diſcindatur funis, tenderet lapis ad terram. Dum vero funis integer pendet, lapis terram verſus niti cenſetur.* By ſome metaphyſical proceſs, which it is needleſs at preſent to trace, this *niſus ad motum* has been called a *tendency* in our language. Indeed the word has now come to ſignify the energy of any active quality in thoſe caſes where its ſimpleſt and moſt immediate manifeſtation is prevented by ſome obſtacle. The ſtone is now ſaid to tend toward the earth, though it does not actually approach it, being withheld by the ſtring. The ſtretching the ſtring in a direction perpendicular to the horizon is conceived as a full manifeſtation of this tendency. This tendency, this energy of its heavineſs, is therefore named by the word which diſtinguiſhes the quality; and it is called *gravitation*, and it is ſaid to *gravitate*.

But Sir Iſaac Newton diſcovered that this deflection of a heavy body differs in no reſpect from that general deflection obſerved in all the bodies of the ſolar ſyſtem. For 16 feet, which is the deflection of a ſtone in one ſecond, has the very ſame proportion to $\frac{1}{19}$th of an inch, which is the ſimultaneous deflection of the moon, that the ſquare of the moon's diſtance from the centre of the earth has to the ſquare of the ſtone's diſtance from it, namely, that of 3600 to 1.

Thus we are enabled to compare all the effects of the mutual tendencies of the heavenly bodies with the tendency of gravity, whoſe effects and meaſures are familiar to us.

If the earth were a ſphere covered to a great depth with water, the water would form a concentric ſpherical ſhell; for the gravitation of every particle of its ſurface would then be directed to the centre, and would be equal. The curvature of its ſurface therefore would be every where the ſame, that is, it would be the uniform curvature of a ſphere.

It has been demonſtrated in former articles, after Sir
Plate DIX. Iſaac Newton, that the gravitation of a particle C (fig. 1.) to the centre O, is to that of a particle E at the ſurface as as CO to EO. In like manner the gravitation of *o* is to that of *p* as *o* O to *p* O. If therefore EO and O*p* are two communicating canals, of equal lengths, the water in both would be in equilibrio, becauſe each column would exert the ſame total preſſure at O. But if the gravitation of each particle in *p* O be diminiſhed by a certain proportion, ſuch as $\frac{1}{100}$th of its whole weight, it is plain that the total preſſure of the column *p* O will be $\frac{1}{100}$th part leſs than that of the column EO. Therefore they will no longer be in equilibrio. The weight of the column EO will prevail; and if a hollow tower P*p* be built at the mouth of the pit *p o*, the water will ſink in EO and riſe in O*p*, till both are again in equilibrio, exerting equal total preſſures at O. Or we may prevent the ſinking at E by pouring in more water into the tower P*p*. The ſame thing muſt happen in the canal *f c* perpendicular to EO, if the gravitation of every particle be diminiſhed by a force acting in the direction CF, and proportional to the diſtance of the particle from C, and ſuch, that when *c* C is equal to *o* O, the force acting on *c* is equal to the force acting on *o*. In order that the former equilibrium may be reſtored after this diminution of the gravitation of the column *f* C it is plain that more water muſt be poured into the oblique tower F*f*. All this is evident when we conſider the matter hydroſtatically. The gravitation of the particle *c* may be repreſented by *o* O; but the diminution of the preſſure occaſioned by this at O is repreſented by C*c*.

Hence we can collect this much, that the whole diminution of preſſure at C is to the whole diminution of preſſure at O as the ſum of all the lines *c* C to the ſum of all the lines *o* O, that is, as *f* C² to *p* O². But the weight of the ſmall quantity of water added in each tower is diminiſhed in the ſame proportion; therefore the quantity added at F*f* muſt be to the quantity added at P*p* as *f* C to *p* O. Therefore we muſt have F*f* : P*p* = *f* C : *p* O, and the points E, F, P, muſt be in the circumference of an ellipſe, of which PO and EO are the tranſverſe and conjugate ſemiaxes.

What we have here ſuppoſed concerning the diminution of gravity in theſe canals is a thing which really obtains in nature. It was demonſtrated, when treating of the *Preceſſion of the Equinoxes*, that if the ſun or moon lie in the direction OP, at a very great diſtance, there reſults from the unequal gravitation of the different particles of the earth a diminution of the gravity of each particle; which diminution is in a direction parallel to OP, and proportional to the diſtance of the particle from a plane paſſing through the centre of the earth at right angles to the line OP.

Thus it happens that the waters of the ocean have their equilibrium diſturbed by the unequal gravitation of their different particles to the ſun or to the moon; and this equilibrium cannot be reſtored till the waters come in from all hands, and riſe up around the line joining the centres of the earth and of the luminary. The ſpherical ocean muſt acquire the form of a prolate ſpheroid generated by the revolution of an ellipſe round its tranſverſe axis. The waters will be higheſt in that place which has the luminary in its zenith, and in the antipodes to that place; and they will be moſt depreſſed in all thoſe places which have the luminary in their horizon. P and P′ will be the poles, and EOQ will be the equator of this prolate ſpheroid.

Mr Ferguſon, in his Aſtronomy, aſſigns another cauſe of this arrangement, *viz.* the difference of the centrifugal forces of the different particles of water, while the earth is turning round the common centre of gravity of the earth and moon. This, however, is a miſtake. It would be juſt if the earth and moon were attached to the ends of a rod, and the earth kept always the ſame face toward the moon.

It is evident that the accumulation at P and P′, and the depreſſion at the equator, muſt augment and diminiſh in the ſame proportion with the diſturbing force. It is alſo evident that its abſolute quantity may be diſcovered by our knowledge of the proportion of the diſturbing force to the force of gravity.—Now this proportion is known; for the proportion of the gravitation of the earth's centre to the ſun or moon, to the force of gravity at the earth's ſurface, is known; and the proportion of the gravitation of the earth's centre to the luminary, to the difference of the gravitations of the centre and of the ſurface, is alſo known, being very nearly the proportion of the diſtance of the luminary to twice the radius of the earth.

Although this reaſoning, by which we have aſcertained the elliptical form of the watery ſpheroid, be ſufficiently convincing, it is very imperfect, being accommodated to one condition only of equilibrium, *viz.* the equilibrium of the canals

Tide. canals fc and co. There are feveral other conditions equally neceffary to which this lax reafoning will not apply, fuch as the direction of the whole remaining gravitation in any point F. This muft be perpendicular to the furface, &c. &c. Nor will this mode of inveftigation afcertain the eccentricity of the fpheroid without a moft intricate procefs. We muft therefore take the fubject more generally, and fhow the proportion and directions of gravity in every point of the fpheroid. We need not, however, again demonftrate that the gravitation of a particle placed any where without a perfect fpherical fhell, or a fphere confifting of concentric fpherical fhells, either of uniform denfity, or of denfities varying according to fome function of the radius, is the fame as if the whole matter of the fhell or fphere were collected in the centre. This has been demonftrated in the article ASTRONOMY. We need only remind the reader of fome confequences of this theorem which are of continual ufe in the prefent inveftigation.

1ft, The gravitation to a fphere is proportional to its quantity of matter directly, and to the fquare of the diftance of its centre from the gravitating particle inverfely.

2d, If the fpheres be homogeneous and of the fame denfity, the gravitations of particles placed on their furfaces, or at diftances which are proportional to their diameters, are as the radii; for the quantities of matter are as the cubes of the radii, and the attractions are inverfely as the fquares of the radii; and therefore the whole gravitations are as $\frac{r^3}{r^2}$, or as r.

3d, A particle placed within a fphere has no tendency to the matter of the fhell which lies without it, becaufe its tendency to any part is balanced by an oppofite tendency to the oppofite part. Therefore,

4th, A particle placed any where *within* a homogeneous fphere gravitates to its centre with a force proportional to its diftance from it.

It is a much more difficult problem to determine the gravitation of particles to a fpheroid. To do this in general terms, and for every fituation of the particle, would require a train of propofitions which our limits will by no means admit; we muft content ourfelves with as much as is neceffary for merely afcertaining the ratio of the axes. This will be obtained by knowing the ratio of the gravitation at the pole to that at the equator. Therefore

Let N m S q N (fig. 2) be a fection through the axis of an oblate homogeneous fpheroid, which differs very little from a fphere. NS is the axis, $m\,q$ is the equatorial diameter, O is the centre, and NMSQ is the fection of the infcribed fphere. Let P be a particle fituated at any diftance without the fphere in its axis produced; it is required to determine the gravitation of this particle to the whole matter of the fpheroid?

Draw two lines PAC, PBD, very near to each other, cutting off two fmall arches AB, CD; draw GAa, HBb, ICc, KDd, perpendicular to the axis; alfo draw OE and AL perpendicular to PAC, and OF perpendicular to PD, cutting PC in f. Join OA.

Let OA, the radius of the infcribed fphere, be r, and OP the diftance of the gravitating particle be d, and Mm, the elevation of the equator of the fpheroid, or the ellipticity, be e. Alfo make AE $= x$, and OE $= y, = \sqrt{r^2 - x^2}$.

Then AE—BF $= \dot{x}$ and F$f = \dot{y}, = \frac{x\,\dot{x}}{\sqrt{r^2 - x^2}}$.

Suppofe the whole figure to turn round the axis OP. The little fpace AB$\,b\,a$ will generate a ring of the redundant matter; fo will CD$\,d\,c$. This ring may be confidered as confifting of a number of thin rings generated by the revolution of Aa. The ring generated by Aa is equal to a parallelogram whofe bafe is the circumference defcribed by A and whofe height is Aa. Therefore let c be the circumference of a circle whofe radius is 1. The ring will be A$a \times c \times$ AG. But becaufe $m\,a$ N is an arch of an ellipfe, we have Mm : Aa = MO : AG = r : AG, and Aa = M$m \times \frac{\text{AG}}{r}, = \frac{e}{r}$ AG. Therefore the furface of this ring is $= c\,\frac{e}{r}\,\text{AG}^2$.

We have fuppofed the fpheroid to be very nearly fpherical, that is, e exceedingly fmall in comparifon of r. This being the cafe, all the particles in Aa, and confequently all the particles in the ring generated by the revolution of Aa, will attract the remote particle P with the fame force that A does very nearly. We may fay the fame thing of the whole matter of the ring generated by the revolution of AB$\,b\,a$. This attraction is exerted in the direction PA by each individual particle. But every action of a particle A is accompanied by the action of a particle A′ in the direction PA′. Thefe two compofe an attraction in the direction PO. The whole attraction in the directions fimilar to PA is $= c \times \frac{e}{r}\frac{\text{AG}^2}{\text{PA}^2} \times$ GH, for GH meafures the number of parallel plates of which the folid ring is compofed. This being decompofed in the direction PG is $= c \times \frac{e}{r} \times \frac{\text{AG}^2 . \text{PG}}{\text{PA}^3} \times$ GH. But $\frac{\text{AG}^2}{\text{PA}^2} = \frac{\text{OE}^2}{\text{PO}^2}$, and $\frac{\text{PG}}{\text{PA}} = \frac{\text{PE}}{\text{PO}}$. Therefore the attraction of the ring, eftimated in the direction PO, is $= c \times \frac{e}{r} \times \frac{\text{OE}^2 . \text{PE}}{\text{PO}^3} \times$ GH.

Farther, by the nature of the circle, we have HG : AB = AG : AO; alfo AB : BL = AO : OE. But PA : AG = PO : OE, and OE $= \frac{\text{AG} \times \text{PO}}{\text{PA}}$. Therefore

$$\text{AB} : \text{BL} = \text{AO} : \frac{\text{AG} . \text{PO}}{\text{PA}}, = \text{AO} . \text{PA} : \text{PO} . \text{AG}$$

Alfo BL : LA = EO : EA,

And LA : Ff = PA : Pf, = ultimately PA : PE. Therefore, by equality, HG : Ff = AG . AO . PA . EO . PA : AO . PO . AG . EA . PE.

Or HG : Ff = EO . PA² : PO . EA . PE.

And HG = F$f \times \frac{\text{EO} . \text{PA}^2}{\text{PO} . \text{PE} . \text{EA}}$.

Now fubftitute this value of HG in the formula expreffing the attraction of the ring. This changes it to $c\,\frac{e}{r} \times \frac{\text{OE}^2 . \text{PE}}{\text{PO}^3} \times \frac{\text{OE} . \text{PA}^2}{\text{PO} . \text{PE} . \text{EA}} \times$ Ff, or $c\,\frac{e}{r} \times \frac{\text{OE}^3 . \text{PA}^2}{\text{PO}^4 . \text{EA}} \times$ Ff. In like manner, the attraction of the ring generated by the revolution of CD$\,d\,c$ is $c\,\frac{e}{r} \times \frac{\text{OE}^3 . \text{PC}^2}{\text{PO}^4 . \text{EA}} \times$ Ff. Therefore the attraction of both is $= c\,\frac{e}{r} \times$ F$f \times \frac{\text{OE}^3}{\text{PO}^4 . \text{EA}} \times \overline{\text{PA}^2 + \text{PC}^2}, = c\,\frac{e}{r} \times$ F$f\,\frac{y^3}{d^4 . x} \times \overline{\text{PA}^2 + \text{PC}^2}$. But PA² + PC² = 2 PE² + 2 EA², = 2 PE² + 2 x^2. Therefore the attraction is $2\,c\,\frac{e}{r\,d^4} \times$ F$f\,\frac{y^3}{x} \times \overline{\text{PE}^2 + x^2}$. But F$f$ $= \dot{y}, = \frac{x}{y}\,\dot{x}$. Therefore F$f\,\frac{y^3}{x} = \frac{x}{y}\,\dot{x} \times \frac{y^3}{x}, = y^2\,\dot{x}$,

=

$= \overline{r^2 - x^2}\,\dot{}$. Therefore the attraction of the two rings is $2c\frac{e}{rd^4} \times \overline{r^2 - x^2} \times \overline{PE^2 + x^2} \times \dot{x}$. But $PE^2 = PO^2 - OE^2, = d^2 - (r^2 - x^2) = d^2 - r^2 + x^2$. Therefore the attraction of the two rings is

$2c\frac{e}{rd^4} \times \overline{r^2 - x^2} \times \overline{d^2 - r^2 + 2x^2}\,\dot{x}, = 2c\frac{e}{rd^4} \times$

$\overline{r^2 d^2 \dot{x} - r^4 \dot{x} + 2r^2 x^2 \dot{x} - d^2 x^2 \dot{x} + r^2 x^2 \dot{x} - 2x^4 \dot{x}} = 2c\frac{e}{rd^4}$

$\times \overline{r^2 d^2 \dot{x} + 3r^2 x^2 \dot{x} - r^4 \dot{x} - d^2 x^2 \dot{x} - 2x^4 \dot{x}}$.

The attraction of the whole shell of redundant matter will be had by taking the fluent of this formula, which is

$2c\frac{e}{rd^4} \times \left(r^2 d^2 x + \frac{3r^2 x^3}{3} - r^4 x - \frac{d^2 x^3}{3} - \frac{2x^5}{5} \right)$,

and then make $x = r$. This gives $2c\frac{e}{rd^4}\,(d^2 r^3 + r^5 - r^5 - \frac{1}{3} d^2 r^3 - \frac{2}{5} r^5)$, which is $= 2c\frac{e}{rd^4}\,(\frac{2}{3} d^2 r^3 - \frac{2}{5} r^5)$, $= \frac{4ce\,r^2}{3d^2} - \frac{4\,r^4}{5d^4}$. To this add the attraction of the inscribed sphere, which is $\frac{2}{3}\frac{c\,r^3}{d^2}$, and we have the attraction of the whole spheroid

$$= \frac{2}{3}\frac{c\,r^3}{d^2} + \frac{4}{3}\frac{c\,e\,r^2}{d^2} - \frac{4}{5}\frac{c\,e\,r^4}{d^4}$$

Cor. 1. If the particle P is situated precisely in N, the pole of the spheroid, the attraction of the spheroid, is $\frac{2}{3} cr + \frac{8}{15} ce$.

If the spheroid is not oblate, but oblong, and if the greater semiaxis be r, and the depression at the equator be e, the analysis is the same, taking e negatively. Therefore the attraction for a particle in the pole, or the gravitation of a particle in the pole, is $\frac{2}{3} cr - \frac{8}{15} ce$.

But if the polar semiaxis be $r + e$, and the equatorial radius be r, so that this oblong spheroid has the same axis with the former oblate one, the gravitation of a particle in the pole is $\frac{2}{3} cr + \frac{2}{15} ce$.

Cor. 2. If a number of parallel planes are drawn perpendicular to the equator of an oblong spheroid, whose longer semiaxis is $r + e$, and equatorial radius r, they will divide the spheroid into a number of similar ellipses; and since the ellipse through the axis has $r + e$ and r for its two semiaxes, and the radius of a circle of equal area with this elipse is a mean proportional between r and $r + e$, and therefore very nearly $= r + \frac{1}{2} e$, when e is very small in comparison of r, a particle on the equator of the oblong spheroid will be as much attracted by these circles of equal areas, with their corresponding ellipses, as by the ellipses. Now the attraction at the pole of an oblate spheroid was $\frac{2}{3} cr + \frac{8}{15} ce$. Therefore putting $\frac{1}{2} e$ in place of e, the attraction on the equator of the oblong spheroid will be equal to $\frac{2}{3} cr + \frac{4}{15} ce$.

Thus we have ascertained the gravitations of a particle situated in the pole, and of one situated in the equator, of a homogeneous oblong spheroid. This will enable us to solve the following problem:

If the particles of a homogeneous oblong fluid spheroid attract each other with a force inversely as the squares of their distances, and if they are attracted by a very distant body by the same law, and if the ratio of the equatorial gravity to this external force be given; to find what must be the proportion of the semiaxis, so that all may be in equilibrio, and the spheroid preserve its form?

Let r be the equatorial radius, and $r + e$ be the polar semiaxis. Then the gravitation at the pole m is $\frac{2}{3} cr + \frac{2}{15} ce$, and the gravitation at the equator is $\frac{2}{3} cr + \frac{4}{15} ce$. Now by the gravitation towards the distant body placed in the direction of the polar axis, the polar gravitation is diminished, and the equatorial gravitation is increased; and the increase of the equatorial gravitation is to the diminution of the polar gravitation as NO to $2m$O. Therefore if the whole attraction of the oblong spheroid for a particle on its equator be to the force which the distant body exerts there, as G to P, and if the spheroid is very nearly spherical, the absolute weight at the equator will be $\frac{2}{3} cr + \frac{4}{15} ce + \frac{2}{3} cr\frac{P}{G}$. And the absolute weight at the pole will be $\frac{2}{3} cr + \frac{2}{15} ce - \frac{2}{3} cr\frac{2P}{G}$. Their difference is $\frac{2}{15} ce + 2cr\frac{P}{G}$.

Now if we suppose this spheroid to be composed of similar concentric shells, all the forces will decrease in the same ratio. Therefore the weight of a particle in a column reaching from the equator to the centre will be to the weight of a similarly situated particle of a column reaching from the pole to the centre, as the weight of a particle at the equator to the weight of a particle at the pole. But the whole weights of the two columns must be equal, that they may balance each other at the centre. Their lengths must therefore be reciprocally as the weights of similarly situated particles; that is, the polar semiaxis must be to the equatorial radius, as the weight of a particle at the equator to the weight of a particle at the pole. Therefore we must have $\frac{2}{15} ce + 2cr\frac{P}{G} : \frac{2}{3} cr + \frac{2}{15} ce - \frac{4}{3} cr\frac{P}{G} = e : r$.

Hence we derive $2r\frac{P}{G} = \frac{8}{15} e$, or $4G : 15P = r : e$. This determines the form of the fluid spheroid when the ratio of G to P is given.

It is well known that the gravitation of the moon to the earth is to the disturbing force of the sun as 178,725 to 1 very nearly. The lunar gravitation is increased as she approaches the earth in the reciprocal duplicate ratio of the distances. The disturbing force of the sun diminishes in the simple ratio of the distances; therefore the weight of a body on the surface of the earth is to the disturbing force of the sun on the same body, in a ratio compounded of the ratio of 178,725 to 1, the ratio of 3600 to 1, and the ratio of 60 to 1; that is, in the ratio of 38604600 to 1. If the mean radius of the earth be 20934500 feet, the difference of the axis, or the elevation of the pole of the watery spheroid produced by the gravitation to the sun, will be $\frac{15}{4} \times \frac{20934500}{38604600}$ feet, or very nearly $24\frac{1}{2}$ inches. This is the tide produced by the sun on a homogeneous fluid sphere.

It is plain, that if the earth consists of a solid nucleus of the same density with the water, the form of the solar tide will be the same. But if the density of the nucleus be different, the form of the tide will be different, and will depend both on the density and on the figure of the nucleus.

If the nucleus be of the same form as the surrounding fluid, the whole will still maintain its form with the same proportion of the axis. If the nucleus be spherical, its action on the surrounding fluid will be the same as if all the matter of the nucleus by which it exceeds an equal bulk of the fluid were collected at the centre. In this case, the ocean cannot maintain the same form: for the action of this central body being proportional to the square of the distance inversely, will augment the gravity of the equatorial fluid more than it augments that of the circumpolar fluid; and the ocean, which was in equilibrio (by supposition), must now become more protuberant at the poles. It may, how-

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ever, be again balanced in an elliptical form, when it has acquired a juſt proportion of the axes. The proceſs for determining this is tedious, but preciſely ſimilar to the preceding.

If the denſity of the nucleus exceed that of the fluid about $\frac{1}{5\frac{1}{2}}$, we ſhall have $r : e = G : 3P$, which is nearly the form which has been determined for the earth, by the menſuration of degrees of the meridian, and by the vibration of pendulums. The curious reader will do well to conſult the excellent diſſertations by Clairaut and Boſcovich on the Figure of the Earth, where this curious problem is treated in the moſt complete manner. Mr Bernoulli, in his diſſertation on the Tides, has committed a great miſtake in this particular. On the other hand, if the nucleus be leſs denſe than the waters, or if there be a great central hollow, the elevation produced by the ſun will exceed $24\frac{1}{2}$ inches.

It is needleſs to examine this any farther. We have collected enough for explaining the chief affections of the tides.

It is known that the earth is not a ſphere, but ſwelled out at the equator by the diurnal rotation. But the change of form is ſo very ſmall in proportion to the whole bulk, that it cannot ſenſibly affect the change of form afterwards induced by the ſun on the waters of the ocean. For the diſturbing force of the ſun would produce a certain protuberance on a fluid ſphere; and this protuberance depends on the ratio of the diſturbing force to the force of gravity at the ſurface of this ſphere. If the gravity be changed in any proportion, the protuberance will change in the ſame proportion. Therefore if the body be a ſpheroid, the protuberance produced at any point by the ſun will increaſe or diminiſh in the ſame proportion that the gravity at this point has been changed by the change of form. Now the change of gravity, even at the pole of the terreſtrial ſpheroid, is extremely ſmall in compariſon with the whole gravity. Therefore the change produced on the ſpheroid will not ſenſibly differ from that produced on the ſphere; and the elevations of the waters above the ſurface, which they would have aſſumed independent of the ſun's action, will be the ſame on the ſpheroid as on the ſphere. For the ſame reaſon, the moon will change the ſurface already changed by the ſun, in the ſame manner as ſhe would have changed the ſurface of the undiſturbed ocean. Therefore the change produced by both theſe luminaries in any place will be the ſame when acting together as when acting ſeparately; and it will be equal to the ſum, or the difference of their ſeparate changes, according as theſe would have been in the ſame or in oppoſite directions.

Let us now conſider the moſt intereſting circumſtances of the form of an elliptical tide, which differs very little from a ſphere.

Let T (fig. 2.) be a point in the ſurface of the inſcribed ſphere, and let Z expreſs the angular diſtance TOQ from the longer axis of the ſurrounding ſpheroid $S\,m\,N\,q$. Let TR, TW be perpendicular to the equatorial diameter and to the axis, ſo that they are the coſine and the ſine of TOQ to the radius TO or QO. Let $S\,q\,N$ be a ſection of the circumſcribed ſphere. Draw OT cutting the ſpheroid in Z and the circumſcribed ſphere in t. Alſo let $s\,o\,n$ be a ſection of a ſphere which has the ſame capacity with the ſpheroid, and let it cut the radius in r. Then,

1. The elevation TZ of the point Z of the ſpheroid above the inſcribed ſphere is $= Qq \times \text{coſ.}^2 Z$, and the depreſſion tZ below the circumſcribed ſphere is $= Qq \times \text{ſine}^2 Z$. Produce RΓ till it meet the ſurface of the ſpheroid in V. The minute triangle VΓZ may be conſidered as a rectilineal, right-angled at Z, and therefore ſimilar to OTR. Therefore $OT : TR = \Gamma V : \Gamma Z$. But in the ellipſe OQ, or $OT : TR = Qq : \Gamma V$. Therefore $OT^2 : TR^2 = Qq : \Gamma Z$, and $\Gamma Z = \frac{Qq \cdot TR^2}{OT^2}, = Qq : \frac{Qq \times \text{coſ.}^2 Z}{1} = Qq \times \text{coſ.}^2 Z$.

And in the very ſame manner it may be ſhown, that $t\,Z = Qq \times \text{ſin.}^2 Z$.

2. The elevation of the point T above another point T′, whoſe angular diſtance TOT′ from the point T is 90°, is $= Qq \times \overline{\text{coſ.}^2 Z - \text{ſin.}^2 Z}$. Call the angle QOT′ Z′. Then $T'Z' = Qq \times \text{coſ.}^2 Z'$, and $TZ - T'Z' = Qq \times \overline{\text{coſ.}^2 Z - \text{coſ.}^2 Z'}$. But the arch QT′ is the complement of QT, and therefore $\text{coſ.}^2 Z' = \text{ſin.}^2 Z$. Therefore $TZ - T'Z' = Qq \times \overline{\text{coſ.}^2 Z - \text{ſin.}^2 Z}$.

3. $Qo = \frac{1}{3} Qq$. For the inſcribed ſphere is to the ſpheroid as OQ to Oq. But the inſcribed ſphere is to the ſphere $s\,o\,n$ as OQ^3 to Oo^3. Therefore becauſe the ſphere $s\,o\,n$ is equal to the ſpheroid $S\,q\,N$, we have $OQ : Oq = OQ^3 : Oo^3$, and Oo is the firſt of two mean proportionals between OQ and Oq. But Qq is very ſmall in compariſon with OQ. Therefore Qo is very nearly $\frac{1}{3}$ of Qq.

Since $s\,o\,n$ is the ſphere of equal capacity, it is the form of the undiſturbed ocean. The beſt way therefore of conceiving the changes of form produced by the ſun or moon, or by both together, is to conſider the elevations or depreſſions which they produce above or below this ſurface. Therefore,

4. The elevation rZ of the point Z above the equicapacious ſphere is evidently $= Qq \times \text{coſ.}^2 Z - \frac{1}{3} Qq$. Alſo the depreſſion rZ of the point Z is $= Qq \times \text{ſin.}^2 Z - \frac{2}{3} Qq$.

N. B. Either of theſe formulæ will anſwer for either the elevation above, or the depreſſion below, the natural ocean: For if $\text{coſ.}^2 Z$ is leſs than $\frac{1}{3}$, the elevation given by the formula will be negative; that is, the point is below the natural ſurface. In like manner, when $\text{ſin.}^2 Z$ is leſs than $\frac{2}{3}$, the depreſſion is negative, and the point is above the ſurface. But if $\text{coſ.}^2 Z$ be $= \frac{1}{3}$, or $\text{ſin.}^2 Z$ be $= \frac{2}{3}$, the point is in the natural ſurface. This marks the place where the ſpheroid and the equal ſphere interſect each other, viz. in P, the arch Po being 54° 44′ very nearly, and PS = 35° 16′.

Let S repreſent the whole elevation of the pole of the ſolar tide above its equator, or the difference between high and low water produced by the ſun; and let M repreſent the whole elevation produced by the moon. Let x and y repreſent the zenith diſtances of the ſun and moon with reſpect to any point whatever on the ocean. Then x and y will be the arches intercepted between that point and the ſummits of the ſolar and lunar tides. Then the elevation produced by both luminaries in that plane is $S \cdot \text{coſ.}^2 x - \frac{1}{3} S + M \cdot \text{coſ.}^2 y - \frac{1}{3} M$; or, more conciſely, $S \cdot \text{coſ.}^2 x + M \cdot \text{coſ.}^2 y - \frac{1}{3}\,\overline{S + M}$, and the depreſſion is $S \cdot \text{ſin.}^2 x + M \cdot \text{ſin.}^2 y - \frac{2}{3}\,\overline{S + M}$.

Let the ſun and moon be in the ſame point of the heavens. The ſolar and lunar tides will have the ſame axis; the coſines of x and y will each be 1, and the elevation at the compound pole will be $S + M - \frac{1}{3}\,\overline{S + M} = \frac{2}{3}\,\overline{S + M}$. The depreſſion at any point 90° from this pole will be $\frac{1}{3}\,\overline{S + M}$, and the whole tide is $S + M$.

Let the moon be in quadrature, as in a (fig. 3). The appearance at s will be known, by conſidering that in this place the coſine of x is 1, and the coſine of y is 0. Therefore the elevation at $s = S - \frac{1}{3}\,\overline{S + M}, = \frac{2}{3} S - \frac{1}{3} M$. The depreſſion at $a = S - \frac{2}{3}\,\overline{S + M} = \frac{1}{3} S - \frac{2}{3} M$. The difference or whole tide $= \overline{S - M}$.

In

In like manner, the whole elevation at a above the inscribed sphere is M — S.

Hence we see that the whole tide, when the moon is in quadrature, is the difference of S and M. We also see, that if M exceeds S, the water will be higher at a than at s. Now it is a matter of observation, that in the quadratures it is high water under the moon, and low water under the sun. It is also a matter of observation, that in the free ocean, the ebb tide, or the water at s, immediately under the sun, is below the natural surface of the ocean. Hence we must conclude, that $\frac{2}{3}$ S is less than $\frac{1}{3}$ M, or that M is more than double of S. This agrees with the phenomena of nutation and precession, which seem to make S $= \frac{2}{5}$ of M.

In all other positions of the sun and moon, the place of high water will be different. It is high water where the sum of the elevations produced by both luminaries above the natural ocean is greatest; and the place of low water is where the depression below the natural ocean is greatest. Therefore, in order that it may be high water, we must have $S \cdot \text{cos.}^2 x + M \cdot \text{cos.}^2 y - \frac{1}{3}\overline{S + M}$ a maximum; or, neglecting the constant quantity $\frac{S + M}{3}$, we must have $S \cdot \text{cos.}^2 x + M \cdot \text{cos.}^2 y$ a maximum.

In like manner, to have low water in a place where the zenith distances of the sun and moon are v and w, we must have $S \cdot \text{sin.}^2 v + M \cdot \text{sin.}^2 w$ a maximum.

Lemma 1. If we consider the sines and cosines of angles as numeral fractions of the radius 1, then we have $\text{cos.}^2 Z = \frac{1}{2} + \frac{1}{2}\,\text{cos.}\,2 Z$, and $\text{sin.}^2 Z = \frac{1}{2} - \frac{1}{2}\,\text{cos.}\,2 Z$.

Let $a\,m\,s$ (fig. 3.) be a quadrant of a circle of which O is the centre, and O s is the radius. On O s describe the semicircle OMS, cutting O m in M. Draw s M, and produce it till it cut the quadrant in n. Also draw MC to the centre of the semicircle, and MD and $n\,d$ perpendicular to O s.

It is plain that s M is perpendicular to OM; and if O s be radius, s M is the sine of the angle s OM, which we may call Z; OM is its cosine: and because O s . OM = OM : OD, and O s : OD = O s^2 : OM^2, and OD may represent cos.^2 Z. Now OD = OC + CD. If O s = 1, then OC $= \frac{1}{2}$. CD = CM · cos. MCD, = CM · cos. 2 MOD, $= \frac{1}{2} \cdot \text{cos.}\,2$ Z. Therefore $\text{cos.}^2 Z = \frac{1}{2} + \frac{1}{2}\,\text{cos.}\,2 Z$.

In like manner, because O s : s M = s M : s D, s D is = sin.^2 Z. This is evidently $= \frac{1}{2} - \frac{1}{2}\,\text{cos.}\,2 Z$.

Lemma 2. $\text{Cos.}^2 Z - \text{sin.}^2 Z = \text{cos.}\,2 Z$. For, because s M is perpendicular to OM, the arch $s\,n$ is double of the arch $s\,m$, and because MD is parallel to $n\,d$, $s\,d$ is = 2 s D, and d D = sin.^2 Z. Therefore O d = $\text{cos.}^2 Z - \text{sin.}^2 Z$. But O d is the cosine of $n\,s$, = cos. 2 Z, and $\text{cos.}^2 Z - \text{sin.}^2 Z = \text{cos.}\,2 Z$.

By the first Lemma we see, that in order that there may be high water at any place, when the zenith distances of the sun and moon are x and y, we must have $S \cdot \text{cos.}\,2 x + M \cdot \text{cos}\,2 y$ a maximum.

That this may be the case, the fluxion of this formula must be = 0. Now we know that the fluxions of the cosines of two arches are as the sines of those arches. Therefore we must have $S \cdot \text{sin.}\,2 x + M \cdot \text{sin.}\,2 y = 0$, or $S \cdot \text{sin.}\,2 x = - M \cdot \text{sin.}\,2 y$, which gives us $\text{sin.}\,2 x : \text{sin.}\,2 y = M : S$.

In like manner, the place of low water requires $\text{sin.}\,2 v : \text{sin.}\,2 w = M : S$.

From this last circumstance we learn, that the place of low water is 90° removed from the place of high water; whereas we might have expected, that the spheroid would have been most protuberant on that side on which the moon is: For the sines of 2 v and of 2 w have the same proportion with the sines of 2 x and of 2 y. Now we know that the sine of the double of any arch is the same with the sine of the double of its complement. Therefore if low water be really distant 90° from high water, we shall have $\text{sin.}\,2 x : \text{sin.}\,2 y = \text{sin.}\,2 v : \text{sin.}\,2 w$. But if it is at any other place, the sines cannot have this proportion.

Now let s be the point of the earth's surface which has the sun in the zenith, and m the point which has the moon in the zenith. Let a be any other point. Draw O a cutting the semicircle OM s in H. Make CM to CS as the disturbing force of the moon to that of the sun; and draw S v parallel, and S t, M r perpendicular to HH. Join MH and MH. The angle HC s is double of the angle HO s, and MCH is double of MOH, or of its equal MOH. Because HMH is a semicircle, HM is perpendicular to MO. Therefore if HH be considered as radius, HM is the sine, and HM is the cosine of MOH. And C r is = MC · cos. 2 y, = M · cos. 2 y. And C t = SC · cos. 2 x. Therefore $t\,r$ or S v is = S · cos. 2 x + M · cos. 2 y. Therefore $t\,r$ or S v will express the whole difference of elevation between b and the points that are 90 degrees from it on either side (by *Lemma* 2.); and if b be the place of high water, it will express the whole tide, because the high and low waters were shewn to be 90° asunder. But when b is the place of high water, S v is a maximum. Because the place of the moon, and therefore the point M, is given, S v will be a maximum when it coincides with SM, and CH is parallel to SM.

This suggests to us the following neat, and not inelegant, solution of the problem for determining the place of high water.

Let s Q $o\,q\,s$ (fig. 4. and 5.) be a section of the terraqueous globe, by a plane passing through the sun and moon, and let O be its centre. Let s be the point which is immediately under the sun, and m the place immediately under the moon. Bisect O s in C, and describe round C the circle OM s LO, cutting O m in M. Take CM to represent the disturbing force of the moon, and make C s to CS as the force of the moon to that of the sun (supposing this ratio to be known). Join MS, and draw CH parallel to it. Draw OH h, and l OL l perpendicular to it. And lastly, draw CI perpendicular to $l\,l$. Then we say that m and its opposite m' are the places of high water, l and l are the places of low water, MS is the height of the tide, and MI, SI are the portions of this tide produced by the moon and sun.

For it is plain, that in this case the line S v of the last proposition coincides with MS, and is a maximum. We may also observe, that MC : CS = sin. MSC : sin. SMC, = sin. HCS : sin. MCH, = sin. 2 h O s : sin. 2 h O m, = sin. 2 x : sin 2 y, or M : S = sin. 2 x : sin. 2 y, agreeably to what was required for the maximum.

It is also evident, that MI = MC · cos. CMI, = M · cos. 2 y, and SI = SC · cos. ISC, = S · cos. 2 x; and therefore MS is the difference of elevation between h and the points l and l, which are 90° from it, and is therefore the place of low water; that is, MS is the whole tide.

The elevation of every other point may be determined in the same way, and thus may the form of the spheroid be completely determined.

If we suppose the figure to represent a section through the earth's equator (which is the case when the sun and moon are in the equator), and farther suppose the two luminaries to be in conjunction, the ocean is an oblong spheroid, whose axis is in the line of the syzigies, and whose equator coincides with the six hour circle. But if the moon be in any other point of the equator, the figure of the ocean will be very complicated. It will not be any figure of revolution; because neither its equator (or most depressed

part,

part), nor its meridians, are circles. The most depressed part of the equator will be in that section through the axis which is perpendicular to the plane in which the luminaries are situated. And this greatest depression, and its shortest equatorial diameter, will be constant, while its other dimensions vary with the moon's place. We need not inquire more minutely into its form; and it is sufficient to know, that all the sections perpendicular to the plane passing thro' the sun and moon are ellipses.

This construction will afford us a very simple, and, we hope, a very perspicuous explanation of the chief phenomena of the tides. The well informed reader will be pleased with observing its coincidence with the algebraic solution of the problem given by Daniel Bernoulli, in his excellent dissertation on the Tides, which shared with M'Laurin and Euler the prize given by the Academy of Sciences at Paris, and with the ease and perspicuity with which the phenomena are deducible from it, being in some sort exhibited to the eye.

In our application, we shall begin with the simplest cases, and gradually introduce the complicating circumstances which accommodate the theory to the true state of things.

We begin, therefore, by supposing the earth covered, to a proper depth, with water, forming an ocean concentric with its solid nucleus.

In the next place, we suppose that this ocean adopts in an instant the form which is consistent with the equilibrium of gravity and the disturbing forces.

Thirdly, We suppose the sun stationary, and the moon to move eastward from him above $12\frac{1}{4}°$ every day.

Fourthly, We suppose that the solid nucleus turns round its proper axis to the eastward, making a rotation in 24 solar hours. Thus any place of observation will successively experience all the different depths of water.

Thus we shall obtain a certain SUCCESSION of phenomena, precisely similar to the succession observed in nature, with this sole difference, that they do not correspond to the contemporaneous situations of the sun and moon. When we shall have accounted for this difference, we shall presume to think that we have given a just theory of the tides.

We begin with the simplest case, supposing the sun and moon to be always in the equator. Let the series begin with the sun and moon in conjunction in the line O *s*. In this case the points *s*, *m*, and *h* coincide, and we have high water at 12 o'clock noon and midnight.

While the moon moves from *s* to Q, O *m* cuts the upper semicircle in M; and therefore CH, which is always parallel to MS, lies between MC and C *s*. Therefore *h* is between *m* and *s*, and we have high water after 12 o'clock, but before the moon's southing. The same thing happens while the moon moves from *o* to *q*, during her third quarter.

But while the moon moves from her first quadrature in Q to opposition in *o* (as in fig. 5.), the line *m* O drawn from the moon's place, cuts the lower semicircle in M and CH, parallel to SM, again lies between M and *s*, and therefore *h* lies between *m* and *o*. The place of high water is to the eastward of the moon, and we have high water after the moon's southing. The same thing happens while the the moon is moving from her last quadrature in *q* to the next syzygy. In short, the point H is always between M and *s*, and the place of high water is always between the moon and the *nearest* syzygy. The place of high water overtakes the moon in each quadrature, and is overtaken by the moon in each syzygy. Therefore during the first and third quarters, the place of high water gradually falls behind the moon for some time, and then gains upon her again, so as to overtake her in the next quadrature. But during the second and fourth quarters, the place of high water advances before the moon to a certain distance, and then the moon gains upon it, and overtakes it in the next syzygy.

If therefore we suppose the moon to advance uniformly along the equator, the place of high water moves unequally, slowest in the times of new and full moon, and swiftest in the time of the quadratures. There must be some intermediate situations where the place of high water neither gains nor loses upon the moon, but moves with the same velocity.

The rate of motion of the point *h* may be determined as follows: Draw C *i*, S *n*, making very small and equal angles with HC and MS. Draw *n* C, and about S, with the distance S *n*, describe the arch *n v*, which may be considered as a straight line perpendicular to *n* S, or to MS.

Then, because SM and S *n* are parallel to CH and C *i*, the points *n* and *i* are contemporaneous situations of M and H, and the arches *n* M, *i* H, are in the ratio of the angular motions of *m* and *h*. Also, because *n v* and *n* M are perpendicular to *n* S and *n* C, the angle *v n* M is equal to the angle S *n* C, or SMC. Also, because the angles *n v* M and MIC are right angles, and the angles *v n* M, CMI, are also equal, the triangles *v n* M, CMI, are similar. Therefore

n M : $n v$ = MC : MI. And

$n v$: iH = n S : i C, or = MS : MC; therefore

n M : i H = MS : MI. Therefore the angular motion of the moon is to the angular motion of the place of high water as MS to MI.

Therefore, when M'S is perpendicular to SC, and the point I coincides with S, the motion of high water is equal to that of the moon. But when M'S is perpendicular SC, H'C is also perpendicular to C *s*, and the angle *h'* O *s* is 45°, and the high water is in the octant. While the moon passes from *s* to *m'*, or the high water from *s* to *h'*, the point I falls between M and S, and the motion of high water is slower than that of the moon. The contrary obtains while the moon moves from *m'* to Q, or the high water from the octant to the quadrature.

It is evident, that the motion of *h* in the third quarter of the lunation, that is, in passing from *o* to *q*, is similar to its motion from *s* to Q. Also, that its motion from Q to *o* must retard by the same degrees as it accelerated in passing from *s* to Q, and that its motion in the last quarter from *q* to *s* is similar to its motion from Q to *o*.

At new and full moon the point I coincides with C, and the point M coincides with *s*. Therefore the motion of the high water at full and change is to the motion of the moon as *s* C to *s* S. But when the moon is in quadrature, I coincides with C, and M with *o*. Therefore the motion of the moon is to that of high water as OS to OC or *s* C. Therefore the motion of high water at full and change is to its motion in the quadratures as OS to S *s*, or as the difference of the disturbing forces to their sum. The motion of the tide is therefore slowest in the syzygies and swiftest in the quadratures; yet even in the syzygies it passes the sun along with the moon, but more slowly.

Let the interval between the morning tide of one day and that of the next day be called a *tide-day*. This is always greater than a solar day, or 24 hours, because the place of high water is moving faster to the eastward than the sun. It is less than a lunar day, or 24h. 50', while the high water passes from the second to the third octant, or from the fourth to the first. It is equal to a lunar day when high water is in the octants, and it exceeds a lunar day while high water passes from the first to the second octant, or from the third to the fourth.

The difference between a solar day and a tide day is called,

called the PRIMING or the RETARDATION of the tides. This is evidently equal to the time of the earth's defcribing in its rotation an angle equal to the motion of the high water in a day from the fun. The fmalleft of thefe retardations is to the greateft as the difference of the difturbing forces to their fum. Of all the phenomena of the tides, this feems liable to the feweft and moft inconfiderable derangements from local and accidental circumftances. It therefore affords the beft means for determining the proportion of the difturbing forces. By a comparifon of a great number of obfervations made by Dr Mafkelyne at St Helena and at Barbadoes (places fituated in the open fea), it appears that the fhorteft tide-day is 24h. 37′, and the longeft is 25h. 27′. This gives M — S : M + S = 37 : 87, and S : M = 2 : 4,06; which differs only 1 part in 124 from the proportion of 2 to 5, which Daniel Bernoulli collected from a variety of different obfervations. We fhall therefore adopt the proportion of 2 to 5 as abundantly exact. It alfo agrees exactly with the phenomena of the nutation of the earth's axis and the preceffion of the equinoxes; and the aftronomers affect to have deduced this proportion from thefe phenomena. But an intelligent reader of their writings will perceive more fineffe than juftice in this affertion. The nutation and preceffion *do not* afford phenomena of which we can affign the fhare to each luminary with fufficient precifion for determining the proportion of their difturbing forces; and it is by means of many arbitrary combinations, and without neceffity, that D'Alembert has made out this ratio. We cannot help being of opinion, that D'Alembert has accommodated his diftribution of the phenomena to this ratio of 2 to 5, which Daniel Bernoulli (the beft philofopher and the moft candid man of that illuftrious family of mathematicians) had, with fo much fagacity and juftnefs of inference, deduced from the phenomena of the tides. D'Alembert could not but fee the value of this inference; but he wanted to fhow his own addrefs in deducing it *proprio marte* forfooth from the nutation and preceffion. His procedure in this refembles that of his no lefs vain countryman De la Place, who affects to be highly pleafed with finding that Mr Bode's difcovery that Meyer had feen the Georgium Sidus in 1756, perfectly agreed with the theory of its motions which he (De la Place) had deduced from his own doctrines. Any well informed mathematician will fee, that De la Place's data afforded no fuch precifion; and the book on the Elliptical Motions of the Planets, to which he alludes, contains no grounds for his inference. This obfervation we owe to the author of a paper on that fubject in the Tranfactions of the Royal Society of Edinburgh. We hope that our readers will excufe this occafional obfervation, by which we wifh to do juftice to the merit of a modeft man, and one of the greateft philofophers of his time. Our only claim in the prefent differtation is the making his excellent performance on the tides acceffible to an Englifh reader not much verfant in mathematical refearches; and we are forry that our limits do not admit any thing more than a fketch of it. But to proceed.

Affuming 2 : 5 as the ratio of SC to CM, we have the angle CMS = 23° 34′ nearly, and $m'ob'$ = 11° 47′; and this is the greateft difference between the moon's place and the place of high water. And when this obtains, the moon's elongation $m'os$ is 56° 47′ from the neareft fyzigy. Hence it follows, that while the moon moves uniformly from 56° 47′ weft elongation to 56° 47′ eaft, or from 123° 13′ eaft to 123° 13′ weft, the tide day is fhorter than the lunar day; and while fhe moves from 56° 47′ eaft to 123° 13′, or from 123° 13′ weft to 56° 47′, the tide-day is longer than the lunar-day.

We now fee the reafon why

———The fwelling tides obey the moon.

The time of high water, when the fun and moon are in the equator, is never more than 47 minutes different from that of the moon's fouthing (+ or — a certain fixed quantity, to be determined once for all by obfervation.)

It is now an eafy matter to determine the hour of high water correfponding to any pofition of the fun and moon in the equator. Suppofe that on the noon of a certain day the moon's diftance from the fun is ms. The conftruction of this problem gives us sh, and the length of the tide day. Call this T. Then fay 360° : sm = T : t, and t is the hour of high water.

Or, if we choofe to refer the time of high water to the moon's fouthing, we muft find the value of mh at the time of the moon's fouthing, and the difference d between the tide day and a mean lunar day L, and fay 360 : mh = d : t, the time of high water before the moon's fouthing in the firft and third quarters, but after it in the fecond and fourth. The following table by Daniel Bernoulli exhibits thefe times for every 10th degree of the moon's elongation from the fun. The firft or leading column is the moon's elongation from the fun or from the point of oppofition. The fecond column is the minutes of time between the moon's fouthing and the place of high water. The marks — and + diftinguifh whether the high water is before or after the moon's fouthing. The third column is the hour and minute of high water. But we muft remark, that the firft column exhibits the elongation, not on the noon of any day, but at the very time of high water. The two remaining columns exprefs the heights of the tides and their daily variations.

ms.	mh.	sh.	MS.	Mσ.
°	′	h. ′		
0	0	0. 0	1000	
	—			13
10	11½—	0.28½	987	38
20	22 —	0.58	949	62
30	31½—	1.28½	887	81
40	40 —	2.—	806	91
50	45 —	2.35	715	105
60	46½—	3.13½	610	92
70	40½—	3.49½	518	65
80	25 —	4.55	453	24
90	0	6.—	429	—
	+			24
100	25 +	7. 5	453	65
110	40½+	8. 0½	518	92
120	46½+	8.46½	610	105
130	45 +	9.25	715	91
140	40 +	10.—	806	81
150	31½+	10.31½	887	62
160	22 +	11. 2	949	38
170	11½+	11.31½	987	13
180	0	12.—	1000	

The height of high water above the low water conftitutes what is ufually called the tide. This is the interefting circumftance in practice. Many circumftances render it almoft impoffible to fay what is the elevation of high water above the natural furface of the ocean. In many places the furface at low water is above the natural furface of the ocean. This is the cafe in rivers at a great diftance from

Tide. their mouths. This may appear abfurd, and is certainly very paradoxical; but it is a fact eftablifhed on the moft unexceptionable authority. One inftance fell under our own obfervation. The low water mark at fpring tide in the harbour of Alloa was found by accurate levelling to be three feet higher than the top of the ftone pier at Leith, which is feveral feet above the high water mark of this harbour. A little attention to the motion of running waters will explain this completely. Whatever checks the motion of water in a canal muft raife its furface. Water in a canal runs only in confequence of the declivity of this furface: (See RIVER). Therefore a flood tide coming to the mouth of a river checks the current of its waters, and they accumulate at the mouth. This checks the current farther up, and therefore the waters accumulate there alfo; and this checking of the ftream, and confequent rifing of the waters, is gradually communicated up the river to a great diftance. The water rifes everywhere, though its furface ftill has a flope. In the mean time, the flood tide at the mouth paffes by, and an ebb fucceeds. This muft accelerate even the ordinary courfe of the river. It will more remarkably accelerate the river now raifed above its ordinary level, becaufe the declivity at the mouth will be fo much greater. Therefore the waters near the mouth, by accelerating, will fink in their channel, and increafe the declivity of the canal beyond them. This will accelerate the waters beyond them; and thus a ftream more rapid than ordinary will be produced along the whole river, and the waters will fink below their ordinary level. Thus there will be an ebb below the ordinary furface as well as a flood above it, however floping that furface may be.

Hence it follows, that we cannot tell what is the natural furface of the ocean by any obfervations made in a river, even though near its mouth. Yet even in rivers we have regular tides, fubjected to all the varieties deduced from this theory.

We have feen that the tide is always proportional to MS. It is greateft therefore when the moon is in conjunction or oppofition, being then S s, the fum of the feparate tides produced by the fun and moon. It gradually decreafes as the moon approaches to quadrature; and when fhe is at Q or q, it is SO, or the difference of the feparate tides. Suppofing S s divided into 1000 equal parts, the length of MS is expreffed in thefe parts in the fourth column of the foregoing table, and their differences are expreffed in the fifth column.

We may here obferve, that the variations of the tides in equal fmall times are proportional to the fine of twice the diftance of the place of high water from the moon. For fince M n is a conftant quantity, on the fuppofition of the moon's uniform motion, M v is proportional to the variation of MS. Now M n : M v = MC : CI = 1 : fin. 2 y, and M n and MC are conftant quantities.

Thus we have feen with what eafe the geometrical conftruction of this problem not only explains all the interefting circumftances of the tides, but alfo points them out, almoft without employing the judgment, and exhibits to the eye the gradual progrefs of each phenomenon. In thefe refpects it has great advantages over the very elegant algebraic analyfis of Mr Bernoulli. In that procefs we advance almoft without ideas, and obtain our folutions as detached facts, without perceiving their regular feries. This is the ufual pre-eminence of geometrical analyfis; and we regret that Mr Bernoulli, who was eminent in this branch, did not rather employ it. We doubt not but that he would have fhown ftill more clearly the connection and gradual progrefs of every particular. His aim, however, being to inftruct thofe who were to calculate tables of the different affections of the tides, he adhered to the algebraic method. Unfortunately it did not prefent him with the eafieft formulæ for practice. But the geometrical conftruction which we have given fuggefts feveral formulæ which are exceedingly fimple, and afford a very ready mode of calculation. Tide.

The fundamental problems are to determine the angle s O h or m O h, having m O s given; and to determine MS.

Let the given angle m O s be called a; and, to avoid the ambiguity of algebraic figns, let it always be reckoned from the neareft fyzigy, fo that we may always have a equal to the fum of x and y. Alfo make $d^2 = \frac{S^2 \times \text{fin.}^2\, 2a}{M^2 + S^2 + 2\, M \times S \times \text{cof.}\, 2a}$, which reprefents the $\frac{S c^2}{S M^2}$ of fig. 4. or fin.^{2} 2 y, and make $p = \frac{S \times \text{fin.}\, 2a}{M + S \times \text{cof.}\, 2a}$, which is the expreffion of $\frac{Sc}{Mc}$ of that figure, or of tan. 2 y. Then we fhall have,

1. $\text{Sin.}\, y = \sqrt{\frac{1 - \sqrt{1 - d^2}}{2}}$. For we fhall have cof. $2y = \sqrt{1 - d^2}$. But fin.$^2 y = \frac{1}{2} - \frac{1}{2}$ cof. $2y = \frac{1 - \sqrt{1 - d^2}}{2}$, and fin. $y = \sqrt{\frac{1 - \sqrt{1 - d^2}}{2}}$.

2. $\text{Tan.}\, y = \frac{p}{1 + \sqrt{1 + p^2}}$. For becaufe p is = tan. $2y$, $\sqrt{1 + p^2}$ is the fecant of $2y$, and $1 + \sqrt{1 + p^2} : 1 = p : \text{tan.}\, y$.

Thefe proceffes for obtaining y directly are abundantly fimple. But it will be much more expeditious and eafy to content ourfelves with obtaining $2y$ by means of the value of its tangent, viz. $\frac{S \cdot \text{fin.}\, 2a}{M + S \cdot \text{cof.}\, 2a}$. Or, we may find x by means of the fimilar value of its tangent $\frac{M d}{S d}$ of fig. 4.

There is ftill an eafier method of finding both $2x$ and $2y$, as follows.

Make M + S : M − S = tan. a : tan. b. Then b is the difference of x and y, as a is their fum. For this analogy evidently gives the tangent of half the difference of the angles CSM and CMS of fig. 4. or of $2x$ and $2y$. Therefore to a, which is half the fum of $2x + 2y$, add b, and we have $2x = a + b$, or $x = \frac{a + b}{2}$, and $y = \frac{a - b}{2}$.

By either of thefe methods a table may be readily computed of the value of x or y for every value of a.

But we muft recollect that the values of S and M are by no means conftant, but vary in the inverfe triplicate ratio of the earth's diftance from the fun and moon; and the ratio of 2 to 5 obtains only when thefe luminaries are at their mean diftances from the earth. The forces correfponding to the perigean medium and apogean diftances are as follow.

			Sun.	Moon.
Apogean	-	-	1,901	4,258
Medium	-	-	2,	5,
Perigean	-	-	2,105	5,925

Hence we fee that the ratio of S to M may vary from 1,901 : 5,925 to 2,105 : 4,258, that is, nearly from 1 : 3 to 1 : 2, or from 2 : 6 to 2 : 4. The folar force does not vary much, and may be retained as conftant without any great error. But the change of the moon's force has great effects on the tides both as to their time and their quantity.

I. In

I. In reſpect of their Time.

1. The tide day following a ſpring tide is 24h. 27′ when the moon is in perigee, but 24h. 35′ when ſhe is in apogee.

2. The tide day following neap tide is 25h. 15′, and 25h. 40′ in theſe two ſituations of the moon.

3. The greateſt interval of time between high water and the moon's ſouthing is 39′ and 61; the angle y being 9° 45′ in the firſt caſe, and 15° 15′ in the ſecond.

II. In reſpect of their Heights.

1. If the moon is in perigee when new or full, the ſpring tide will be 8 feet inſtead of 7, which correſponds to her mean diſtance. The very next ſpring tide happens when ſhe is near her apogee, and will be 6 feet inſtead of 7. The neap tides happen when ſhe is at her mean diſtance, and will therefore be 3 feet.

But if the moon be at her mean diſtance when new or full, the two ſucceeding ſpring tides will be regular or 7 feet, and one of the neap tides will be 4 feet and the other only 2 feet.

Mr Bernoulli has given us the following table of the time of high water for theſe three chief ſituations of the moon, namely, her perigee, mean diſtance, and apogee. It may be had by interpolation for all intermediate poſitions with as great accuracy as can be hoped for in phenomena which are ſubject to ſuch a complication of diſturbances. The firſt column contains the moon's elongation from the ſun. The columns P, M, A, contain the minutes of time which elapſe between the moon's ſouthing and high water, according as ſhe is in perigee, at her mean diſtance, or in apogee. The ſign — indicates the priority, and + the poſteriority, of high water to the moon's ſouthing.

☽ and ⊙	P.	M.	A.
0	0	0	0
	—	—	—
10	9½	11½	14
20	18	22	27½
30	26	31½	39½
40	33	40	50
50	37½	45	56
60	38½	46½	58
70	33½	40½	50½
80	22	25	31
90	0	0	0
	+	+	+
100	21	25	31
110	33½	40½	50½
120	38½	46½	58
130	37½	45	50
140	33	40	5
150	26	31½	39½
160	18	22	27½
170	9½	11½	14
180	0	0	0

The reader will undoubtedly be making ſome compariſon in his own mind of the deductions from this theory with the actual ſtate of things. He will find ſome conſiderable reſemblances; but he will alſo find ſuch great differences as will make him very doubtful of its juſtneſs. In very few places does the high water happen within ⅛ths of an hour of the moon's ſouthing, as the theory leads him to expect; and in no place whatever does the ſpring tide fall on the day of new and full moon, nor the neap tide on the day of her quadrature. There always happen two or three days later. By comparing the difference of high water and the moon's ſouthing in different places, he will hardly find any connecting principle. This ſhows evidently that the cauſe of this irregularity is local, and that the juſtneſs of the theory is not affected by it. By conſidering the phenomena in a navigable river, he will learn the real cauſe of the deviation. A flood tide arrives at the mouth of a river. The true theoretical tide differs in no reſpect from a wave. Suppoſe a ſpring tide actually formed on a fluid ſphere, and the ſun and moon then annihilated. The elevation muſt ſink, preſſing the under waters aſide, and cauſing them to riſe where they were depreſſed. The motion will not ſtop when the ſurface comes to a level; for the waters arrived at that poſition with a motion continually accelerated. They will therefore paſs this poſition as a pendulum paſſes the perpendicular, and will riſe as far on the other ſide, forming a high water where it was low water, and a low water where it was high water; and this would go on for ever, oſcillating in a time which mathematicians can determine, if it were not for the viſcidity, or ſomething like friction, of the waters. If the ſphere is not fluid to the centre, the motion of this wave will be different. The elevated waters cannot ſink without diſplacing themſelves ſidewiſe, and occaſioning a great horizontal motion, in order to fill up the hollow at the place of low water. This motion will be greateſt about half way between the places of high and low water. The ſhallower we ſuppoſe the ocean the greater muſt this horizontal motion be. The reſiſtance of the bottom (tho' perfectly ſmooth and even) will greatly retard it all the way to the ſurface. Still, however, it will move till all be level, and will even move a little farther, and produce a ſmall flood and ebb where the ebb and flood had been. Then a contrary motion will obtain; and after a few oſcillations, which can be calculated, it will be inſenſible. If the bottom of the ocean (which we ſtill ſuppoſe to cover the whole earth) be uneven, with long extended valleys running in various directions, and with elevations reaching near the ſurface, it is evident that this muſt occaſion great irregularities in the motion of the undermoſt waters, both in reſpect of velocity and direction, and even occaſion ſmall inequalities on the ſurface, as we ſee in a river with a rugged bottom and rapid current. The deviations of the under currents will drag with them the contiguous incumbent waters, and thus occaſion greater ſuperficial irregularities.

Now a flood arriving at the mouth of a river, muſt act preciſely as this great wave does. It muſt be propagated up the river (or along it, even though perfectly level) in a certain time, and we ſhall have high water at all the different places in ſucceſſion. This is diſtinctly ſeen in all rivers. It is high water at the mouth of the Thames at three o'clock, and later as we go up the river, till at London bridge we have not high water till three o'clock in the morning, at which time it is again high water at the Nore. But, in the mean time, there has been low water at the Nore, and high water about half way to London; and while the high water is proceeding to London, it is ebbing at this intermediate place, and is low water there when it is high water at London and at the Nore. Did the tide extend as far beyond London as London is from the Nore, we ſhould have three high waters with two low waters interpoſed. The moſt remarkable inſtance of this kind is the Maragnon or Amazon river in South America. It appears by the obſervations of Condamine and others, that between Para, at the mouth of the river, and the conflux of the Madera

Tide.

dera and Maragnon, there are seven coexistent high waters, with six low waters between them. Nothing can more evidently shew that the tides in these places are nothing but the propagation of a wave. The velocity of its superficial motion, and the distance to which it will sensibly go, must depend on many circumstances. A deep channel and gentle acclivity will allow it to proceed much farther up the river, and the distance between the successive summits will be greater than when the channel is shallow and steep. If we apply the ingenious theory of Chevalier Buat, delivered in the article RIVER, we may tell both the velocity of the motion and the interval of the successive high waters. It may be imitated in artificial canals, and experiments of this kind would be very instructive. We have said enough at present for our purpose of explaining the irregularity of the times of high water in different places, with respect to the moon's southing. For we now see clearly, that something of the same kind must happen in all great arms of the sea which are of an oblong shape, and communicate by one end with the open ocean. The general tide in this ocean must proceed along this channel, and the high water will happen on its shores in succession. This also is distinctly seen. The tide in the Atlantic ocean produces high water at new and full moon at a later and later hour along the south coast of Great Britain in proportion as we proceed from Scilly islands to Dover. In the same manner it is later and later as we come along the east coast from Orkney to Dover. Yet even in this progress there are considerable irregularities, owing to the sinuosities of the shores, deep indented bays, prominent capes, and extensive ridges and valleys in the channel. A similar progress is observed along the coasts of Spain and France, the tide advancing gradually from the south, turning round Cape Finisterre, ranging along the north coast of Spain, and along the west and north coasts of France.

The attentive consideration of these facts will not only satisfy us with respect to this difficulty, but will enable us to trace a principle of connection amidst all the irregularities that we observe.

We now add, that if we note the difference between the time of high water of spring tide, as given by theory, for any place, and the *observed time* of high water, we shall find this interval to be very nearly constant thro' the whole series of tides during a lunation. Suppose this interval to be forty hours. We shall find every other phenomenon succeed after the same interval. And if we suppose the moon to be in the place where she was 40 hours before, the observation will agree pretty well with the theory, as to the succession of tides, the length of tide day, the retardations of the tides, and their gradual diminution from spring to neap tide. We say pretty well; for there still remain several small irregularities, different in different places, and not following any observable law. These are therefore local, and owing to local causes. Some of these we shall afterwards point out. There is also a general deviation of the theory from the real series of tides. The neap tides, and those adjoining, happen a little earlier than the corrected theory points out. Thus at Brest (where more numerous and accurate observations have been made than at any other place in Europe), when the moon changes precisely at noon, it is high water at [illegible]h. [illegible]8′. When the moon enters her second quarter at noon, it is high water at [illegible]h. 4[illegible], instead of 9h. 48′, which theory assigns.

Something similar, and within a very few minutes equal, to this is observed in *every* place on the sea-coast. This is therefore something general, and indicates a real defect in the theory.

But this arises from the same cause with the other general deviation, viz. that the greatest and least tides do not happen on the days of full and half moon, but a certain time after. We shall attempt to explain this.

Tide.

We set out with the supposition, that the water acquired in an instant the elevation competent to its equilibrium. But this is not true. No motion is instantaneous, however great the force; and every motion and change of motion produced by a sensible or finite force increases from nothing to a sensible quantity by infinitely small degrees. Time elapses before the body can acquire any sensible velocity; and in order to acquire the same sensible velocity by the action of different forces acting similarly, a time must elapse inversely proportional to the force. An infinitely small force requires a finite time for communicating even an infinitely small velocity; and a finite force, in an infinitely small time, communicates only an infinitely small velocity; and if there be any kind of motion which changes by insensible degrees, it requires a finite force to prevent this change. Thus a bucket of water, hanging by a cord lapped round a light and easily moveable cylinder, will run down with a motion uniformly accelerated; but this motion will be prevented by hanging an equal bucket on the other side, so as to act with a finite force. This force prevents only infinitely small accelerations.

Now let ALKF (fig. 6.) be the solid nucleus of the earth, surrounded by the spherical ocean *bhdg*. Let this be raised to a spheroid BHIG by the action of the moon at M, or in the direction of the axis CM. If all be at rest, this spheroid may have the form precisely competent to its equilibrium. But let the nucleus, with its spheroidal ocean, have a motion round C in the direction AFKL from west to east. When the line of water BA is carried into the situation *sq* infinitely near to BA, it is no longer in equilibrio; for *s* is too elevated, and the part now come to B is too much depressed. There is a force tending to depress the waters at *s*, and to raise those now at B; but this force is infinitely small. It cannot therefore restore the shape competent to equilibrium till a sensible time has elapsed; therefore the disturbing force of the moon cannot keep the summit of the ocean in the line MC. The force must be of a certain determinate magnitude before it can in an instant undo the instantaneous effect of the rotation of the waters and keep the summit of the ocean in the same place. But this effect is possible; for the depression at *s* necessary for this purpose is nearly as the distance from B, being a depression, not from a straight line, but from a circle described with the radius CB. It is therefore an infinitesimal of the first order, and may be restored in an instant, or the continuation of the depression prevented by a certain finite force. Therefore there is some distance, such as B*y*, where the disturbing force of the moon may have the necessary intensity. Therefore the spherical ocean, instead of being kept continually accumulated at B and D, as the waters turn round, will be kept accumulated at *y* and *y′*, but at a height somewhat smaller. It is much in this way that we keep melted pitch or other clammy matter from running off from a brush, by continually turning it round, and it hangs protuberant, not from the lowest point, but from a point beyond it, in the direction of its motion. The facts are very similar. The following experiment will illustrate this completely, and is quite a parallel fact. Conceive GDH, the lower half of the ellipse, to be a supple heavy rope or chain hanging from a roller with a handle. The weight of the rope makes it hang in an oblong curve, just as the force of the moon raises the waters of the ocean. Turn the roller very slowly, and the rope, unwinding at one side and winding up on the other side of the roller, will continue to form the same curve: but turn the roller very briskly in the direction FKL, and the rope will now hang like the curve *uy′v*, considerably advanced

advanced from the perpendicular, fo far, to wit, that the force of gravity may be able in an inftant to undo the infinitely fmall elevation produced by the turning.

We are very anxious to have this circumftance clearly conceived, and its truth firmly eftablifhed; becaufe we have obferved it to puzzle many perfons not unaccuftomed to fuch difcuffions: we therefore hope that our readers, who have got over the difficulty, will indulge us while we give yet another view of this matter, which leads to the fame conclufion.

It is certain that the interval between high and low water is not fufficient for producing all the accumulation neceffary for equilibrium in an ocean fo very fhallow. The horizontal motion neceffary for gathering together fo much water along a fhallow fea would be prodigious. Therefore it never attains its full height; and when the waters, already raifed to a certain degree, have paffed the fituation immediately under the moon, they are ftill under the action of accumulating forces, although thefe forces are now diminifhed. They will continue rifing, till they have fo far paft the moon that their fituation fubjects them to depreffing forces. If they have acquired this fituation with an accelerated motion, they will rife ftill farther by their inherent motion, till the depreffing forces have deftroyed all their acceleration, and then they will begin to fink again. It is in this way that the nutation of the earth's axis produces the greateft inclination, not when the inclining forces are greateft, but three months after. It is thus that the warmeft time of the day is a confiderable while after noon, and that the warmeft feafon is confiderably after midfummer. The warmth increafes till the momentary wafte of heat exceeds the momentary fupply. We conclude by faying, that it may be demonftrated, that, in a fphere fluid to the centre, the time of high water cannot be lefs, and may be more, than three lunar hours after the moon's fouthing. As the depth of the ocean diminifhes, this interval alfo diminifhes.

It is perhaps impoffible to affign the diftance By at which the fummit of the ocean may be kept while the earth turns round its axis. We can only fee, that it muft be lefs when the accumulating force is greater, and therefore lefs in fpring tides than in neap tides; but the difference may be infenfible. All this depends on circumftances which we are little acquainted with: many of thefe circumftances are local; and the fituation of the fummit of the ocean, with refpect to the moon, may be different in different places.

Nor have we been able to determine theoretically what will be the height of the fummit. It will certainly be lefs than the height neceffary for perfect equilibrium. Daniel Bernoulli fays, that, after very attentive confideration, he is convinced that the height at new or full moon will be to the theoretical height as the cofine of the angle BCy to radius, or that the height at y will be $\mathrm{B}b \times \frac{\mathrm{C}x}{\mathrm{C}b}$.

The refult of all this reafoning is, that we muft always fuppofe the fummit of the tide is at a certain diftance eaftward from the place affigned by the theory. Mr Bernoulli concludes, from a very copious comparifon of obfervations at different places, that the place of high water is about 20 degrees to the eaftward of the place affigned by the theory. Therefore the table formerly given will correfpond with obfervation, if the leading column of the moon's elongation from the fun be altered accordingly. We have inferted it again in this place, with this alteration, and added three columns for the times of high water. Thus changed it will be of great ufe.

We have now an explanation of the acceleration of the neap tides, which fhould happen 6 hours later than the fpring tides. They are in fact tides correfponding to pofitions of the moon, which are 20° more, and not the real fpring and neap tides. Thefe do not happen till two days after; and if the really greateft and leaft tides be obferved, the leaft will be found 6 hours later than the firft.

Elon. of Moon.	High Water before or after Moon's Southing.			Time of High Water.		
	Perigee.	M. Dift.	Apogee.	Perigee.	M. Dift.	Apogee.
0	18 after	22 after	27½ after	0.18	0.22	0.27
10	9½ do.	11½	14	0.40½	0.51½	0.54
20	0 do.	0	0	1.20	1.20	1.20
30	9½ bef.	11½ bef.	14 bef.	1.50½	1.48	1.46
40	18 do.	22	27½	2.22	2.18	2.12
50	26	31½	39½	2.54	2.48	2.40
60	33	40	50	3.27	3.20	3.10
70	37½	45	[illegible]	4.02½	3.55	3.42
80	38½	46½	58	4.41½	4.33	4.22
90	33½	40½	50½	5.26½	5.19	5.09
100	22	25	31	6.10	6.15	6.09
110	0	0	0	7.20	7.20	7.20
120	22 after	25 after	31 after	8.21	8.25	8.31
130	33½ after	40½	50½	9.13½	9.20	9.30
140	38½	46½	58	9.58½	10.06	10.18
150	37½	45	56	10.37½	10.43	10.56
160	33	40	[illegible]	11.13	11.20	11.30
170	26	31½	39½	11.46	11.51	11.59
180	18	22	27½	0.18	0.22	0.27

This table is general; and exhibits the time of high water, and their difference from thofe of the moon's fouthing, in the open fea, free from all local obftructions. If therefore the time of high water in any place on the earth's equator (for we have hitherto confidered no other) be different from this table (fuppofed correct), we muft attribute the difference to the diftinguifhing circumftances of the fituation. Thus every place on the equator fhould have high water on the day that the moon, fituated at her mean diftance, changes precifely at noon, at 22 minutes paft noon; becaufe the moon paffes the meridian along with the fun by fuppofition. Therefore, to make ufe of this table, we muft take the difference between the firft number of the column, intitled time of high water, from the time of high water at full and change peculiar to any place, and add this to all the other numbers of that column. This adapts the table to the given place. Thus, to know the time of high water at Leith when the moon is 50° eaft of the fun, at her mean diftance from the earth, take 22′ from 4h. 30′, there remains 4.08. Add this to 2h. 48′, and we have 6h. 56′ for the hour of high water. (The hour of high water at new and full moon for Edinburgh is marked 4h. 30′ in Mafkelyne's tables, but we do not pretend to give this as the exact determination. This would require a feries of accurate obfervations.)

It is by no means an eafy matter to afcertain the time of high water with precifion. It changes fo very flowly, that we may eafily miftake the exact minute. The [illegible] is to have a pipe with a fmall hole near its bottom, and a float with a long graduated rod. The water gets in by the fmall hole and raifes the float, and the [illegible] of the hole prevents the fudden and irregular ftarts which waves would occafion. Inftead of obferving the moment of high water, obferve the height of the road about half an hour before, and wait after high water till the rod comes again to that height: take the middle between them. The water [illegible]

Tide.

sensibly half an hour before the top of the tide, and quickly changes the height of the rod, so that we cannot make a great mistake in the time.

Mr Bernoulli has made a very careful comparison of the theory thus corrected, with the great collection of observations preserved in the *Depot de la Marine* at Brest and Rochefort *; and finds the coincidence very great, and far exceeding any rule which he had ever seen. Indeed we have no rules but what are purely empirical, or which suppose a uniform progression of the tides.

* See Mr Cassini Mem. Acad. Paris, 1734.

The heights of the tides are much more affected by local circumstances than the regular series of their times. The regular spring tide should be to the neap tide in the same proportion in all places; but nothing is more different than this proportion. In some places the spring tide is not double of the neap tide, and in other places it is more than quadruple. This prevented Bernoulli from attempting to fix the proportion of M to S by means of the heights of the tides. Newton had, however, done it by the tides at Bristol, and made the lunar force almost five times greater than the solar force. But this was very ill-founded, for the reason now given.

Yet Bernoulli saw, that in all places the tides gradually decreased from the syzigies to the quadratures. He therefore presumed, that they decreased by a similar law with the theoretical tides, and has given a very ingenious method of accommodating the theory to any tides which may be observed. Let A be the spring tide, and B the neap tide in any place. Then form an M and an S from these, by making $M = \frac{A+B}{2}$, and $S = \frac{A-B}{2}$; so that $M + S$ may be $= A$, and $M - S = B$ agreeable to theory. Then with this M and S compose the general tide T, agreeable to the construction of the problem. We may be persuaded that the result cannot be far from the truth. The following table is calculated for the three chief distances of the moon from the earth.

Elong. ☽ & ☉	Height of the Tide.		
	Moon in Perigee.	Moon in M. Dist.	Moon in Apogee.
0	0,99A+0,15B	0,88A+0,12B	0,79A+0,08B
10	1,10A+0,04B	0,97A+0,03B	0,87A+0,02B
20	1,14A+0,00B	1,00A+0,00B	0,90A+0,00B
30	1,10A+0,04B	0,97A+0,03B	0,87A+0,02B
40	0,99A+0,15B	0,88A+0,12B	0,79A+0,08B
50	0,85A+0,32B	0,75A+0,25B	0,68A+0,18B
60	0,67A+0,53B	0,59A+0,41B	0,53A+0,29B
70	0,46A+0,75B	0,41A+0,59B	0,37A+0,41B
80	0,28A+0,96B	0,25A+0,75B	0,23A+0,53B
90	0,13A+1,13B	0,12A+0,88B	0,11A+0,62B
100	0,03A+1,24B	0,03A+0,97B	0,03A+0,68B
110	0,00A+1,28B	0,00A+1,00B	0,00A+0,70B
120	0,03A+1,24B	0,03A+0,97B	0,03A+0,68B
130	0,13A+1,13B	0,12A+0,85B	0,11A+0,62B
140	0,28A+0,96B	0,25A+0,75B	0,23A+0,53B
150	0,46A+0,75B	0,41A+0,59B	0,37A+0,41B
160	0,67A+0,53B	0,59A+0,41B	0,53A+0,29B
170	0,85A+0,32B	0,75A+0,25B	0,68A+0,18B
180	0,99A+0,15B	0,88A+0,12B	0,79A+0,08B

Observe that this table is corrected for the retardation arising from the inertia of the waters. Thus when the moon is 20 degrees from the sun, the mean distance tide is 1,00A+0,00B, which is the theoretical tide corresponding to conjunction or opposition.

We have now given in sufficient detail the phenomena of the tides along the equator, when the sun and moon are both in the equator, shewing both their times and their magnitude. When we recollect that all the sections of an oblong spheroid by a plane passing through an equatorial diameter are ellipses, and that the compound tide is a combination of two such spheroids, we perceive that every section of it through the centre, and perpendicular to the plane in which the sun and moon are situated, is also an ellipse, whose shorter axis is the equatorial diameter of a spring tide. This is the greatest depression in all situations of the luminaries; and the points of greatest depression are the lower poles of every compound tide. When the luminaries are in the equator, these lower poles coincide with the poles of the earth. The equator, therefore, of every compound tide is also an ellipse; the whole circumference of which is lower than any other section of this tide, and gives the place of low water in every part of the earth. In like manner, the section through the four poles, upper and lower, gives the place of high water. These two sections are terrestrial meridians or hour circles, when the luminaries are in the equator.

Hence it follows, that all that we have already said as to the times of high and low water may be applied to every place on the surface of the earth, when the sun and moon are in the equator. But the heights of tide will diminish as we recede from the equator. The heights must be reduced in the proportion of radius to the cosine of the latitude of the place. But in every other situation of the sun and moon all the circumstances vary exceedingly. It is very true, that the determination of the elevation of the waters in any place whatever is equally easy. The difficulty is, to exhibit for that place a connected view of the whole tide, with the hours of flood and ebb, and the difference between high and low water. This is not indeed difficult; but the process by the ordinary rules of spherical trigonometry is tedious. When the sun and moon are not near conjunction or opposition, the shape of the ocean resembles a turnip, which is flat and not round in its broadest part. Before we can determine with precision the different phenomena in connection, we must ascertain the position or attitude of this turnip; marking on the surface of the earth both its elliptical equators. One of these is the plane passing thro' the sun and moon, and the other is perpendicular to it, and marks the place of low water. And we must mark in like manner its first meridian, which passes through all the four poles, and marks on the surface of the earth the place of high water. The position of the greatest section of this compound spheroid is frequently much inclined to the earth's equator; nay, sometimes is at right angles to it, when the moon has the same right ascension with the sun, but a different declination. In these cases the ebb tide on the equator is the greatest possible; for the lower poles of the compound spheroid are in the equator. Such situations occasion a very complicated calculus. We must therefore content ourselves with a good approximation.

And first, with respect to the times of high water. It will be sufficient to conceive the sun and moon as always in one plane, *viz.* the ecliptic. The orbits of the sun and moon are never more inclined than $5\frac{1}{2}$ degrees. This will make very little difference; for when the luminaries are so situated that the great circle through them is much inclined to the equator, they are then very near to each other, and the form of the spheroid is little different from what it would be if they were really in conjunction or opposition. It will therefore be sufficient to consider the moon in three different situations.

1. In the equator. The point of highest water is never far-

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ther from the moon than 15°, when she is in apogee and the sun in perigee. Therefore if a meridian be drawn thro' the point of highest water to the equator, the arch *m h* of fig. 4. will be represented on the equator by another arch about $\frac{1}{12}$ of this by reason of the inclination of the equator and ecliptic. Therefore, to have the time of high water, multiply the numbers of the columns which express the difference of high water and the moon's southing by $\frac{11}{12}$, and the products give the real difference.

2. Let the moon be in her greatest declination. The arch of right ascension corresponding to *mh* will be had by multiplying *m h*, or the time corresponding to it in the table, by $\frac{13}{12}$.

3. When the moon is in a middle situation between these two extremes, the numbers of the table will give the right ascension corresponding to *m h* without any correction, the distance from the equator compensating for the obliquity of the ecliptic arch *mh*.

The time of low water is not so easily found; and we must either go through the whole trigonometrical process, or content ourselves with a less perfect approximation. The trigonometrical process is not indeed difficult: We must find the position of the plane through the sun and moon. A great circle through the moon perpendicular to this is the line of high water; and another perpendicular circle cutting this at right angles is the circle of low water.

But it will be abundantly exact to consider the tide as accompanying the moon only.

Let NQSE (fig. 7.) be a section of the terraqueous globe, of which N and S are the north and south poles and EOQ the equator. Let the moon be in the direction OM, having the declination BQ. Let D be any place on the earth's surface. Draw the parallel LDC of latitude. Let B′F *b′f* be the ocean, formed into a spheroid, of which B *b* is the axis and *f* F the equator.

As the place D is carried along the parallel CDL by the rotation of the earth, it will pass in succession through different depths of the watery spheroid. It will have high water when at C and L, and low water when it crosses the circle *f* OF. Draw the meridian N *d* G, and the great circle B *d b*. The arch GQ, when converted into lunar hours (each about 62 minutes), gives the duration of the flood *dc* and of the subsequent ebb *c d*, which happen while the moon is above the horizon; and the arch EG will give the durations of the flood and of the ebb which happen when the moon is below the horizon. It is evident, that these two floods and two ebbs have unequal durations. When D is at C it has high water; and the height of the tide is CC′. For the spheroid is supposed to touch the sphere on the equator *f* OF, so that of CC′ is the difference between high and low water. At L the height of the tide is LL′; and if we describe the circle L N *q*, C′ *q* is the difference of these high waters, or of these tides.

Hence it appears, that the two tides of one lunar day may be considerably different, and it is proper to distinguish them by different names. We shall call that a *superior tide* which happens when the moon is above the horizon during high water. The other may be called the *inferior tide*. The duration of the superior tide is measured by 2 GQ, and that of the inferior tide by 2 EG, and 4 GO measures the difference between the whole duration of a superior and of an inferior tide.

From this construction we may learn in general, 1. When the moon has no declination, the durations and also the heights of the superior and inferior tides are equal in all parts of the world. For in this case the tide equator *f* F coincides with the meridian NOS, and the poles B *b′* of the watery spheroid are on the earth's equator.

2. When the moon has declination, the duration and also the height of a superior tide at any place is greater than that of the inferior; or is less than it, according as the moon's declination and the latitude of the place are of the same or opposite names.

This is an important circumstance. It frequently happens that the inferior tide is found the greatest when it should be the least; which is particularly the case at the Nore. This shows, without further reasoning, that the tide at the Nore is only a branch of the regular tide. The regular tide comes in between Scotland and the continent; and after travelling along the coast reaches the Thames, while the regular tide is just coming in again between Scotland and the continent.

3. If the moon's declination is equal to the [illegible] of the place, or exceeds it, there will be only one tide in a lunar day. It will be a superior or an inferior tide, according as the declination of the moon and the latitude of the place are of the same or opposite kinds. For the equator of the tide cuts the meridian in *f* and F. Therefore a place which moves in the parallel *c f* has high water when at *c*, and 12 lunar hours afterwards, has low water when at *f*. And any place *k* which is still nearer to the pole N has high water when at *k*, and 12 lunar hours afterwards has low water at *m*. Therefore, as the moon's declination extends to 30°, all places farther north or south than the latitude 60° will sometimes have only one tide in a lunar day.

4. The sine of the arch GO, which measures $\frac{1}{4}$th of the difference between the duration of a superior and inferior tide, is = tan. lat. × tan. decl. For in the spherical triangle *d* OG

Rad : cotan. *d* OG = tan. *d* G : sin. GO, and

Sin. GO = tan. *d* OQ × tan. *d* G, = tan. decl. × tan. lat.

Hence we see, that the difference of the durations of the superior and inferior tides of the same day increase both with the moon's declination and with the latitude of the place.

The different situations of the moon and of the place of observation affect the heights of the tides no less remarkably. When the point D comes under the meridian NBQ in which the moon is situated, there is a superior high water. and the height of the tide above the low water of that day is CC′. When D is at L, the height of the inferior tide is LL′. The elevation above the inscribed sphere is M × cos.² *y*, *y* being the zenith distance of the moon at the place of observation. Therefore at high water, which by the theory is in the place directly under the moon, the height of the tide is as the square of the cosine of the moon's zenith or nadir distance.

Hence we derive a construction which solves all questions relating to the height of the tides with great facility, free from all the intricacy and ambiguities of the algebraic analysis employed by [illegible].

With the radius CQ = M (the elevation produced by the moon above the inscribed sphere) describe the circle *p* Q *P* E (fig. 8.) to represent a meridian, of which P and *p* are the poles, and EQ the equator. [illegible] CP in O; and round O describe the circle PBCD. Let M be the place over which the moon is vertical, and Z be the place of observation. MQ is the moon's declination, and ZQ is the latitude of the place. Draw MC *m*, ZCN, cutting the small circle in A and B. Draw A [illegible] perpendicular to C [illegible], and draw CI [illegible], which will cut off an arch [illegible] = QM. MZ and [illegible] N are the moon's zenith and nadir distances. Draw the diameter BD, and the perpendiculars IK, GH, and AF. Also draw OA, PA, AB [illegible].

Then DF is the superior tide, DK is the inferior tide, and DH is the arithmetical mean tide.

[illegible]

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For the angles BCA, BDA, standing on BA, are equal. Alfo the angles IDB, ICN, are equal, being fupplements of the angle ICB. Therefore, if BD be made radius, DA and DI are the fines of the zenith and nadir diftances of the moon.

But BD : DA = DA : DF. Therefore DF = M × cof.² [illegible], = the height Z s of the fuperior tide. Alfo DK = M · cof.² [illegible], = the height [illegible] of the inferior tide.

Alfo, becaufe IA is bifected in G, KF is bifected in H, and $DH = \frac{DK + DF}{2}$, = the medium tide.

Let us trace the relation of the confequences of the various pofitions of Z and M, as we formerly confidered the refults of the various fituations of the fun and moon.

Firft, then, let Z retain its place, and let M gradually approach it from the equator. When M is in the equator, A and I coincide with C, and the three points F, K, and H, coincide in *i*.

As M approaches to Z, A and I approach to B and D; DF increafes, and DK diminifhes. The fuperior or inferior tide is greateft when the moon is in M or in N; and DF is then = M. As the moon paffes to the northward of the place, the fuperior and inferior tides both diminifh till I comes to D; at which time MQ is equal to ZP, and there is no inferior tide. This however connot happen if z P is greater than 30°, becaufe the moon never goes farther from the equator. M ftill going north, we have again a perpendicular from I on BD, but below I, indicating that the inferior tide, now meafured by DK, belongs to the hemifpheroid next the moon. Alfo, as M advances from the equator northward, DH diminifhes continually. Firft, while H lies between O and B, becaufe G approaches O; and afterwards, when G is above O and H lies between O and D. It is otherwife, however, if ZQ is greater than 45°; for then DB is inclined to EQ the other way, and DH increafes as the point G rifes.

In the next place, let M retain its pofition, and Z proceed along the meridian.

Let us begin at the equator, or fuppofe Q the place of obfervation. BD then coincides with CP, and the three lines DF, DK, and DH, all coincide with PG, denoting the two equal tides Q *q* and E *e* and their medium, equal to either. As Z goes northward from Q, BOD detaches itfelf from COP; the line DF increafes, while DK and DH diminifh. When Z has come to M, F and B coincide with A, and DK and DH are ftill more diminifhed. When Z paffes M, all the three lines DF, DK, and DH, continue to diminifh. When Z comes to latitude 45°, DB is parallel to IA and EQ, and the point H coincides with O. This fituation of Z has the peculiar property that DH (now DO) is the fame, whatever be the declination of the moon. For IA being always parallel to DB, OK and OF will be equal, and DO will be half of DK and DF however they may vary. When Z gets fo far north that ZP is = MQ, the diameter *bd* falls on I; fo that *dk* vanifhes, and we have only *df*. And when Z goes ftill farther north, *dk* appears on the other fide of I. When Z arrives at the pole, BD again coincides with PC, D with C, and DF, DK, and DH, coincide with CG.

Thefe variations of the points F, K, and H, indicate the following phenomena.

1. The greateft tides happen when the moon is in the zenith or nadir of the place of obfervation: for then the point B coincides with A, and DF becomes DB; that is, = M. indicating the full tide BB′.

2. When the moon is in the equator, the fuperior and inferior tides have equal heights, = M · cof.² lat. For then A and I coincide with C, and the points F and K coincide in *i*, and D *i* is = DB · cof.² BDC, = M · cof.² lat.

3. If the place of obfervation is in the equator, the inferior and fuperior tides are again equal, whatever is the moon's declination: For then B coincides with C, and the points F, K, and H, coincide with G; and PG = PC · cof.² APG, = M · cof.² decl. moon.

4. The fuperior tides are greater or lefs than the inferior tides according as the latitude and declination are of the fame or of oppofite names. For by making Q*q* = QZ, and drawing *z*C*n*, cutting the fmall circle in *n*, we fee that the figure is reverfed. The difference between the fuperior and inferior tides is KF, or IA × cofin. of the angle formed by IA and DB; that is, of the angle BD*i*, which is the complement of twice ZQ: becaufe BOC = 2 ZCQ. Now IA is 2 GA, = 2 OA · fin. 2 MQ = PC · fin. 2 MQ, = M · fin. 2 decl. Therefore the difference of the fuperior and inferior tides is M · fin. 2 declin. fin. 2 lat.

5. If the colatitude be equal to the declination, or lefs than it, there will be no inferior tide, or no fuperior tide, according as the latitude of the place and declination of the moon are of the fame or oppofite names.

For when PZ = MQ, D coincides with I, and IK vanifhes. When PZ is lefs than MQ, the point D is between C and I, and the point Z never paffes through the equator of the watery fpheroid; and the low water of its only tide is really the fummit of the inferior tide.

6. At the pole there is no daily tide: but there are two monthly tides = M · fin.² declin. and it is low water when the moon is in the equator.

7. The medium tide, reprefented by DH, is $= M \times \frac{1 + \text{cof. } 2\text{ lat.} \times \text{cof. } 2\text{ declin.}}{2}$. For DH = DO + OH. Now OH is equal to OG × cof. GOH = OG · cof. 2 ZQ. And OG = OA · cof. GOA, = OA · cof. 2 MQ. Therefore OH = OA · cof. 2 ZQ · cof. 2 MQ. Therefore DH = OA + OA · cof. 2 ZQ · cof. 2 MQ = $M \times \frac{1 + \text{cof. } 2\text{ZQ} \cdot \text{cof. } 2\text{ MQ}}{2}$. Let this for the future be called *m*.

N. B. The moon's declination never exceeds 30°. Therefore cof. 2 MQ is always a pofitive quantity, and never lefs than $\frac{1}{2}$, which is the cofine of 60°. While the latitude is lefs than 45°, cof. 2 lat. is alfo a pofitive quantity. When it is precifely 45° the cofine of its double is *o*; and when it is greater than 45, the cofine of its double is negative. Hence we fee,

1. That the medium tides are equally affected by the northern and fouthern declinations of the moon.

2. If the latitude of the place is 45°, the medium tide is always $\frac{1}{2}$ M. This is the reafon why the tides along the coafts of France and Spain are fo little affected by the declination of the moon.

3. If the latitude is lefs than 45°, the mean tides increafe as the moon's declination diminifhes. The contrary happens if ZQ is greater than 45°. For DH increafes or diminifhes while the point G feparates from C according as the angle COD is greater or lefs than COB; that is, according as PCZ is greater or lefs than ZCQ.

4. When Z is in the equator, H coincides with G, and the effect of the moon's declination on the height of the tides is the moft fenfible. The mean tide is then $= M \frac{1 + \text{cof. } 2\text{ MQ}}{2}$.

All that we have now faid may be faid of the folar tide, putting S in place of M.

Alfo the fame things hold true of fpring tides, putting M + S in place of M.

But,

Fig. 1.

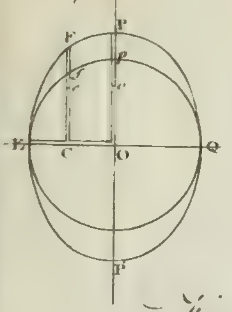


Fig. 2.

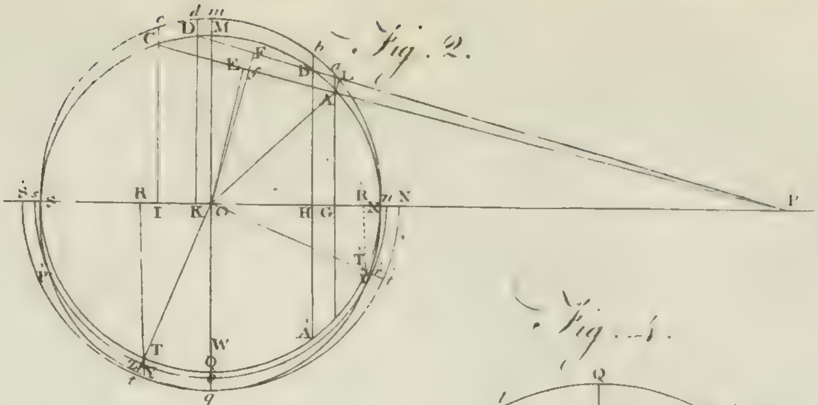


Fig. 3.

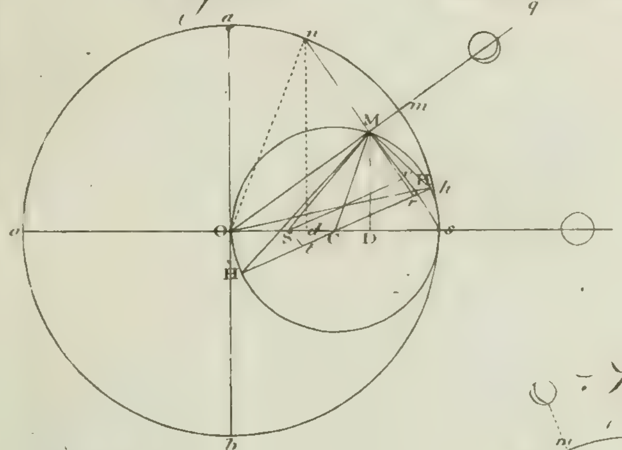


Fig. 4.

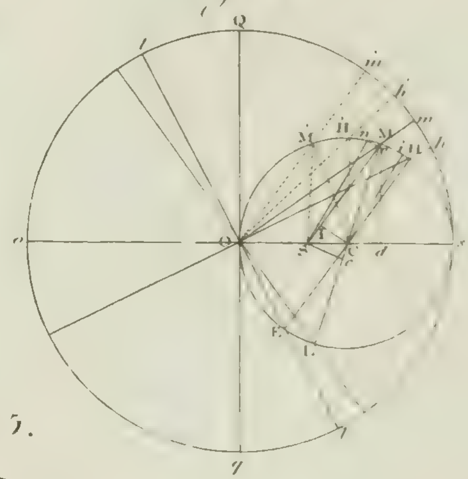


Fig. 5.

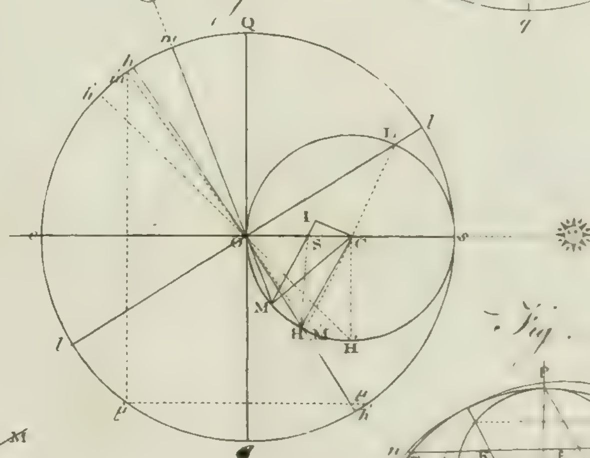


Fig. 6.

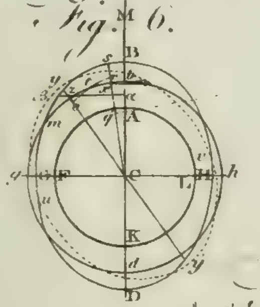


Fig. 7.

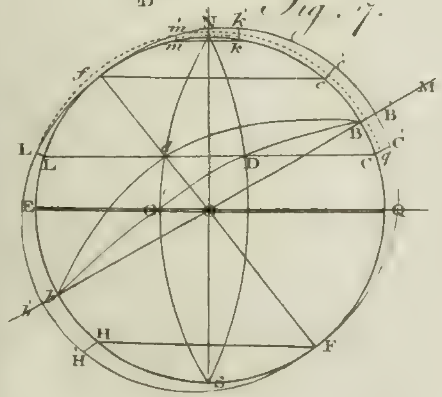
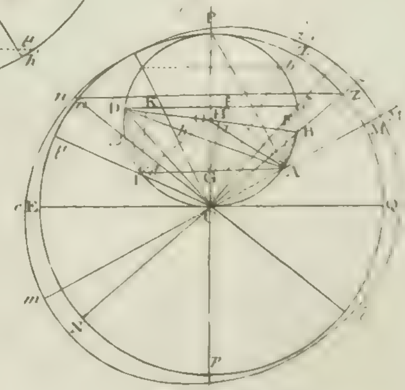


Fig. 8.



But in order to aſcertain the effects of declination and latitude on other tides, we muſt make a much more complicated conſtruction, even tho' we ſuppoſe both luminaries in the ecliptic. For in this caſe the two depreſſed poles of the watery ſpheroid are not in the poles of the earth; and therefore the ſections of the ocean, made by meridians, are by no means ellipſes.

In a neap tide, the moon is vertical at B (fig. 7. or 8.), and the ſun at ſome point of fF, 90° from B. If O be this point, the conſtruction for the heights of the tides may be made by adding to both the ſuperior and inferior tides for any point D, the quantity $\overline{M + S - DF \text{ or } DK} \times \text{ſin.}^2\, d\,O, = \overline{M + S - \text{tide}} \times \frac{\text{ſin.}^2\, 2\,Q}{\text{coſ.}^2\, MQ}$, as is evident.

But if the ſun be vertical at d, d will be the higheſt part of the circle fOF, and no correction is neceſſary. But in this caſe the circle of high water will be inclined to the meridian in an angle equal to dBO (fig. 7.), and neither the times nor elevations of high water will be properly aſcertained, and the error in time may be conſiderable in high latitudes.

The inaccuracies are not ſo great in intermediate tides, and reſpect chiefly the time of high water and the height of low water.

The exact computation is very tedious and peculiar, ſo that it is hardly poſſible to give any account of a regular progreſs of phenomena; and all we can do is, to aſcertain the preciſe heights of detached points. For which reaſons, we muſt content ourſelves with the conſtruction already given. It is the exact geometrical expreſſion of Bernoulli's analyſis, and its conſequences now related contain all that he has inveſtigated. We may accommodate it very nearly to the real ſtate of things, by ſuppoſing PC equal, not to CO of fig. 4. but to MS, exhibiting the whole compound tide. And the point B, inſtead of repreſenting the moon's place, muſt repreſent the place of high water,

Thus have we obtained a general, though not very accurate, view of the phenomena which muſt take place in different latitudes and in different declinations of the ſun and moon, provided that the phyſical theory which determines the form and poſition of the watery ſpheroid be juſt. We have only to compute, by a very ſimple proceſs of ſpherical trigonometry, the place of the pole of this ſpheroid. The ſecond conſtruction, in fig. 8. ſhows us all the circumſtances of the time and height of high water at any point. It will be recollected, that in computing this place of the pole, the anticipation of 20 degrees, ariſing from the inertia of the waters, muſt be attended to.

Were we to inſtitute a compariſon of this theory with obſervation, without farther conſideration, we ſhould ſtill find it unfavourable, partly in reſpect of the heights of the tides, and more remarkably in reſpect of the time of low water. We muſt again conſider the effects of the inertia of the waters, and recollect, that a regular theoretical tide differs very little in its progreſs from the motion of a wave. Even along the free ocean, its motion much reſembles that of any other wave. All waves are propagated by an oſcillatory motion of the waters, preciſely ſimilar to that of a pendulum. It is well known, that if a pendulum receive a ſmall impulſe in the time of every deſcent, its vibrations may be increaſed to infinity. Did the ſucceſſive actions of the ſun or moon juſt keep time with the natural propagation of the tides, or the natural oſcillations of the waters, the tides would alſo augment to infinity: But there is an infinite odds againſt this exact adjuſtment. It is much more probable that the action of to-day interrupts or checks the oſcillation produced by yeſterday's action, and that the motion which we perceive in this day's tide is what remains, and is compounded with the action of to-day. This being the caſe, we ſhould expect that the nature of any tide will depend much on the nature of the preceding tide. Therefore we ſhould expect that the ſuperior and inferior tides of the ſame day will be more nearly equal than the theory determines. The whole courſe of obſervation confirms this. In latitude 45°, the ſuperior and inferior tides of one day may differ in the proportion of $2\frac{1}{2}$ to 1, and the tides correſponding to the greateſt and leaſt declinations of the moon may differ nearly as much. But the difference of the ſuperior and inferior tides, as they occur in the liſt of Obſervations at Rochefort, is not the third part of this, and the changes made by the moon's declination is not above one-half. Therefore we ſhall come much nearer the true meaſure of a ſpring tide, by taking the arithmetical mean, than by taking either the ſuperior or inferior.

We ſhould expect leſs deviation from the theory in the gradual diminution of the tides from ſpring tide to neap tide, and in the gradual changes of the medium tide by the declination of the moon; becauſe the ſucceſſive changes are very ſmall; and when they change in kind, that is, diminiſh after having for ſome time augmented, the change is by inſenſible degrees. This is moſt accurately confirmed by obſervation. The vaſt collection made by Caſſini of the Obſervations at Breſt being examined by Bernoulli, and the medium of the two tides in one day being taken for the tide of that day, he found ſuch an agreement between the progreſſion of theſe medium tides and the progreſſion of the lines MS of fig. 4. that the one ſeemed to be calculated by the other. He found no leſs agreement in the changes of the medium tides by the moon's declination.

In like manner, the changes produced by the different diſtances of the moon from the earth, were found abundantly conformable to the theory, although not ſo exact as the other. This difference or inferiority is eaſily accounted for: When the moon changes in her mean diſtance, one of the neap tides is uncommonly ſmall, and therefore the ſucceſſive diminutions are very great, and one tide ſenſibly affects another. The ſame circumſtance operates when ſhe changes in apogee, by reaſon of a very large ſpring tide. And the changes correſponding both to the ſun's diſtance from the earth and his declination agreed almoſt exactly.

All theſe things conſidered together, we have abundant reaſon to conclude, that not only the theory itſelf is juſt in principle (a thing which no intelligent naturaliſt can doubt), but alſo that the data which are aſſumed in the application are properly choſen; that is, that the proportion of 2 to 5 is very nearly the true proportion of the mean ſolar and lunar forces. If we now compute the medium tide for any place in ſucceſſion, from ſpring tide to neap tide, and ſtill more, if we compute the ſeries of times of their occurrence, we ſhall find as great an agreement as can be deſired. Not but that there are many irregularities; but theſe are evidently ſo anomalous, that we can aſcribe them to nothing but circumſtances which are purely local.

This general rule of computation muſt be formed in the folowing manner:

The ſpring tide, according to theory, being called A, and the neap tide B, recollect that the ſpring tide, according to the regular theory, is meaſured by M + S. Recollect alſo, that when the lunar tide only is conſidered, the ſuperior ſpring tide is M × ſin.², ZM (fig. 8). But when we conſider the action of two adjoining tides on each other, we find it ſafer to take the medium of the ſuperior and inferior tides for the meaſure; and this is $M \times 1 + \frac{\text{coſ.}^2\, 2\,ZQ \times \text{coſ.}^2\, 2\,MQ}{2}$. Let this be called m. This

Tide. being totally the effect of M as modified by latitude and declination, may be taken as its proper measure, by which we are to calculate the other tides of the monthly series from spring tide to neap tide.

In like manner, we must compute a value for S, as modified by declination and latitude; call this s. Then say,

$$M + S : A = m + s : A \times \frac{m+s}{M+S}.$$

This fourth proportional will give the spring tide as modified for the given declination of the luminaries, and the latitude of the place.

Now recollect, that the medium tide, when the luminaries are in the equator, is $A \times \text{cof.}^2 \text{lat.}$ Therefore let F be the spring tide *observed* at any place when the luminaries are in the equator; and let this be the medium of a great many observations made in these circumstances. This gives $A \cdot \text{cof.}^2 \text{lat.}$ (as modified by the peculiar circumstances of the place) $=$ F. Therefore the fourth proportional now given changes to $F \times \frac{m+s}{M+S \cdot \text{cof.}^2 \text{lat.}}$ And a similar substitute for B is $G \times \frac{m-s}{M-S \cdot \text{cof.}^2 \text{lat.}}$

Lastly, To accommodate our formulæ to every distance of the earth from the sun and moon, let D and Δ be the mean distances of the sun and moon, and d and δ their distances at the given time; and then the two substitutes become

$$\frac{\Delta^3 d^3 M + \delta^3 D^3 S}{d^3 \delta^3 (M+S)} \times F \times \frac{m+s}{(M+S)\ \text{cof.}^2 \text{lat.}}$$

$$\frac{\Delta^3 d^3 M - \delta^3 D^3 S}{d^3 \delta^3 (M-S)} \times G \times \frac{m+s}{(M-S)\ \text{cof.}^2 \text{lat.}}$$

The half sum of these two quantities will be the MC, and their half difference will be the SC, of fig. 4. with which we may now operate, in order to find the tide for any other day of the menstrual series, by means of the elongation a of the moon from the sun; that is, we must say $MC + CS : MC - CS = \tan. a : \tan. b$; then $x = \frac{a+b}{2}$, and $y = \frac{a-b}{2}$. And MS, the height of the tide, is $MC \times \text{cof.}\ 2y + CS \times \text{cof.}\ 2x$.

Such is the general theory of the tides, deduced from the principle of universal gravitation, and adjusted to that proportion of the solar and lunar forces which is most consistent with other celestial phenomena. The comparison of the greatest and least daily retardations of the tides was with great judgment preferred to the proportion of spring and neap tides, selected by Sir Isaac Newton for this purpose. This proportion must depend on many local circumstances. When a wave or tide comes to the mouths of two rivers, and sends a tide up each, and another tide of half the magnitude comes a fortnight after; the proportion of tides sent up to any given places of these rivers may be extremely different. Nay, the proportion of tides sent up to two distant places of the same river can hardly be the same; nor are they the same in any river that we know. It can be demonstrated, in the strictest manner, that the farther we go up the river, where the declivity is greater, the neap tide will be smaller in proportion to the spring tide. But it does not appear that the time of succession of the different tides will be much affected by local circumstances. The tide of the second day of the moon being very little less than that of the first, will be nearly as much retarded, and the intervals between their arrivals cannot be very different from the real intervals of the undisturbed tides; accordingly, the succession of the highest to the highest but one is found to be the same in all places, when not disturbed by *different* winds. In like manner, the succession of the lowest and the lowest but one is found equally invariable; and the highest and the lowest tides observed in any place *must* be accounted the spring and neap tides of that place, whether they happen on the day of full and half moon or not. Nay, we can see here the explanation of a general deviation of the theory which we formerly noticed. A low tide, being less able to overcome obstructions, will be sooner stopped, and the neap tides should happen a little earlier than by the undisturbed theory.

With all these corrections, the theory now delivered will be found to correspond, with observation, with all the exactness that we can reasonably expect. We had an opportunity of comparing it with the phenomena in a place where they are very singular, viz. in the harbour of Bisselstedt in Iceland. The equator of the watery spheroid frequently passes through the neighbourhood of this place, in a variety of positions with respect to its parallel of diurnal revolution, and the differences of superior and inferior tides are most remarkable and various. We found a wonderful conformity to the most diversified circumstances of the theory.

There is a period of 18 years, respecting the tides in Iceland, taken notice of by the ancient Saxons; but it is not distinctly described. Now this is the period of the moon's nodes, and of the greatest and least inclination of her orbit to the equator. It is therefore the period of the positions of the equator of the tides which ranges round this island, and very sensibly affects them.

Hitherto we have supposed the tides to be formed on an ocean completely covering the earth. Let us see how those may be determined which happen in a small and confined sea, such as the Caspian or the Black Sea. The determination in this case is very simple. As no supply of water is supposed to come into the bason, it is susceptible of a tide only by sinking at one end and rising at the other. This may be illustrated by fig. 6. where C s, C y, are two perpendicular planes bounding a small portion of the natural ocean. The water will sink at z and rise at x, and form a surface $o\,t\,r$ parallel to the equilibrated surface $y\,s$. It is evident that there will be high water, or the greatest possible rise at r, when the bason comes to that position where the tangent is most of all inclined to the diamater. This will be when the angle t CB is 45° nearly, and therefore three lunar hours after the moon's southing; at the same time, it will be low water at the other end. It is plain that the rise and fall must be exceedingly small, and that there will be no change in the middle. The tides of this kind in the Caspian Sea, in latitude 45°, whose extent in longitude does not exceed eight degrees, are not above seven inches; a quantity so small, that a slight breeze of wind is sufficient to check it, and even to produce a rise of the waters in the opposite direction. We have not met with any accounts of a tide being observed in this sea.

It should be much greater, though still very small, in the Mediterranean Sea. Accordingly, tides are observed there, but still more remarkably in the Adriatic, for a reason which will be given by and by. We do not know that tides have been observed in the great lakes of North America. These tides, though small, should be very regular.

Should there be another great bason in the neighbourhood of $z\,x$, lying east or west of it, we should observe a curious phenomenon. It would be low water on one side of the shore z when it is high water on the other side of this partition. If the tides in the Euxine and Caspian Seas, or in the American lakes which are near each other, could be observed, this phenomenon should appear, and would be one of the prettiest examples of universal gravitation that can be

be conceived. Something like it is to be seen at Gibraltar. It is high water on the east side of the rock about 10 o'clock at full and change, and it is high water on the west side, not a mile distant, at 12. This difference is perhaps the chief cause of the singular current which is observed in the Straits mouth. There are three currents observed at the same time, which change their directions every 12 hours. The small tide of the Mediterranean proceeds along the Barbary shore, which is very uniform all the way from Egypt, with tolerable regularity. But along the northern side, where it is greatly obstructed by Italy, the islands, and the east coast of Spain, it sets very irregularly; and the perceptible high water on the Spanish coast differs four hours from that of the southern coast. Thus it happens, that one tide ranges round Europa point, and another along the shore near Ceuta, and there is a third current in the middle different from both. Its general direction is from the Atlantic Ocean into the Mediterranean Sea, but it sometimes comes out when the ebb tide in the Atlantic is considerable.

Suppose the moon over the middle of the Mediterranean. The surface of the sea will be level, and it will be half tide at both ends, and therefore within the Straits of Gibraltar. But without the Straits it is within half an hour of high water. Therefore there will be a current setting *in* from the Atlantic. About three and an half hours after, it is high water within and half ebb without. The current now sets out from the Mediterranean. Three hours later, it is low water without the Straits and half ebb within; therefore the current has been setting out all this while. Three hours later, it is half flood without the Straits and low water within, and the current is again setting in, &c

Were the earth fluid to the centre, the only sensible motion of the waters would be up and down, like the waves on the open ocean, which are not brushed along by strong gales. But the shallowness of the channel makes a horizontal motion necessary, that water may be supplied to form the accumulation of the tide. When this is formed on a flat shelving coast, the water must flow in and out, on the flats and sands, while it rises and falls. These horizontal motions must be greatly modified by the channel or bed along which they move. When the channel contracts along the line of flowing water, the wave, as it moves up the channel, and is checked by the narrowing shores, must be reflected back, and keep a-top of the waters still flowing in underneath. Thus it may rise higher in these narrow seas than in the open ocean. This may serve to explain a little the great tides which happen on some coasts, such as the coast of Normandy. At St Malo the flood frequently rises 50 feet. But we cannot give any thing like a full or satisfactory account of these singularities. In the Bay of Fundy, and particularly at Annapolis Royal, the water sometimes rises above 100 feet. This seems quite inexplicable by any force of the sun and moon, which cannot raise the waters of the free ocean more than eight feet. These great floods are unquestionably owing to the proper timing of certain oscillations or currents adjoining, by which they unite, and form one of great force. Such violent motions of water are frequently seen on a small scale in the motions of brooks and rivers; but we are too little acquainted with hydraulics to explain them with any precision.

We have seen that there is an oscillation of waters formed under the sun and moon; and that in consequence of the rotation of the earth, the inertia and the want of perfect fluidity of the waters, and obstructions in the channel, this accumulation never reaches the place where it would finally settle if the earth did not turn round its axis. The consequence of this must be a general current of the waters from east to west. This may be seen in another way. The moon in her orbit round the earth has her gravity to the earth diminished by the sun's disturbing force, and therefore moves in an orbit less incurvated than she would describe independent of the sun's action. She therefore employs a longer time. If the moon were so near the earth as almost to touch it, the same thing would happen. Therefore suppose the moon turning round the earth, almost in contact with the equator, with her natural undisturbed periodic time, and that the earth is revolving round its axis in the same time, the moon would remain continually above the same spot of the earth's surface (suppose the city of Quito), and a spectator in another planet would see the moon always covering the same spot. Now let the sun act. This will not affect the rotation of the earth because the action on one part is exactly balanced by the action on another. But it will affect the moon. It will move more slowly round the earth's centre, and at a greater distance. It will be left behind by the city of Quito, which it formerly covered. And as the earth moves round from west to east, the moon, moving more slowly, will have a motion to the west with respect to Quito. In like manner, every particle of water has its gravity diminished, and its diurnal motion retarded; and hence arises a general motion or current from east to west. This is very distinctly perceived in the Atlantic and Pacific Oceans. It comes round the Cape of Good Hope, ranges along the coast of Africa, and then sets directly over to America, where it meets a similar stream which comes in by the north of Europe. Meeting the shores of America, it is deflected both to the south along the coast of Brazil, and to the north along the North American shores, where it forms what is called the *Gulf Stream*, because it comes from the Gulf of Mexico. This motion is indeed very slow, this being sufficient for the accumulation of seven or eight feet on the deep ocean; but it is not altogether insensible.

We may expect differences in the appearances on the western shores of Europe and Africa, and on the western shore of America, from the appearances on the eastern coasts of America and of Asia, for the general current obstructs the waters from the western shores, and sends them to the eastern shores. Also when we compare the wide opening of the northern extremity of the Atlantic Ocean with the narrow opening between Kamtschatka and America, we should expect differences between the appearances on the west coasts of Europe and of America. The observations made during the circumnavigations of Captain Cook and others show a remarkable difference. All along the west coast of North America the interior tide is very trifling, and frequently is not perceived.

In the very same manner, the disturbing forces of the sun and moon form a tide in the fluid air which surrounds this globe, consisting of an elevation and depression, which move gradually from east to west. Neither does this tide ever attain that position with respect to the disturbing planets which it would do were the earth at rest on its axis. Hence arises a motion of the whole air from east to west; and this is the principal cause of the trade-winds. They are a little accelerated by being heated, and therefore expanding. They expand more to the westward than in the opposite direction, because the air expands on that side into air, which is now cooling and contracting. These winds very evidently follow the sun's motion, tending more to the south or north as he goes south or north. Were this motion considerably affected by the expansion of heated air, we should find the air rather coming northward and southward from the torrid zone,

Tide.

zone, in confequence of its expanfion in that climate. We repeat it, it is almoft folely produced by the aerial tide, and is neceffary for the very formation of this tide. We cannot perceive the accumulation. It cannot affect the barometer, as many think, becaufe, though the air becomes deeper, it becomes deeper only becaufe it is made lighter by the gravitation to the fun. Inftead of preffing more on the ciftern of the barometer, we imagine that it preffes lefs; becaufe, like the ocean, it never attains the height to which it tends. It remains always too low for equilibrium, and therefore it fhould prefs with lefs force on the ciftern of a barometer.

There is an appearance precifely fimilar to this in the planet Jupiter. He is furrounded by an atmofphere which is arranged in zones or belts, probably owing to climate differences of the different latitudes, by which each feems to have a different kind of fky. Something like this will appear to a fpectator in the moon looking at this earth. The general weather and appearance of the fky is confiderably different in the torrid and temperate zones. Jupiter's belts are not of a conftant fhape and colour; but there often appear large fpots or tracts of cloud, which retain their fhape during feveral revolutions of Jupiter round his axis. To judge of his rotation by one of thefe, we fhould fay that he turns round in 9.55. There is alfo a brighter fpot which is frequently feen, occupying one certain fituation on the body of Jupiter. This is furely adherent to his body, and is either a bright coloured country, or perhaps a tract of clouds hovering over fome volcano. This fpot turns round in 9.51½. And thus there is a general current in his atmofphere from eaft to weft.

Both the motion of the air and of the water tend to diminifh the rotation of the earth round its axis: for they move flower than the earth, becaufe they are retarded by the luminaries. They muft communicate this retardation to the earth, and muft take from it a quantity of motion precifely equal to what they want, in order to make up the equilibrated tide. In all probability this retardation is compenfated by other caufes; for no retardation can be obferved. This would have altered the length of the year fince the time of Hipparchus, giving it a fmaller number of days. We fee caufes of compenfation. The continual wafhing down of foil from the elevated parts of the earth muft produce this effect, by communicating to the valley on which it is brought to reft the excefs of diurnal velocity which it had on the mountain top.

While we were employed on this article, a book was put into our hands called *Studies of Nature*, by a Mr Saint Pierre. This author fcouts the Newtonian theory of the tides, as erroneous in principle, and as quite infufficient for explaining the phenomena; and he afcribes all phenomena of the tides to the liquefaction of the ices and fnows of the circumpolar regions, and the greater length of the polar than of the equatorial axis of the earth. He is a man of whom we wifh to fpeak with refpect, for his conftant attention to final caufes, and the proof thence refulting of the wifdom and goodnefs of God. For this he is entitled to the greater praife, that it required no fmall degree of fortitude to refift the influence of national example, and to retain his piety in the midft of a people who have drunk the very dregs of the atheifm of ancient Greece. This is a fpecies of merit rarely to be met with in a Frenchman of the prefent day; but as a philofopher, M. de St Pierre can lay claim to no other merit except that of having collected many important facts. The argument which he employs to prove that the earth is a prolate fpheroid, is a direct demonftration of the truth of the contrary opinion; and the melting of the ice and fnows at the poles cannot produce the fmalleft motion in the waters. Were there even 10 times more ice and fnow floating on the northern fea than there is, and were it all to melt in one minute, there would be no flux from it; for it would only fill up the fpace which it formerly occupied in the water. Of this any perfon will be convinced, who fhall put a handful of fnow fqueezed hard into a jar of water, and note the exact height of the water. Let the fnow melt, and he will find the water of the fame height as before.

Tide || Tillœa.

Tide-Waiters, or *Tidefmen*, are inferior officers belonging to the cuftomhoufe, whofe employment is to watch or attend upon fhips until the cuftoms be paid: they get this name from their going on board fhips on their arrival in the mouth of the Thames or other ports, and fo come up with the tide.

TIEND, in Scots law. See Teind.

TIERCE, or Teirce, a meafure of liquid things, as wine, oil, &c. containing the third part of a pipe, or 42 gallons.

TIERCED, in heraldry, denotes the fhield to be divided by any part of the partition-lines, as party, coupy, tranchy, or tailly, into three equal parts of different colours or metals.

TIGER, in zoology. See Felis.

Tiger-Wolf, the name by which the hyæna is called at the Cape of Good Hope. See Hyæna.

TIGRIS, a river of Afia, which has its fource near that of the Euphrates in the mountain Tchildir in Turkomania: afterwards it feparates Diarbeck from Erzerum, and Khufiftan from Irac-Arabia; and uniting with the Euphrates at Gorno, it falls into the gulf of Bafforah, under the name of *Schat el-Arab*. This river paffes by Diarbekar, Gezira, Mouful, Bagdad, Gorno, and Bafforah.

TILIA, Lime or Linden-tree, in botany: A genus of plants belonging to the clafs of *polyandria*, and order of *monogynia*; and in the natural fyftem ranging under the *Columniferæ*. The calyx is quinquepartite; the corolla pentapetalous; the berry is dry, globofe, quinquelocular, quinquevalve, and opening at the bafe. There are four fpecies; the europæa and americana, pubefcens and alba.

The *europæa*, or common lime-tree, is generally fuppofed to be a native of Britain; but we are informed by Mr Coxe, that Mr Pennant told him (on what authority is not mentioned), that it was imported into England before the year 1652.

Coxe's Travels in Switzerland, vol. i. p. 64.

The leaves are heart-fhaped, with the apex produced, and ferrated on the edges; the flowers grow in a thin umbel, from three to nine together, of a whitifh colour and a fragrant fmell; very grateful to bees. The wood is light, fmooth, and of a fpongy texture, ufed for making lafts and tables for fhoemakers, &c. Ropes and bandages are made of the bark, and mats and ruftic garments of the inner rind, in Carniola and fome other countries.—The lime-tree contains a gummy juice, which being repeatedly boiled and clarified produces a fubftance like fugar.

TILLEMONT (Sebaftian le Nain de). See Nain.

TILLER *of a Ship*, a ftrong piece of wood faftened in the head of the rudder, and in fmall fhips and boats called the *helm*.

TILLŒA, in botany: A genus of plants belonging to the clafs of *tetrandria*, the order of *tetragynia*, and in the natural fyftem ranging under the 13th order, *Succulentæ*. The calyx has three or four divifions; the petals are three or four, and equal; the capfules three or four, and polyfpermous. There are four fpecies; of which one only, the mufcofa, is a native of England, and is not mentioned among the Scotch plants.

The *mufcofa*, or procumbent tillœa, has proftrate ftems, almoft

almoſt erect, generally red, and grow longer after flowering. The parts of fructification are always three. The leaves grow in pairs, and are fleſhy. It is found on dry heaths in Norfolk and Suffolk, and flowers in May and June.

TILLOTSON (John), a celebrated archbiſhop of Canterbury, was the ſon of Robert Tillotſon of Sowerby, in the pariſh of Hallifax in Yorkſhire, clothier; and was born there in the year 1630. He ſtudied in Clare-hall, Cambridge; and in 1656 left this college, in order to become tutor to the ſon of Edmund Prideaux, Eſq; of Ford-abbey in Devonſhire. He was afterwards curate to Dr Hacket vicar of Cheſhunt, in Hertfordſhire. In 1663, he was preſented by Sir Thomas Barnardiſton to the rectory of Ketton or Keddington in the county of Suffolk; but was the next year choſen preacher to Lincoln's Inn, when he procured Ketton to be beſtowed on his curate. He was greatly admired in London for his ſermons; and in the ſame year was choſen Tueſday-lecturer at St Lawrence's church, London, where his lectures were frequented by all the divines of the city, and by many perſons of quality and diſtinction. In 1666, he took the degree of Doctor of Divinity at Cambridge; in 1669, was made prebendary of Canterbury; in 1672, was admitted dean of that cathedral; and three years after, was made a prebendary of St Paul's cathedral, London. In 1679, he became acquainted with Charles earl of Shrewſbury, whom he converted from Popery; and the next year refuſed to ſign the clergy of London's addreſs of thanks to king Charles II. for not agreeing to the bill of excluſion of the duke of York. In 1683, he viſited the unhappy Lord Ruſſel when under condemnation; and attended him in his laſt moments on the ſcaffold. In 1689, he was inſtalled dean of St Paul's; made clerk of the cloſet to King William and Queen Mary; and appointed one of the commiſſioners to prepare matters to be laid before the convocation, in order to a comprehenſion of all Proteſtants, as well diſſenters as churchmen; but this attempt was fruſtrated by the zeal of thoſe members of that body, who refuſed to admit of any alteration in things confeſſedly indifferent. In 1691, Dr Tillotſon was, notwithſtanding the warmeſt remonſtrances and intreaties on his part, conſecrated archbiſhop of Canterbury, and four days after was ſworn one of the privy-council; their majeſties always repoſing an entire confidence in his prudence, moderation, and integrity. In 1694, he was ſeized with a dead palſy, of which he died in the 65th year of his age. He was interred in the church of St Lawrence Jury, London, where a handſome monument is erected to his memory. This learned and pious divine, while living, was greatly inveighed againſt by the enemies of the revolution. After his death there was found a bundle of bitter libels which had been publiſhed againſt him, on which he had written with his own hand, "I forgive the authors of theſe books, and pray God that he may alſo forgive them." It is remarkable, that while this truly great man was in a private ſtation, he always laid aſide two-tenths of his income for charitable uſes. One volume in folio of Dr Tillotſon's ſermons was publiſhed in his life-time, and corrected by his own hand; theſe Barbeyrac tranſlated into French. Thoſe which came abroad after his death, from his chaplain Dr Barker, made two volumes in folio, the copy of which was ſold for 2500 l. and this was the only legacy he left to his family, his extenſive charity having conſumed his yearly revenues as conſtantly as they came to his hands. However, King William gave two grants to his widow; the firſt of which was an annuity of 400 l. during the term of her natural life, and the ſecond of 200 l. as an addition to the former annuity. Dr Tillotſon wrote ſome other works beſides his Sermons; and alſo publiſhed Dr Barrow's works, and Dr Wilkins's Treatiſe of the Principles and Duties of Natural Religion, and a volume of that divine's Sermons.

TIMBER, wood fit for building, &c. See TREE, and *STRENGTH of Materials*.

TIMBERS, the ribs of a ſhip, or the incurvated pieces of wood, branching outward from the keel in a vertical direction, ſo as to give ſtrength, figure, and ſolidity, to the whole fabric. See SHIP-BUILDING, book i. ch. ii.

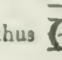
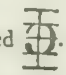
TIME, a ſucceſſion of phenomena in the univerſe, or a mode of duration marked by certain periods or meaſures, chiefly by the motion and revolution of the ſun.

The general idea which time gives in every thing to which it is applied, is that of limited duration. Thus we cannot ſay of the Deity, that he exiſts in time; becauſe eternity, which he inhabits, is abſolutely uniform, neither admitting limitation nor ſucceſſion. See METAPHYSICS, n° 209.

TIME, in muſic, is an affection of ſound, by which it is ſaid to be long or ſhort, with regard to its continuance in the ſame tone or degree of tune.

Muſical time is diſtinguiſhed into *common* or *duple* time, and *triple* time.

Double, *duple*, or *common* time, is when the notes are in a duple duration of each other, *viz*. a ſemibreve equal to two minims, a minim to two crotchets, a crotchet to two quavers, &c.

Common or double time is of two kinds. The firſt when every bar or meaſure is equal to a ſemibreve, or its value in any combination of notes of a leſs quantity. The ſecond is where every bar is equal to a minim, or its value in leſs notes. The movements of this kind of meaſure are various, but there are three common diſtinctions; the firſt *ſlow*, denoted at the beginning of the line by the mark C; the ſecond *briſk*, marked thus ; and the third *very briſk*, thus marked .

Triple time is when the durations of the notes are triple of each other, that is, when the ſemibreve is equal to three minims, the minim to three crotchets, &c. and it is marked T.

TIME-Keepers, or *Inſtruments for meaſuring Time*. See CLOCK, DIAL, WATCH, &c.

Harriſon's TIME-Keeper. See HARRISON and LONGITUDE.

TIMOLEON, a celebrated Corinthian general, who reſtored the Syracuſians to their liberty, and drove the Carthaginians out of Sicily. See SYRACUSE, n° 50—54.

TIMON the *Sceptic*, who is not to be confounded with Timon the *Miſanthrope*, was a Phliaſian, a diſciple of Pyrrho, and lived in the time of Ptolemy Philadelphus. He took ſo little pains to invite diſciples to his ſchool, that it has been ſaid of him, that as the Scythians ſhot flying, Timon gained pupils by running from them. He was fond of rural retirement; and was ſo much addicted to wine, that he held a ſucceſsful conteſt with ſeveral celebrated champions in drinking. Like Lucian, he wrote with ſarcaſtic humour againſt the whole body of philoſophers. The fragments of his ſatirical poem *Silli*, often quoted by the ancients, have been carefully collected by Henry Stephens in his *Poeſis Philoſophica*. Timon lived to the age of 90 years.

TIMON, ſurnamed *Miſanthropos*, or the *Man-hater*, a famous Athenian, who lived about 420 B. C. He was one day aſked, why he loved the young Alcibiades while he deteſted all the reſt of the human race? on which he replied, "It is becauſe I foreſee that he will be the ruin of the Athenians."

Timon, Timotheus

nians." He carefully avoided all sorts of company; yet went one day to an assembly of the people, and cried with a loud voice, "That he had a fig-tree on which several persons had hanged themselves; but as he intended to cut it down, in order to build a house on the place where it stood, he gave them notice of it, that if any of them had a mind to hang themselves, they must make haste and do it speedily." He had an epitaph engraved on his tomb, filled with imprecations against those who read it. Shakespeare has formed tragedy on his story.

TIMOR, an island of Asia, in the East-Indian sea, to the south of the Moluccas, and to the east of the island of Java, being 150 miles in length, and 37 in breadth. It abounds in sandal-wood, wax, and honey; and the Dutch have a fort here. The inhabitants are Pagans, and are little better than savages; and some pretend they had not the use of fire many years ago.

TIMOTHEUS, one of the most celebrated poet-musicians of antiquity, was born at Miletus, an Ionian city of Caria, 446 years B. C. He was contemporary with Philip of Macedon and Euripides; and not only excelled in lyric and dithyrambic poetry, but in his performance upon the cithara. According to Pausanias, he perfected that instrument by the addition of four new strings to the seven which it had before; though Suidas says it had nine before, and that Timotheus only added two, the 10th and 11th, to that number. See LYRE.

With respect to the number of strings upon the lyre of Timotheus: The account of Pausanias and Suidas is confirmed in the famous senatus-consultum against him, still extant, preserved at full length in Boethius. Mr Stillingfleet has given an extract from it, in proof of the simplicity of the ancient Spartan music. The fact is mentioned in Athenæus; and Casaubon, in his notes upon that author, has inserted the whole original text from Boethius, with corrections. The following is a faithful translation of this extraordinary Spartan act of parliament. "Whereas Timotheus the Milesian, coming to our city, has dishonoured our ancient music, and, despising the lyre of seven strings, has, by the introduction of a greater variety of notes, corrupted the ears of our youth; and by the number of his strings, and the novelty of his melody, has given to our music an effeminate and artificial dress, instead of the plain and orderly one in which it has hitherto appeared; rendering melody infamous, by composing in the chromatic instead of the enharmonic: —————————— The kings and the ephori have therefore resolved to pass censure upon Timotheus for these things: and, farther, to oblige him to cut all the superfluous strings of his eleven, leaving only the seven tones; and to banish him from our city; that men may be warned for the future not to introduce into Sparta any unbecoming custom." ———

The same story, as related in Athenæus, has this additional circumstance, That when the public executioner was on the point of fulfilling the sentence, by cutting off the new strings, Timotheus, perceiving a little statue in the same place, with a lyre in his hand of as many strings as that which had given the offence, and showing it to the judges, was acquitted.

It appears from Suidas, that the poetical and musical compositions of Timotheus were very numerous, and of various kinds. He attributes to him 19 nomes, or canticles, in hexameters; 36 proems, or preludes; 18 dithyrambics; 21 hymns; the poem in praise of Diana; one panegyric; three tragedies, the Persians, Phinidas, and Laertes; to which must be added a fourth, mentioned by several ancient authors, called *Niobe*, without forgetting the poem on the birth of Bacchus. Stephen of Byzantium makes him author

Tim ‖ Tipper

of 18 books of nomes, or airs, for the cithara, to 8000 verses; and of 1000 προοιμια, or preludes, for the nomes of the flutes.

Timotheus died in Macedonia, according to Suidas, at the age of 97; though the Marbles, much better authority, say at 90; and Stephen of Byzantium fixes his death in the fourth year of the 105th Olympiad, two years before the birth of Alexander the Great; whence it appears, that this Timotheus was not the famous player on the flute so much esteemed by that prince, who was animated to such a degree by his performance as to seize his arms; and who employed him, as Athenæus informs us, together with the other great musicians of his time, at his nuptials. However, by an inattention to dates, and by forgetting that of these two musicians of the same name the one was a Milesian and the other a Theban, they have been hitherto often confounded.

TIMUR BECK. See TAMERLANE.

TIN, one of the four imperfect metals.

For an account of its metalline qualities, and the various states in which it is found, see MINERALOGY, page 118. For its chemical qualities, see the places referred to in CHEMISTRY-*Index*. For the method of essaying and smelting its ore, see METALLURGY, Part ii. sect. vi.; Part iii. sect. vi. See also CORNWALL, and PHARMACY-*Index*.— An advantageous commerce has been lately opened between Cornwall and the East Indies and China. In 1791 about 3000 tons of tin were raised in Cornwall; of which 2200 tons were sold in the European market for L. 72 each, and 800 tons carried to India and China at L. 62 *per* ton.

TINCAL, the name by which crude or impure borax is called. See BORAX and CHEMISTRY-*Index*.

TINCTURE, in pharmacy. See PHARMACY-*Index*.

TINDAL (Dr Matthew), a famous English writer, was the son of the reverend Mr John Tindal of Beer-Ferres in Devonshire, and was born about the year 1657. He studied at Lincoln college in Oxford, whence he removed to Exeter, and was afterwards elected fellow of All Souls. In 1685 he took the degree of doctor of law, and in the reign of James II. declared himself a Roman Catholic; but soon renounced that religion. After the revolution he published several pamphlets in favour of government, the liberty of the press, &c. His "Rights of the Christian Church asserted," occasioned his having a violent contest with the high-church clergy; and his treatise "Christianity as old as the Creation," published in 1730, made much noise, and was answered by several writers, particularly by Dr Conybeare, Mr Forster, and Dr Leland. Dr Tindal died at London in August 1733. He left in manuscript a second volume of his "Christianity as old as the Creation;" the preface to which has been published. Mr Pope has satirized Dr Tindal in his Dunciad.

TINDALE (William). See TYNDALE.

TINNING, the covering or lining any thing with melted tin, or tin reduced to a very fine leaf. Looking-glasses are foliated or tinned with thin plates of beaten tin, the whole bigness of the glass, applied or fastened thereto by means of quicksilver. See *FOLIATING of Looking Glasses*.

TINNING of Copper. See COPPER, n° 25—28.

TINNITUS AURIUM, a noise in the ears like the continued sound of bells, very common in many disorders, particularly in nervous fevers.

TIPPERARY, a county of the province of Munster in Ireland, bounded on the west by that of Limerick and Clare, on the east by the county of Kilkenny and Queen's County, on the south by the county of Waterford, and on the north and north-east by King's-county and the territory of the ancient O'Carols. It extends about 42 miles in length,

length, 27 in breadth, containing 599,500 acres, divided into 12 baronies, in which are ſeveral market towns and boroughs. It ſends eight members to parliament, *viz.* two for the county, two for the city of Caſhel, and two for each of the boroughs of Clonmell, Fetherd, and Thurles. The north part of it is mountainous and cold; but in the ſouth the air is milder, and the ſoil much more fertile, producing plenty of corn, and good paſture for the numerous herds of cattle and flocks of ſheep with which it abounds. The north part is called *Ormond*, and for a long time gave the title of *earl*, and afterwards of *marquis* and *duke*, to the noble family of Butler, deſcended from a ſiſter of Thomas a Becket archbiſhop of Canterbury, till, at the acceſſion of George I. the laſt duke was attainted of high-treaſon, and died abroad. In that part of the county, the family had great prerogatives and privileges granted them by Edward III. Another diſtrict in this county was anciently called the *County of the Holy Croſs of Tipperary*, from a famous abbey in it ſtyled *Holy Croſs*, on account of a piece of Chriſt's croſs that was ſaid to be preſerved there. This abbey and diſtrict enjoyed alſo ſpecial privileges in former times. The remains of the abbey, or rather the ſpot where it ſtood, are ſtill held in great veneration, and much reſorted to by the Roman Catholics.

TIPSTAFF, an officer who attends the judges with a kind of ſtaff tipped with ſilver, and takes into his charge all priſoners who are committed or turned over at a judge's chambers.

TIPULA, the CRANE-FLY; a genus of inſects belonging to the order of *diptera*. The mouth is a prolongation of the head; the upper-jaw is arched. They have two palpi, which are curved, and longer than the head. The proboſcis is ſhort, and bends inwards. Gmelin enumerates 123 ſpecies, of which 14 are Britiſh. They are divided into two families. 1. Thoſe with wings diſplayed. 2. Thoſe with wings incumbent, and which in form reſemble a gnat.

This two-winged inſect is often taken for the gnat, which it reſembles, but has not its miſchievous inſtinct, nor its murderous proboſcis. The larger tipulæ go by the name of *ſempſtreſſes*, the ſmall ones by that of *culiciform*; the latter, in fine ſummer evenings, flutter about the water-ſide in legions, through which a perſon may paſs on his way unhurt. The ſhrill noiſe they make with their wings is not very diſcernible. Tipulæ, before they become inhabitants of the air, creep under the form of grubs. Thoſe which turn to larger tipulæ dwell in holes of decayed willows, in the dampeſt places, where they change into chryſalids, and in that ſtate have the faculty of breathing thro' two ſmall curve horns; beſides which they are endowed with progreſſive motion, but not retrogreſſive, being impeded by little ſpines placed on every ring of the abdomen. When the ſhroud is torn, the inſect, prettily apparelled, eſcapes from his gloomy habitation by means of his wings, which often are variegated, and takes his paſtime in the fields. Its long legs, and its wings, mutually aſſiſt each other when it either walks or flies. The larvæ and chryſalids of the little tipulæ are found in water. They are various in colour, form, and carriage; ſome being grey, others brown, and others red; ſome, like the polypus, furniſhed with a pair of arms; ſeveral with cylindrical tubes that perform the office of vent-holes. Theſe ſwim with nimbleneſs; thoſe never leave the holes they have dug for themſelves in the banks of rivulets. Laſtly, others make a ſilken cod that receives part of their body; but all of them, after a period, renounce their reptile and aquatic life, and receive wings from the hands of nature. Their frame is then ſo weak, that a touch is enough to cruſh them. They are ſometimes of a beautiful green, ſometimes coal-black; and the moſt remarkable are thoſe whoſe fore-legs, extraordinarily long, do not touch the ground, and are moveable like antennæ. In this ſtate of perfection, the tipulæ being provided with proper organs, apply themſelves to the propagation of the ſpecies. Thoſe ſame poor inſects, who in the ſtate of larvæ have eſcaped the voraciouſneſs of fiſhes, often become, in their progreſs through the air, a prey to equally mercileſs birds.

TIRE, in the ſea language, is a row of cannon placed along a ſhip's ſide, either above upon deck, or below, diſtinguiſhed by the epithets of *upper* and *lower tires*.

TIROL, a county of Germany in the circle of Auſtria, under which may be included the territories belonging to the biſhops of Brixen, Trent, and Chur, Teutonic Order, and the prince of Deitrichſtein, the Auſtrian ſeigniories before the Arlberg, and the Auſtrian diſtricts in Swabia. It is 150 miles in length, and 120 in breadth, and contains 28 large towns.

The face of the country is very mountainous. Of theſe mountains, ſome have their tops always buried in ſnow; others are covered with woods, abounding with a variety of game; and others are rich in metals, and marble of all colours. Of the lower, ſome yield plenty of corn, others wine, and woods of cheſnut trees. The valleys are exceeding fertile alſo, and pleaſant. In ſome places conſiderable quantities of flax are raiſed, in others there is a good breed of horſes and horned cattle; and, among the mountains, abundance of chamois and wild goats. In this country are alſo found precious ſtones of ſeveral ſorts; as granates, rubies, amethyſts, emeralds, and a ſpecies of diamonds, agates, cornelians, chalcedonies, malachites, &c. nor is it without hot-baths, acid waters, ſalt-pits, mines of ſilver, copper, and lead, mineral colours, alum, and vitriol. The principal river of Tirol is the Inn, which, after traverſing the country, and receiving a number of leſſer ſtreams into it, enters Bavaria, in which, at Paſſau, it falls into the Danube. The men here are very tall, robuſt, and vigorous; the women alſo are ſtout, and generally fair; and both ſexes have a mixture of the Italian and German in their tempers and characters. As there is little trade or manufacture in the country, except what is occaſioned by the mines and ſalt-works, many of the common people are obliged to ſeek a ſubſiſtence elſewhere. A particular kind of ſalutation is uſed all over Tirol. When a perſon comes into a houſe, he ſays, "Hail! Jeſus Chriſt:" the anſwer is, "May Chriſt be praiſed, and the Holy Virgin his mother." Then the maſter of the houſe takes the viſitor by the hand. This ſalutation is fixed up in print at all the doors, with an advertiſement tacked to it, importing, that pope Clement XI. granted 100 days indulgence, and a plenary abſolution, to thoſe who ſhould pronounce the ſalutation and anſwer, as often as they did it. The emperor has forts and citadels ſo advantageouſly ſituated on rocks and mountains all over the country, that they command all the valleys, avenues, and paſſes that lead into it. The inhabitants, however, to keep them in good humour, are more gently treated, and not ſo highly taxed as thoſe of the other hereditary countries. As to the ſtates, they are much the ſame in this country as in the other Auſtrian territories, except that the peaſants here ſend deputies to the diets. Tirol came to the houſe of Auſtria in the year 1363, when Margaret, counteſs thereof, bequeathed it to her uncles the dukes of Auſtria. The arms of Tirol are an eagle gules, in a field argent. The counts of Trap are hereditary ſtewards; the lords of Gloſz, chamberlains; the princes of Trautſon, marſhals; the counts of Wolkenſtein, maſters of the horſe and carvers; the houſe of Spaur, cup-bearers; the counts of Kungl, ſewers and

Titan. rangers; the counts of Brandis, keepers of the jewels; the house of Welsperg, purveyors and staff bearers; and the counts of Coalto, falconers. Besides the governor, here are three sovereign colleges, subordinate to the court at Vienna, which sit at Inspruck, and have their different departments. Towards the expences of the military establishment of this county, the proportion is 100,000 florins yearly; but no more than one regiment of foot is generally quartered in it.

Tirol is divided into six quarters, as they are called; namely, those of the Lower and Upper Innthal, Vintsgow, Etch, Eitack, and Pusterthal.

TITAN, in fabulous history, the son of Cœlus and Terra, and the eldest brother of Saturn, suffered the latter to enjoy the crown, on condition that he should bring up none of his male issue, by which means the crown would at length revert to him; but Jupiter being spared by the address of Rhea, Saturn's wife, Titan and his chrildren were so enraged at seeing their hopes frustrated, that they took up arms to revenge the injury; and not only defeated Saturn, but kept him and his wife prisoners till he was delivered by Jupiter, who defeated the Titans; when from the blood of these Titans slain in the battle, proceeded serpents, scorpions, and all venomous reptiles. See SATURN.

Such is the account given by the poets of this family of Grecian and Roman gods. From the fragments of Sanchoniatho, however, and other ancient writers, many learned men have inferred that the Titans were an early race of ambitious heroes, who laid the foundation of that idolatry which quickly overspread the world, and that by assuming the names of the luminaries of heaven they contrived to get themselves every where adored as the *Dii majorum gentium*. That the word *Titan* signifies the sun, there can indeed be very little doubt. Every one knows that such was its signification in the Æolic dialect; and as it is evidently compounded of *Ti*, which, in some oriental tongues, signifies *bright* or *clear*, and *Tan*, which signifies a *country* or the *earth*, it may be safely concluded that *Titan* was the name of the sun before the word was imported into Greece. But the great question among antiquarians is, of what country was that race which, assuming to themselves the names of the heavenly bodies, introduced into the world that species of idolatry which is known by the appellation of *Hero-worship?*

M. Pezron, in a work published many years ago, and entitled *The Antiquities of Nations*, maintains that the Titans were a family of Sacæ or Scythians, who made their first appearance beyond Media and mount Imaus, in the upper regions of Asia; that they were the descendants of Gomer the son of Japheth and grandson of Noah; and that after conquering a great part of the world, upon entering Upper Phrygia, they quitted their ancient name of Gomerians or Cimmerians, and assumed that of Titans. All this, he says, happened before the birth of Abraham and the foundation of the Assyrian monarchy; and he makes Uranus, their second prince in the order of succession, to have conquered Thrace, Greece, the Island of Crete, and a great part of Europe. Uranus was succeeded by Saturn, and Saturn by Jupiter, who flourished, he says, 300 years before Moses, and divided his vast empire between himself, his brother Pluto, and his cousin-german Atlas, who was called *Telamon*. For the truth of this genealogy of the Titans M. Pezron appeals to the most approved Greek historians; but unluckily for his hypothesis these writers have not a single sentence by which it can be fairly supported. It supposes not only the great antiquity of the Scythians, but likewise their early progress in arts and sciences, contrary to what we have proved in other articles of this work. See SCULPTURE, n° 4 and 5. and SCYTHIA.

Others, taking the fragment of Sanchoniatho's Phenician history for their guide, have supposed the Titans to have been the descendants of Ham. Of this opinion was bishop Cumberland; and our learned friend Dr Doig, to whom we have been indebted for greater favours, indulged us with the perusal of a manuscript, in which, with erudition and ingenuity struggling for the pre-eminence, he traces that impious family from the profane son of Noah, and shows by what means they spread the indolatrous worship of themselves over the greater part of the ancient world. Cronus, of whose exploits some account has been given elsewhere (see SANCHONIATHO), he holds to be Ham; and tracing the progress of the family from Phœnicia to Cyprus, from Cyprus to Rhodes, thence to Crete, and from Crete to Samathrace, he finds reason to conclude that the branch called *Titans* or *Titanides* flourished about the era of Abraham, with whom, or with his son Isaac, he thinks the Cretan Jupiter must have been contemporary. As they proceeded from countries which were the original seat of civilization to others in which mankind had sunk into the grossest barbarism, it was easy for them to persuade the ignorant inhabitants that they derived the arts of civil life from their parent the sun, and in consequence of their relation to him to assume to themselves divine honours. To ask how they came to think of such gross impiety, is a question as foolish as it would be to ask how Ham their ancestor became so wicked as to entail the curse of God upon himself and his posterity. The origin of evil is involved in difficulties; but leaving all inquiries into it to be prosecuted by the metaphysician and moralist, it is surely more probable that the worship of dead men originated among the descendants of Ham than among those of Shem and Japheth; and that the fragment of Sanchoniatho, when giving an account of the origin of the Titans, the undoubted authors of that worship, is more deserving of credit than the fabulous and comparitively late writers of Greece and Rome.

Tit. Tith.

TITHES, in ecclesiastical law, are defined to be the tenth-part of the increase, yearly arising and renewing from the profits of lands, the stock upon lands, and the personal industry of the inhabitants: the first species being usually called *predial*, as of corn, grass, hops, and wood; the second *mixed*, as of wool, milk, pigs, &c. consisting of natural products, but nurtured and preserved in part by the care of man; and of these the tenth must be paid in gross; the third *personal*, as of manual occupations, trades, fisheries, and the like; and of these only the tenth-part of the clear gains and profits is due.

We shall, in this article, consider, 1. The original of the right of tithes. 2. In whom that right at present subsists. 3. Who may be discharged, either totally or in part, from paying them.

1. As to their original, we will not put the title of the clergy to tithes upon any divine right; though such a right certainly commenced, and we believe as certainly ceased, with the Jewish theocracy. Yet an honourable and competent maintenance for the ministers of the gospel is undoubtedly *jure divino*, whatever the particular mode of that maintenance may be. For, besides the positive precepts of the New Testament, natural reason will tell us, that an order of men who are separated from the world, and excluded from other lucrative professions for the sake of the rest of mankind, have a right to be furnished with the necessaries, conveniences, and moderate enjoyments of life, at their expence; for whose benefit they forego the usual means of providing them. Accordingly all municipal laws have provided a liberal and decent maintenance for their national priests or clergy; ours, in particular, have established this of tithes, probably in imitation of the Jewish law: and perhaps, *Blackst. Comment.*

haps, conſidering the degenerate ſtate of the world in general, it may be more beneficial to the Engliſh clergy to found their title on the law of the land, than upon any divine right whatſoever, unacknowledged and unſupported by temporal ſanctions.

We cannot preciſely aſcertain the time when tithes were firſt introduced into this country. Poſſibly they were contemporary with the planting of Chriſtianity among the Saxons by Auguſtin the monk, about the end of the ſixth century. But the firſt mention of them which we have met with in any written Engliſh law, is a conſtitutional decree, made in a ſynod held A. D. 786, wherein the payment of tithes in general is ſtrongly enjoined. This canon or decree, which at firſt bound not the laity, was effectually confirmed by two kingdoms of the heptarchy, in their parliamentary conventions of eſtates, reſpectively conſiſting of the kings of Mercia and Northumberland, the biſhops, dukes, ſenators, and people. Which was a few years later than the time that Charlemagne eſtabliſhed the payment of them in France, and made that famous diviſion of them into four parts; one to maintain the edifice of the church, the ſecond to ſupport the poor, the third the biſhop, and the fourth the parochial clergy.

The next authentic mention of them is in the *fœdus Edwardi et Guthruni;* or the laws agreed upon between king Guthrun the Dane, and Alfred and his ſon Edward the Elder, ſucceſſive kings of England, about the year 900. This was a kind of treaty between thoſe monarchs, which may be found at large in the Anglo-Saxon laws: wherein it was neceſſary, as Guthrun was a Pagan, to provide for the ſubſiſtence of the Chriſtian clergy under his dominion; and accordingly, we find the payment of tithes not only enjoined, but a penalty added upon non-obſervance: which law is ſeconded by the laws of Athelſtan, about the year 930. And this is as much as can certainly be traced out with regard to their legal original.

2. We are next to conſider the perſons to whom tithes are due. Upon their firſt introduction, though every man was obliged to pay tithes in general, yet he might give them to what prieſts he pleaſed; which were called *arbitrary conſecrations of tithes*; or he might pay them into the hands of the biſhop, who diſtributed among his dioceſian clergy the revenues of the church, which were then in common. But when dioceſes were divided into pariſhes, the tithes of each pariſh were allotted to its own particular miniſter; firſt by common conſent or the appointments of lords of manors, and afterwards by the written law of the land.

Arbitrary conſecrations of tithes took place again afterwards, and were in general uſe till the time of king John. This was probably owing to the intrigues of the regular clergy, or monks of the Benedictine and other orders, under archbiſhop Dunſtan and his ſucceſſors: who endeavoured to wean the people from paying their dues to the ſecular or parochial clergy (a much more valuable ſet of men than themſelves), and were then in hopes to have drawn, by ſanctimonious pretences to extraordinary purity of life, all eccleſiaſtical profits to the coffers of their own ſocieties. And this will naturally enough account for the number and riches of the monaſteries and religious houſes which were founded in thoſe days, and which were frequently endowed with tithes. For a layman, who was obliged to pay his tithes ſomewhere, might think it good policy to erect an abbey, and there pay them to his own monks, or grant them to ſome abbey already erected: ſince for this donation, which really coſt the patron little or nothing, he might, according to the ſuperſtition of the times, have maſſes for ever ſung for his ſoul. But in proceſs of years, the income of the poor laborious pariſh-prieſts being ſcandalouſly reduced by theſe arbitrary conſecrations of tithes, it was remedied by pope Innocent III. about the year 1200, in a decretal epiſtle ſent to the archbiſhop of Canterbury, and dated from the palace of Lateran: which has occaſioned Sir Henry Hobart and others to miſtake it for a decree of the council of Lateran, held A. D. 1179, which only prohibited what was called the *infeodation of tithes*, or their being granted to mere laymen; whereas this letter of pope Innocent to the archbiſhop enjoined the payment of tithes to the parſons of the reſpective pariſhes where every man inhabited, agreeable to what was afterwards directed by the ſame pope in other countries. This epiſtle, ſays Sir Edward Coke, bound not the lay ſubjects of this realm; but being reaſonable and juſt, it was allowed of, and ſo became *lex terræ*. This put an effectual ſtop to all the arbitrary conſecrations of tithes; except ſome footſteps which ſtill continue in thoſe portions of tithes which the parſon of one pariſh hath, though rarely, a right to claim in another: for it is now univerſally held, that tithes are due, of common right, to the parſon of the pariſh, unleſs there be a ſpecial exemption. This parſon of the pariſh may be either the actual incumbent, or elſe the appropriator of the benefice; appropriations being a method of endowing monaſteries, which ſeems to have been deviſed by the regular clergy, by way of ſubſtitution to arbitrary conſecrations of tithes.

3. We obſerved that tithes are due of common right to the parſon, unleſs by ſpecial exemption; let us therefore ſee, *thirdly*, who may be exempted from the payment of tithes, and how lands and their occupiers may be exempted or diſcharged from the payment of tithes, either in part or totally; firſt, by a real compoſition; or, ſecondly, by cuſtom or preſcription.

Firſt, a real compoſition is when an agreement is made between the owner of the lands and the parſon or vicar, with the conſent of the ordinary and the patron, that ſuch lands ſhall for the future be diſcharged from payment of tithes, by reaſon of ſome land or other real recompenſe given to the parſon in lieu and ſatiſfaction thereof. This was permitted by law, becauſe it was ſuppoſed that the clergy would be no loſers by ſuch compoſition; ſince the conſent of the ordinary, whoſe duty it is to take care of the church in general, and of the patron, whoſe intereſt it is to protect that particular church, were both made neceſſary to render the compoſition effectual: and hence have ariſen all ſuch compoſitions as exiſt at this day by force of the common law. But experience ſhowing that even this caution was ineffectual, and the poſſeſſions of the church being by this and other means every day diminiſhed, the diſabling ſtatute 13 Eliz. c. 10. was made; which prevents, among other ſpiritual perſons, all parſons and vicars from making any conveyances of the eſtates of their churches, other than for three lives or 21 years. So that now, by virtue of this ſtatute, no real compoſition made ſince the 13 Eliz. is good for any longer term than three lives or 21 years, though made by conſent of the patron and ordinary: which has indeed effectually demoliſhed this kind of traffic; ſuch compoſitions being now rarely heard of, unleſs by authority of parliament.

Secondly, a diſcharge by cuſtom or preſcription, is where time out of mind ſuch perſons or ſuch lands have been either partially or totally diſcharged from the payment of tithes. And this immemorial uſage is binding upon all parties; as it is in its nature an evidence of univerſal conſent and acquieſcence, and with reaſon ſuppoſes a real compoſition to have been formerly made. This cuſtom or preſcription is either *de modo decimandi*, or *de non decimando*.

A *modus decimandi*, commonly called by the ſimple name of

Tithes

of a *modus* only, is where there is by custom a particular manner of tithing allowed, different from the general law of taking tithes in kind, which are the actual tenth-part of the annual increase. This is sometimes a pecuniary compensation, as twopence an acre for the tithe of land: sometimes it is a compensation in work and labour, as that the parson shall have only the twelfth cock of hay, and not the tenth, in consideration of the owner's making it for him: sometimes, in lieu of a large quantity of crude or imperfect tithe, the parson shall have a less quantity when arrived at greater maturity, as a couple of fowls in lieu of tithe-eggs, and the like. Any means, in short, whereby the general law of tithing is altered, and a new method of taking them is introduced, is called a *modus decimandi*, or special manner of tithing.

A prescription *de non decimando* is a claim to be entirely discharged of tithes, and to pay no compensation in lieu of them. Thus the king by his prerogative is discharged from all tithes. So a vicar shall pay no tithes to the rector, nor the rector to the vicar, for *ecclesia decimas non solvit ecclesiae*. But these personal privileges (not arising from or being annexed to the land) are personally confined to both the king and the clergy; for their tenant or lessee shall pay tithes, though in their own occupation their lands are not generally tithable. And, generally speaking, it is an established rule, that in lay hands, *modus de non decimando non valet*. But spiritual persons or corporations, as monasteries, abbots, bishops, and the like, were always capable of having their lands totally discharged of tithes by various ways: as, 1. By real composition. 2. By the pope's bull of exemption. 3. By unity of possession; as when the rectory of a parish, and lands in the same parish, both belonged to a religious house, those lands were discharged of tithes by this unity of possession. 4. By prescription; having never been liable to tithes, by being always in spiritual hands. 5. By virtue of their order; as the Knights Templars, Cistercians, and others, whose lands were privileged by the pope with a discharge of tithes. Though, upon the dissolution of abbeys by Henry VIII. most of these exemptions from tithes would have fallen with them, and the lands become tithable again, had they not been supported and upheld by the statute 31 Henry VIII. c. 13. which enacts, that all persons who should come to the possession of the lands of any abbey then dissolved, should hold them free and discharged of tithes, in as large and ample a manner as the abbeys themselves formerly held them. And from this original have sprung all the lands which being in lay hands, do at present claim to be tithe-free: for if a man can show his lands to have been such abbey-lands, and also immemorially discharged of tithes by any of the means before-mentioned, this is now a good prescription *de non decimando*. But he must show both these requisites: for abbey-lands, without a special ground of discharge, are not discharged of course; neither will any prescription *de non decimando* avail in total discharge of tithes, unless it relates to such abbey-lands.

It is universally acknowledged that the payment of tithes in kind is a great discouragement to agriculture. They are inconvenient and vexatious to the husbandman, and operate as an impolitic tax upon industry. The clergyman, too, frequently finds them troublesome and precarious; his expences in collecting are a considerable drawback from their value, and his just rights are with difficulty secured: he is too often obliged to submit to imposition, or is embroiled with his parishioners in disputes and litigations, no less irksome to his feelings than prejudicial to his interest, and tending to prevent those good effects which his precepts should produce. It is therefore of the utmost importance to parochial tranquillity, and even to religion, that some just and reasonable standard of composition could be fixed. Land has been proposed, but in the present state of the division of property this is impossible: and as money is continually changing in its value, it would also be a very improper standard, unless some plan could be formed by which the composition could be increased as the value of money diminishes. A plan of this kind has been published in the Transactions of the Society instituted at Bath, Vol. IV. which those who are interested in this subject may consult for farther information.

Tithing, Titian.

TITHING, (*Tithinga*, from the Sax. *Theothunge*, i.e. *Decuriam*), a number or company of ten men, with their families, knit together in a kind of society, and all bound to the king, for the peaceable behaviour of each other. Anciently no man was suffered to abide in England above forty days, unless he were enrolled in some tithing.—One of the principal inhabitants of the tithing was annually appointed to preside over the rest, being called the *tithing-man*, the head-borough, and in some countries the borsholder, or borough's ealder, being supposed the discreetest man in the borough, town, or tithing. The distribution of England into tithings and hundreds is owing to king Alfred. See BORSHOLDER.

TITIANO VECELLI, or TITIAN, the most universal genius for painting of all the Lombard school, the best colourist of all the moderns, and the most eminent for histories, portraits, and landscapes, was born at Cadore, in the province of Friuli, in the state of Venice, in 1477, or in 1480 according to Vasari and Sandrart. His parents sent him at ten years of age to one of his uncles at Venice, who finding that he had an inclination to painting, put him to the school of Giovanni Bellino.

Pilkin[g]'s Diction[ary] of Pai[nters]

But as soon as Titian had seen the works of Giorgione, whose manner appeared to him abundantly more elegant, and less constrained than that of Bellino, he determined to quit the style to which he had so long been accustomed, and to pursue the other that recommended itself to him, by having more force, more relief, more nature, and more truth. Some authors affirm, that he placed himself as a disciple with Giorgione; yet others only say, that he cultivated an intimacy with him; but it is undoubtedly certain that he studied with that great master; that he learned his method of blending and uniting the colours; and practised his manner so effectually, that several of the paintings of Titian were taken for the performances of Giorgione; and then his success inspired that artist with an invincible jealousy of Titian, which broke off their connection for ever after.

The reputation of Titian rose continually; every new work contributed to extend his fame through all Europe; and he was considered as the principal ornament of the age in which he flourished. And yet, Sandrart observes, that amidst all his applause, and constant employment at Venice, his income and fortune were inconsiderable; and he was more remarkable for the extensiveness of his talents, than for the affluence of his circumstances. But when his merit was made known to the emperor Charles V. that monarch knew how to set a just value on his superior abilities; he enriched him by repeated bounties, allowed him a considerable pension, conferred on him the honour of knighthood, and what was still more, honoured him with his friendship. He painted the portrait of that benefactor several times; and it is recorded by Sandrart, that one day, while the emperor was sitting for his picture, a pencil happening to drop from the painter, he stooped, took it up, and returned it; obligingly answering to the modest apology of the artist

(who blushed at the condescension of so great a monarch), that the merit of a Titian was worthy of the attendance of an emperor.

The excellence of Titian was not so remarkably apparent in the historical compositions which he painted as in his portraits and landscapes, which seem to be superior to all competition; and even to this day, many of them preserve their original beauty, being as much the admiration of the present age as they have deservedly been of the ages past. — It is observed of Titian by most writers, that in the different periods of his life he had four different manners; one resembling his first instructor Bellino, which was somewhat stiff; another, in imitation of Giorgione, more bold, and full of force; his third manner was the result of experience, knowledge, and judgment, beautifully natural, and finished with exquisite care, which manner was peculiarly his own; and in those pictures which he painted between the years of approaching old age and his death may be noticed his fourth manner. His portraits were very differently finished in his early, and in his latter time, according to the testimony of Sandrart. At first he laboured his pictures highly, and gave them a polished beauty and lustre, so as to produce their effect full as well when they were examined closely as when viewed at a distance; but afterwards, he so managed his penciling, that their greatest force and beauty appeared at a more remote view, and they pleased less when they were beheld more nearly. So that many of those artists who studied to imitate him, being misled by appearances which they did not sufficiently consider, have imagined that Titian executed his work with readiness and a masterly rapidity; and concluded that they should imitate his manner most effectually by a freedom of hand and a bold pencil: Whereas in reality, Titian took abundance of pains to work up his pictures to so high a degree of perfection; and the freedom that appears in the handling was entirely effected by a skilful combination of labour and judgment.

It cannot be truly affirmed, that Titian equalled the great masters of the Roman school in design; but he always took care to dispose his figures in such attitudes as showed the most beautiful parts of the body. His taste in designing men was not generally so correct or elegant as it appeared in his boys and female figures; but his colouring had all the look of real flesh, his figures breathe. He was not so bold as Giorgione, but in tenderness and delicacy he proved himself much superior to him and all other artists. The expression of the passions was not his excellence, though even in that respect many of his figures merited the justest commendation; but he always gave his figures an air of ease and dignity. His landscapes are universally allowed to be unequalled, whether we consider the forms of his trees, the grand ideas of nature which appear in his scenery, or his distances which agreeably delude and delight the eye of every observer; and they are executed with a light, tender, and mellow pencil. He learned from nature the harmony of colours, and his tints seem astonishing, not only for their force, but their sweetness; and in that respect his colouring is accounted the standard of excellence to all professors of the art.

It would prove almost an endless task to enumerate the variety of works executed by this illustrious artist, at Rome, Venice, Bologna, and Florence, as well as those which are to be seen in other cities of Italy, in England, Spain, Germany, and France; but there are two, which are mentioned as being truly admirable. One is, a Last Supper, preserved in the Refectory at the Escurial in Spain, which is inimitably fine; the other is at Milan, representing Christ crowned with Thorns. The principal figure in the latter has an attitude full of grace and dignity more than mortal, and the countenance shows a benevolence and humility, combined with dignity and pain, which no pencil but that of Titian could so feelingly have described. It is admirably coloured, and tenderly and delicately pencilled; the heads are wonderfully beautiful, the composition excellent, and the whole has a charming effect by the chiaro scuro.

He was of so happy a constitution, that he was never ill till the year 1576, when he died of the plague, at 99 years of age. His disciples were Paulo Veronese, Giacomo Tintoret, Giacomo de Porte Bassano, and his sons.

TITLARK, in ornithology. See ALAUDA.

TITLE, an appellation of dignity or rank given to princes and persons of distinction.

Titles were not so common among the ancient Greeks or Romans as they are in modern times. Till the reign of Constantine the title of *Illustrious* was never given except to those who were distinguished in arms or letters: But at length it became hereditary in the families of princes, and every son of a prince was illustrious. The title of *Highness* was formerly given only to kings. The kings of England before the reign of Henry VIII. were addressed by the title of *your Grace*. That monarch first assumed the title of *Highness*, and afterwards that of *Majesty*. The title of majesty was first given him by Francis I. in their enterview in 1520. Charles V. was the first king of Spain who assumed the same title.

Princes, nobles, and clergy generally have one title derived from their territories and estates, and another derived from their rank or from some other remarkable circumstance. The Pope is called the *Bishop of Rome*, and has the title of *Holiness*. A cardinal has his name generally from some church, and is saluted by the name of *Eminent*, or *most Eminent*. An archbishop, besides being named from his diocese, is called *his Grace* and *most Reverend*: a bishop is also distinguished by the name of his diocese, and has the title of *his Lordship* and *right Reverend*. Inferior clergymen are denominated *Reverend*.

The titles of crowned heads derived from their dominions it is unnecessary to mention. It will be sufficient to mention those by which they are addressed. To an emperor is given the title of *Imperial Majesty*; to kings, that of *Majesty*; to the princes of Great Britain, *Royal Highness*; to those of Spain, *Infant*; to electors, *Electoral Highness*; to the grand duke of Tuscany, *Most Serene Highness*; to the other princes of Italy and Germany, *Highness*; to the Doge of Venice, *Most Serene Prince*; to the grand-master of Malta, *Eminence*; to nuncios and ambassadors of crowned heads, *Excellency*; to dukes, *Grace*; to marquisses, earls, and barons, *Lordship*.

The emperor of China, among his titles, takes that of *Tien Su*, "Son of Heaven." The Orientals, it is observed, are exceedingly fond of titles: the simple governor of Schiras, for instance, after a pompous enumeration of qualities, lordships, &c. adds the titles of *Flower of Courtesy*, *Nutmeg of Consolation*, and *Rose of Delight*.

TITLE, in law, denotes any right which a person has to the possession of a thing, or an authentic instrument whereby he can prove his right. See the articles RIGHT, PROPERTY, &c.

TITLE to the Crown in the British Constitution. See SUCCESSION.

TITMOUSE, in ornithology. See PARUS.

TITULAR, denotes a person invested with a title, in virtue of which he holds an office or benefice, whether he perform the functions thereof or not.

TITUS VESPASIANUS, the Roman emperor, the son of Vespasian; of whom it is related, that not being able to recollect

Titus, Tobacco.

ollect any remarkable good action he had done on a certain day, he exclaimed, "I have lost a day!" He might truly be called the *father of his people*; and though Rome laboured under various public calamities during his reign, such was his equitable and mild administration, that he constantly preserved his popularity. He was a great lover of learning, and composed several poems. He reigned but two years; and it is thought Domitian his brother poisoned him, A. D. 81, aged 41. See (*History of*) ROME.

TIVIOT HILLS. See CHEVIOT.

TIVOLI, the modern name of TIBUR.

TOAD, in zoology. See RANA.

Toad-Fish. See LOPHIUS.

Toad-Flax, in botany. See ANTIRRHINUM.

Toad-Stone, a genus of argillaceous earths examined by Dr Withering. He describes it as of a dark-brownith grey colour; its texture granular; neither effervescing with acids nor striking fire with steel. The cavities of it are filled with crystallized spar, and in a strong heat it is fusible *per se*. An hundred parts of toad-stone contain from 56 to 63.5 of siliceous earth, near 15 of argillaceous earth, 7.5 of calcareous earth, and 16 of oxydated iron. Dr Kirwan observes, that the toad stone is not much different from basaltes, only that it is softer: it contains also a smaller proportion of iron, and a larger one of siliceous earth.

Phil. Transact. for 1782.

TOBACCO, in botany. See NICOTIANA and SNUFF.

The Indians (says Dr Leake) poison their arrows with the oil of tobacco, which, infused into a fresh wound, occasions sickness and vomiting, or convulsions and death; with what safety therefore, setting aside propriety, the subtle powder of this plant, called *snuff*, may be applied to the tender, internal surface of the nose, it may be proper to inquire; for, if the oil of tobacco is a mortal poison when applied to the open vessels of a wound, surely this plant, when taken in substance as snuff, must in a certain degree be injurious. From the infinite number of nerves diffused over the mucous membrane of the nose, it is endowed with exquisite feeling; and, the better to preserve the sense of smelling, those nerves are continually lubricated with moisture.

By the almost caustic acrimony of snuff, this moisture is dried up, and those fine, delicate nerves, the organs of smelling, are rendered callous and insensible. To this self-evident bad effect may be added the *narcotic* or stupifying power of tobacco, by which not only the brain and nerves are injured, but also the eyes depending upon their influence, together with the sense of smelling; and, from the force with which snuff is usually drawn up the nose, its passage will be obstructed, and the voice lose its clearness and distinct articulation.

Besides those pernicious qualities, snuff often involuntarily descends into the stomach, creating nausea, loss of appetite, and vomiting; and by its narcotic power will diminish nervous influence and impair digestion; it discolours the skin contiguous to the nose, and will taint the sweetest breath with the rank odour of a tobacco cask. For this reason the ladies of fashion in France seldom take snuff till they are married; a very high compliment, no doubt, to their husbands. The only advantage of taking snuff is that of sneezing, which, in sluggish, phlegmatic habits, will give universal concussion to the body, and promote a more free circulation of the blood; but of this benefit, snuff-takers are deprived, from being familiar with its use.

We have been told, that tobacco, when chewed, is a preservative against hunger: but this is a vulgar error; for, in reality, it may more properly be said to destroy appetite by the profuse discharge of saliva, which has already been considered as a powerful, dissolving fluid, essential both to appetite and digestion. In smoking, the fumes of tobacco induce a kind of pleasing insensibility not easily described. Its narcotic odour, thus administered, equally infatuates the ignorant savage and the intelligent philosopher; but, by the large expence of saliva thereby occasioned, it is productive of many disorders of the head and stomach, particularly the last.

Tobacco-Pipe-Fish. See FISTULARIA.

Tobacco-tongs. See PHARMACY-*Index*.

TOBAGO, one of the Caribbee islands, ceded to Great Britain by the treaty of Paris in 1763, taken by the French in 1781, and retaken by the British in 1793. It lies in the latitude of 11 degrees 10 minutes north, and 59 degrees 40 minutes longitude west from London, about 40 leagues south-by-west from Barbadoes, 35 south-east from St Vincents, 20 south-east from Grenada, 12 north-east from the Spanish island of Trinidada, and between 30 and 40 north-east from the Spanish main. According to the latest accounts, it is somewhat more than 30 miles in length from north east to south west, between 8 and 9 in breadth, and from 23 to 25 leagues in circumference. The English visited this island very early, Sir Robert Dudley being there in the reign of queen Elizabeth. In that of Charles I. William earl of Pembroke procured a grant of this, with two other small islands; but died before he was able to carry into execution his design of settling them. In A. D. 1632 some merchants of Zealand sent over a small colony thither, and gave it the name of *New Walcheren*; but before they were able thoroughly to establish themselves, they were destroyed by the Indians assisted by the Spaniards. Ten years after, James Duke of Courland sent a colony thither, who settled themselves upon Great Courland bay, and made a considerable progress in planting. A. D. 1654, Messieurs Adrian and Cornelius Lampsins, two opulent merchants of Flushing, sent a considerable number of people thither, who settled on the other side of the island, and lived in amity with the Courlanders, until they learned that the king of Sweden had seized the person of their duke and dispossessed him of his dominions, when they attacked and forced his subjects to submit. The duke being afterwards restored, he obtained from Charles II. a grant of this island, dated the 17th of November 1664. In the second Dutch war the count d'Estrees, by order of his master, totally ruined it at the close of the year 1677; and from that time it continued waste till Britain took possession of it after the treaty of Paris. The climate, notwithstanding its vicinity to the line, is so tempered by the breezes from the sea, as to be very supportable even to Europeans; and hath the same advantages with that of Grenada, in having regular seasons, and also in being exempt from the hurricanes. There are throughout the island many rising grounds, though, except at the north-east extremity, there is no part of it that can be styled mountainous; and even there the country is far from being rugged or impassable. The soil, if we may credit either Dutch or French writers, is as fertile and luxuriant as any of the islands, and very finely diversified. Ground provisions of all sorts have been raised in great plenty, a vast variety of vegetables, excellent in their kind, some for food, some for physic. Almost every species of useful timber is to be found here, and some of an enormous size; amongst others, the true cinnamon and nutmeg tree, as the Dutch confess, and of which none could be better judges; whole groves of sassafras, and of trees that bear the true gum copal, with other odoriferous plants that render the air wholesome and pleasant. It is as well watered as can be wished, by rivers that fall into the sea on both sides, many smaller streams, and fine fresh springs in almost every part of the island. The sea-coast is indented by 10 or 12 fair and spacious bays, and there are amongst these one

one or two ports capable of receiving as large ſhips as ever viſited thoſe ſeas. There are wild hogs in great plenty, abundance of fowls of different kinds, and a vaſt variety of ſea and river fiſh. At the north eaſt extremity lies Little Tobago, which is two miles long, and about half a mile broad, very capable of improvement.

TOBOLSKI, the capital of Siberia, is ſituated at the confluence of the rivers Tobol and Irtiſh, in N. Lat. 58° 12′, E. Long. 68° 18′. The city ſtands upon the aſcent of a high hill, the lower part of which is inhabited by Mahometan Tartars, who carry on a conſiderable traffic upon the river Irtiſh, and convey their merchandiſe quite acroſs Great Tartary, as far as China. The river Irtiſh is reckoned as rapid as the Danube; runs from the ſouth, and empties itſelf into the Oby: the Tobol waſhes the other ſide of the town, and a little below it falls into the Irtiſh. By means of theſe two rivers, there is a conſtant flow of merchandiſe into the city during the ſummer ſeaſon. Tobolſki is therefore a great mart for the commodities of Muſcovy, Tartary, and other countries: and here is a great concourſe of merchants. All ſorts of proviſions are plentiful and cheap. An hundred weight of rice is ſold for 16 copecs, equal to about eight pence Sterling; a ſturgeon weighing 40 pounds, for half that money; an ox for two rix-dollars, and every other article in proportion: the adjacent country abounds with game in great variety. The ſupreme court of judicature for all Siberia is held in this city, which is alſo the ſeat of a metropolitan, ſent hither from Moſcow to exerciſe ſpiritual juriſdiction over the whole kingdom. Tobolſki is well fortified, and defended by a ſtrong garriſon, under the command of the waiwode, who reſides in the place, and takes charge of the fur tribute, which is here depoſited in proper magazines. This governor enjoys a very extenſive command, and can occaſionally bring into the field 9000 men, beſides a ſtrong body of Tartars on horſeback, to make head againſt the Kalmucks and Coſſacks, in their repeated incurſions. A ſufficient number of Ruſſians, called *Jemſciks*, are kept in continual pay by the government, on the banks of the Irtiſh, to ſupply travellers on the czar's account with men, boats, or carriages, to convey them as far as Surgut on the Oby, a voyage of 200 leagues by water. This is the common method of travelling in the ſummer; but in winter the journey by land is not half ſo long, being performed in ſleds over the ice and ſnow, with which the country is covered. Theſe ſleds are moved by a pair of dogs, which will draw a load of 300 pounds with ſurpriſing expedition. They are hired at eaſy rates, and during one half of the year may be ſeen flying over the ſnow in great numbers. The city is ſuppoſed to contain 15,000 inhabitants. It is 800 miles eaſt from Moſcow, and 1000 from Peterſburgh.

TODDA PANNA. See CYCAS.

TODDY, a name given to the juice of the cocoa nut tree. See ARAK.—Toddy is alſo a name given to a mixture of ſpirits, water, and ſugar.

Tody-Bird. See LOXIA, ſpecies 11.

TODUS, the TODY, in ornithology, a genus belonging to the order of *picæ*. The beak is ſlender, depreſſed, broad, and the baſe beſet with briſtles. The noſtrils are ſmall and oval. The toes are placed three before and one behind; the middle are greatly connected to the outer. There are 15 ſpecies according to Dr Latham.

"Birds of this genus (ſays that eminent ornithologiſt) inhabit the warmer parts of America. They vary conſiderably in their bills as to breadth, but all of them have a certain flatneſs, or depreſſion, which is peculiar. They have great affinity to the flycatchers; and indeed, to ſpeak the truth, the two genera run much into one another: however, in one thing they differ materially; for in the tody the outer and middle toes are much connected, whereas in the flycatcher genus they are divided to their origin."

TOGA, in Roman antiquity, a wide woollen gown or mantle, which ſeems to have been of a ſemicircular form, without ſleeves; differing both in richneſs and largeneſs according to the circumſtances of the wearer, and uſed only upon occaſion of appearing in public.

Every body knows that the toga was the diſtinguiſhed mark of a Roman: hence, the *jus togæ*, or privilege of a Roman citizen; *i. e.* the right of wearing a Roman habit, and of taking, as they expound it, fire and water through the Roman empire.

TOKAY WINE, derives its name from a town of Hungary, where it is produced. There are four ſorts of wine made from the ſame grapes, diſtinguiſhed at Tokay by the names of *eſſence*, *auſbruch*, *maſlach*, and the common wine. The eſſence is made by picking out the half-dried and ſhrivelled grapes, and putting them into a perforated veſſel, where they remain as long as any juice runs off by the mere preſſure of their own weight. This is put into ſmall caſks. The auſbruch is made by pouring the expreſſed juice of the grapes from which the former had been preſſed on thoſe that yielded the eſſence, and treading them with the feet. The liquor is then allowed to ſtand a day or two to ferment, and then is poured into ſmall caſks, which are kept in the air for about a month, and afterwards put into cellars. The ſame proceſs is again repeated by the addition of more juice to the grapes which have already undergone the two former preſſures, and they are now wrung with the hands; and thus is had the maſlach. The common wine is made by taking all the grapes together at firſt, and ſubmitting them to the greateſt preſſure: this is chiefly prepared by the peaſants. The eſſence is thick, and very ſweet and luſcious: it is chiefly uſed to mix with the other kinds. The auſpruch is the wine commonly exported, and which is known in foreign countries by the name of *Tokay*.

The goodneſs of it is determined by the following rules. The colour ſhould neither be reddiſh nor very pale, but a light ſilver: in trying it, the palate and tip of the tongue ſhould be wetted without ſwallowing it, and if it manifeſt any acrimony to the tongue, it is not good; but the taſte ought to be ſoft and mild: when poured out, it ſhould form globules in the glaſs, and have an oily appearance: when genuine, the ſtrongeſt is always of the beſt quality: when ſwallowed, it ſhould have an earthy aſtringent taſte in the mouth, which is called the taſte of the root. All Tokay wine has an aromatic taſte, which diſtinguiſhes it from every other ſpecies of wine. It keeps to any age, and improves by time: but is never good till about three years old. It is the beſt way to tranſport it in caſks; for when it is on the ſeas, it ferments three times every ſeaſon, and thus refines itſelf. When in bottles, there muſt be an empty ſpace left between the wine and the cork, otherwiſe it would burſt the bottle. A little oil is put upon the ſurface, and a piece of bladder tied over the cork. The bottles are always laid on their ſides in ſand. *Philoſophical Tranſactions*, vol. lxiii. part ii. p. 292, &c.

TOKENS. See *Tradeſmens-Tokens*.

TOISE, a French meaſure containing ſix of their feet, or a fathom.

TOLAND (John), a very famous writer, was born near Londonderry in Ireland, 1670, and educated in the Popiſh religion; but at 16 years of age embraced the principles of the Proteſtants. He ſtudied three years at the univerſity of Glaſgow; was created maſter of arts in the univerſity of Edinburgh; and afterwards completed his ſtudies at Leyden, where he reſided two years. He then went to Oxford,

where,

Toland.

where, having the advantage of the public library, he collected materials upon various ſubjects, and compoſed ſome pieces; among which was, A Diſſertation to prove the received hiſtory of the tragical death of Atilius Regulus, the Roman conſul, to be a fable. He began likewiſe a work of greater conſequence, in which he undertook to ſhow that there are no myſteries in the Chriſtian religion. He publiſhed it in 1696 at London, under the title of *Chriſtianity not myſterious*. This book gave great offence, and was attacked by ſeveral writers. He afterward wrote in favour of the Hanoverian ſucceſſion, and many other pieces. In 1707 he went into Germany, where he viſited ſeveral courts; and in 1710 he was introduced to Prince Eugene, who gave him ſeveral marks of his generoſity. Upon his return to England he was for ſome time ſupported by the liberality of the earl of Oxford lord-treaſurer, and kept a country-houſe at Epſom; but ſoon loſing his lordſhip's favour, he publiſhed ſeveral pamphlets againſt that miniſter's meaſures. In the four laſt years of his life he lived at Putney, but uſed to ſpend moſt part of the winter in London. Mr Toland died at London in 1722. He was a man of uncommon abilities, publiſhed a number of curious tracts, and was perhaps the moſt learned of all the infidel writers; but his private character was far from being an amiable one; for he was extremely vain, and wanted thoſe ſocial virtues which are the chief ornaments as well as duties of life. His poſthumous works, two volumes octavo, were publiſhed in 1726, with an account of his life and writings, by Mr Des Maizeaux.

TOLEDO, an ancient and trading city of Spain in New Caſtile, of which it was formerly the capital. About two centuries ago it is ſaid to have contained more than 200,000 inhabitants; but they are now diminiſhed to 20,000, or at moſt to 30,000. It is advantageouſly ſeated on the river Tajo, which ſurrounds it on two ſides; and on the land-ſide it has an ancient wall built by a Gothic king, and flanked with 100 towers. It is ſeated on a mountain, which renders the ſtreets uneven, and which are narrow; but the houſes are fine, and there are a great number of ſuperb ſtructures, beſides 17 public ſquares, where the markets are kept. The fineſt buildings are the royal caſtle and the cathedral church; which laſt is the richeſt and moſt conſiderable in Spain. It is ſeated in the middle of the city, joining to a handſome ſtreet, with a fine ſquare before it. Several of the gates are very large, and of bronze. There is alſo a ſuperb ſteeple extremely high, from whence there is a very diſtant proſpect. The Sagrario, or principal chapel, is a real treaſury, in which are 15 large cabinets let into the wall, full of prodigious quantities of gold and ſilver veſſels, and other works. There are two mitres of ſilver gilt, ſet all over with pearls and precious ſtones, with three collars of maſſy gold, enriched in like manner. There are two bracelets and an imperial crown of the Virgin Mary, conſiſting of large diamonds and other jewels. The weight of the gold in the crown is 15 pounds. The veſſel which contains the conſecrated wafer is of ſilver gilt, as high as a man, and ſo heavy, that it requires 30 men to carry it; within it is another of pure gold enriched with jewels. Here are 38 religious houſes, moſt of which are worthy a traveller's notice, with many other ſacred buildings, a great number of churches belonging to 27 pariſhes, and ſome hoſpitals. Without the town are the remains of an amphitheatre, and other antiquities.

Bourgoanne's Travels in Spain, vol. ii.

Toledo is an archbiſhop's ſee, and the ſeat of the primate of Spain. His revenue is ſaid to be worth 400,000 ducats, but there are large deductions to be made from it. It pays 15,000 ducats to the monks of the Eſcurial, beſides ſeveral other penſions. Toledo has alſo a univerſity. It was formerly celebrated for the exquiſite temper of the ſword blades made there. It is ſituated in eaſt longitude 3. 15. in north latitude 39. 50. and is 37 miles ſouth from Madrid.

Swinburne's Travels in Spain.

Toleration.

TOLERATION, in matters of religion, is either civil or eccleſiaſtical. Civil toleration is an impunity and ſafety granted by the ſtate to every ſect that does not maintain doctrines inconſiſtent with the public peace; and eccleſiaſtical toleration is the allowance which the church grants to its members to differ in certain opinions, not reputed fundamental.

As the gods of Paganiſm were almoſt all local and tutelary, and as it was a maxim univerſally received that it was the duty of every man to worſhip, together with his own deities, the tutelary gods of the country in which he might chance to reſide, there was no room for perſecution in the Heathen world, on account of different ſentiments in religion, or of the different rites with which the various deities were worſhipped. Had the primitive Chriſtians joined their fellow-citizens in the worſhip of Jupiter, Juno, and the reſt of the rabble of Roman divinities, they would have been ſuffered to worſhip, without moleſtation, the Creator of the world and the Redeemer of mankind; for in that caſe the God of the Chriſtians would have been looked upon as a Being of the ſame kind with the gods of the empire; and the great principle of intercommunity would have remained unviolated. But the true God had expreſsly prohibited both Jews and Chriſtians from worſhipping any other god beſides Himſelf; and it was their refuſal to break that precept of their religion which made their Heathen maſters look upon them as Atheiſts, and perſecute them as a people inimical to the ſtate. Utility, and not truth, was the object for which the Heathen legiſlatures ſupported the national religion. They well knew that the ſtories told by their poets of their different divinities, of the rewards of Elyſium, and of the puniſhments of Tartarus, were a collection of ſenſeleſs fables; but they had nothing better to propoſe to the vulgar, and they were not ſuch ſtrangers to the human heart, as to ſuppoſe that mankind could live together in ſociety without being influenced in their conduct by ſome religion.

Widely different from the genius of Paganiſm was the ſpirit of the Jewiſh diſpenſation. Truth, which is in fact always coincident with general utility, was the great object of the Moſaic law. The children of Iſrael were ſeparated from the reſt of the world, to preſerve the knowledge, and worſhip of the true God, at a time when all the other nations on earth, forgetting the Lord that made them, were falling proſtrate to ſtocks and ſtones, and worſhipping devils and impure ſpirits. Such was the contagion of idolatry, and ſo ſtrong the propenſity of the Iſraelites to the cuſtoms and manners of the Egyptians, and other polytheiſtic nations around them, that the purpoſe of their ſeparation could not have been ſerved, had not Jehovah condeſcended to become not only their tutelary God, but even their ſupreme civil Magiſtrate (ſee THEOLOGY, n° 151.); ſo that under the Moſaic economy, idolatry was the crime of high treaſon, and as ſuch juſtly puniſhed by the laws of the ſtate. Among the Jews, the church and ſtate were not indeed different ſocieties. They were ſo thoroughly incorporated, that what was a ſin in the one was a crime in the other; and the forfeiture of eccleſiaſtical privileges was the forfeiture of the rights of citizens.

In many reſpects the Chriſtian religion is directly oppoſite to the ritual law of Moſes. It is calculated for all nations, and intended to be propagated among all. Inſtead of ſeparating one people from another, one of its principal objects is to diſſeminate univerſal benevolence, and to inculcate

Toleration. cate upon the whole human race, that mutual love which naturally springs from the knowledge that all men are brethren. Its ultimate end being to train its votaries for heaven, it concerns itſelf no farther with the affairs of earth than to enforce by eternal ſanctions the laws of morality; and the kingdom of its Founder not being of this world, it leaves every nation at liberty to fabricate its own municipal laws, ſo as beſt to ſerve its own intereſt in the various circumſtances in which it may be placed; and denounces a curſe upon all who pay not to thoſe laws the fulleſt obedience, when they were not obviouſly inconſiſtent with the laws of piety and virtue, which are of prior obligation. The Chriſtian church therefore muſt always remain a diſtinct ſociety from the ſtate; and tho', till the preſent age of hazardous innovations, it has been deemed expedient in every country, where the truth of the goſpel is admitted, to give to the religion of Chriſt a legal eſtabliſhment, and to confer immunities on its miniſters, this meaſure has been adopted, not to ſecure the purity of the faith which appeals to the private judgment of each individual, but merely to preſerve the peace of ſociety, and to put a reſtraint upon thoſe actions of which human laws cannot take cognizance. With religion, Chriſtian governments have no farther concern than as it tends to promote the practice of virtue. The early Chriſtians, however, not underſtanding the principle upon which penal laws were employed to preſerve the purity of the Jewiſh religion; and, as our bleſſed Lord obſerved to two of his apoſtles, not knowing what ſpirit they were of—haſtily concluded that they had a right to enforce the doctrines and worſhip of the New Teſtament, by the ſame means which had been uſed to preſerve the Iſraelites ſteady to the doctrines and worſhip of the Old. Hence, though they had ſuffered the crueleſt perſecutions themſelves (ſee PERSECUTION), they no ſooner got the power of the ſtate in their hands, than they perſecuted the Pagans for their idolatry; and afterwards, when hereſies aroſe in the church, perſecuted one another for expreſſing in different phraſes metaphyſical propoſitions, of ſuch a nature as no human mind can fully comprehend. The apoſtle had forewarned them that there muſt be hereſies in the church, that they who are approved may be made manifeſt; but it did not occur to them that perſecution for opinion is the worſt of all hereſies, as it violates at once truth and charity.

Hitherto theſe unhallowed means of bringing Chriſtians to uniformity of faith and practice, had been only occaſionally employed from their not accurately diſtinguiſhing between the ſpirit of the goſpel and that of the law; but as ſoon as the biſhops of Rome had brought the inhabitants of Europe to recognize their infallibility in explaining articles of faith, and deciding points of controverſy, perſecution became a regular and permanent inſtrument of eccleſiaſtical diſcipline. To doubt or to deny any doctrine to which theſe unerring inſtructors had given the ſanction of their approbation, was held to be not only a reſiſting of the truth, but an act of rebellion againſt their ſacred authority; and the ſecular power, of which, by various arts, they had acquired the abſolute direction, was inſtantly employed to avenge both.

"Thus Europe had been accuſtomed, during many centuries, to ſee ſpeculative opinions propagated or defended by force, the charity and mutual forbearance which Chriſtianity recommends with ſo much warmth, were forgotten, the ſacred rights of conſcience and of private judgment were unheard of; and not only the idea of toleration, but even the word itſelf, in the ſenſe now affixed to it, was unknown. A right to extirpate error by force, was univerſally allowed to be the prerogative of thoſe who poſſeſſed the knowledge of truth;" and though the firſt reformers did not arro-

Robertſon's Hiſtory of Charles V.

gate to themſelves in direct terms that infallibility which they had refuſed to the church of Rome, they were not leſs confident of the truth of their own doctrines, and required with equal ardour the princes of their party to check ſuch as preſumed to impugn or to oppoſe them. To this requeſt too many of theſe princes lent a willing ear. It flattered at once their piety and their pride to be conſidered as poſſeſſing all the rights of Jewiſh princes; and Henry the VIII. of England, after labouring to make his divines declare that all authority eccleſiaſtical as well as civil flows from the crown, perſecuted alternately the Papiſts and Proteſtants. Many of his ſucceſſors, whoſe characters were much better than his, thought themſelves fully authorized, in virtue of their acknowledged ſupremacy over all ranks and conditions of men, to enforce by means of penal laws a uniformity of faith and worſhip among their ſubjects; and it was not till the revolution that any ſect in England ſeems to have fully underſtood, that all men have an unalienable right to worſhip God in the manner which to them may ſeem moſt ſuitable to his nature, and the relation in which they ſtand to him; or that it is impoſſible to produce uniformity of opinion by any other means than candid diſquiſition and ſound reaſoning. That the civil magiſtrate has a right to check the propagation of opinions which tend only to ſap the foundations of virtue, and to diſturb the peace of ſociety, cannot, we think, be queſtioned; but that he has no right to reſtrain mankind from publicly profeſſing any ſyſtem of faith, which comprehends the being and providence of God, the great laws of morality, and a future ſtate of rewards and puniſhments, is as evident as that it is the object of religion to fit mankind for heaven, and the whole duty of the magiſtrates to maintain peace, liberty, and property, upon earth. We have elſewhere obſerved (ſee TEST), that among a number of different ſects of Chriſtians, it is not the ſuperior purity of the ſyſtem of faith profeſſed by one of them, that gives it a right to the immunities of an eſtabliſhment in preference to all its rivals; but tho' the legiſlature is authorized, in certain circumſtances, to make a leſs pure ſyſtem the religion of the ſtate, it would be the height of abſurdity to ſuppoſe that any man, or body of men, can have authority to prevent a purer ſyſtem from being acknowledged as the religion of individuals. For propagating opinions and purſuing practices which neceſſarily create civil diſturbance, every man is anſwerable to the laws of his country; but for the ſoundneſs of his faith, and the purity of his worſhip, he is anſwerable to no tribunal but that which can ſearch the heart.

When churches are eſtabliſhed, and creeds drawn up as guides to the preaching of the national clergy, it is obvious that every clergyman who teaches any thing directly contrary to the doctrine of ſuch creeds, violates the condition on which he holds his living, and may be juſtly deprived of that living, whether his obnoxious opinion be in itſelf true or falſe, important or unimportant; but his puniſhment ſhould be extended no farther. To expel a Chriſtian from private communion for teaching any doctrine which is neither injurious to the ſtate nor contrary to the few ſimple articles which compriſe the ſum of the Chriſtian faith, is the groſſeſt tyranny; and the governors of that church which is guilty of it, uſurp the prerogative of their bleſſed Lord, who commanded the apoſtles themſelves not to be called maſters in this ſenſe; for one (ſays he) is your maſter (καθηγητής), even Chriſt. It is indeed a hardſhip to deprive a man of his living for conſcientiouſly illuſtrating what he believes to be a truth of the goſpel, only becauſe his illuſtration may be different from that which had formerly been given by men fallible like himſelf; but if the eſtabliſhment of human compilations of faith be neceſſary, this hardſhip

cannot

Tolt || Toleration.

cannot be removed, but by making such compilations as simple as possible, and drawing them up in Scripture language. Such a reformation, could it be effected peaceably, would serve other good purposes; for while it would sufficiently guard the purity of the faith, it would withdraw that temptation which too many establishments throw in the way of men, to subscribe to the truth of what they do not really believe; and it would effectually banish from the Christian church every thing which can be called by the name of *persecution*. See NONCONFORMISTS.

TOLL, a tax or custom paid for liberty to vend goods in a market or fair, or for keeping roads in proper repair. The first appointment of a toll on highways of which we read, took place in 1346. See ROAD.

TOLOUSE. See TOULOUSE.

TOLU, a town of South America in Terra Firma, and in the government of Carthagena; famous for the fine balsam of Tolu, brought into Europe from thence, and produced from a tree like a pine. It is seated on a bay of the North Sea, 60 miles south of Carthagena. W. Long. 72. 55. N. Lat. 9. 40.

TOLUIFERA, the BALSAM OF TOLU-TREE; a genus of plants belonging to the class of *decandria*, and order of *monogynia*. There is only one species; the *balsamum*.

This tree grows to a considerable height; it sends off numerous large branches, and is covered with rough, thick, greyish bark: the leaves are elliptical or ovate, entire, pointed, alternate, of a light green colour, and stand upon short strong footstalks: the flowers are numerous, and produced in lateral racemi: the calyx is bell-shaped, divided at the brim into five teeth, which are nearly equal, but one is projected to a greater distance than the others: the petals are inserted into the receptacle, and are five in number, of which four are equal, linear, and a little longer than the calyx; the fifth is much the largest, inversely heart-shaped, and its unguis is of the length of the calyx: the 10 filaments are very short, and furnished with long antheræ: the germen is oblong: there is no style: the stigma is pointed: the fruit is a round berry.

Woodville's Medical Botany.

It grows in Spanish America, in the province of Tolu, behind Carthagena, whence we are supplied with the balsam, which is brought to us in little gourd-shells. This balsam is obtained by making incisions in the bark of the tree, and is collected into spoons, which are made of black wax, from which it is poured into proper vessels.

This balsam is of a reddish yellow colour, transparent, in consistence thick and tenacious: by age it grows so hard and brittle, that it may be rubbed into a powder between the finger and thumb. Its smell is extremely fragrant, somewhat resembling that of lemons; its taste is warm and sweetish, and on being chewed it adheres to the teeth. Thrown into the fire it immediately liquifies, takes flame, and disperses its agreeable odour. Though it does not dissolve in water, yet if boiled in it for two or three hours in a covered vessel, the water receives its odoriferous smell: water also suffers a similar impregnation from the balsam by distillation. With the assistance of mucilage it unites with water, so as to form a milky solution. It dissolves entirely in spirit of wine, and easily mixes with distilled oils, but less easily with those of the expressed kind. Distilled without addition, it produces not only an empyreumatic oil, of a pale dark colour, but sometimes a small portion of a saline matter, similar to that of the flowers of benzoin.

This balsam possesses the same general virtues with the balsam of Gilead, and that of Peru; it is, however, less heating and stimulating, and may therefore be employed with more safety. It has been chiefly used as a pectoral, and is said to be an efficacious corroborant in gleets and seminal weaknesses. It is directed by the Pharmacopœias in the syrupus tolutanus, tinctura tolutana, and syrupus balsamicus. See PHARMACY-*Index*.

Tomatoes || Tomb.

TOMATOES. See SOLANUM.

TOMB, includes both the grave or sepulchre wherein a defunct is interred, and the monument erected to preserve his memory. The word is formed from the Greek [illegible], *tumulus*, "sepulchre;" or, according to Menage, from the Latin *tumba*, which signifies the same.

In many nations it has been customary to burn the bodies of the dead; and to collect the ashes with pious care into an urn, which was deposited in a tomb or sepulchre. See BURNING. Among many nations it has also been the practice to lay the dead body in a tomb, without consuming it, after having wrapped it up decently, and sometimes placing it in a coffin. See COFFIN.

The tombs of the Jews were generally hollow places hewn out of a rock. Abraham buried Sarah in a cave. Such was the place too in which the kings of Judah and Israel were interred; and such was the place in which the body of our Saviour was deposited by Joseph of Arimathea. But it is probable that the common people buried their dead in graves; for our Saviour compares the Pharisees to "graves which appear not, and the men that appear not are not aware of them." Over the tombs, perhaps only of people of distinction, a stone or monument was erected, to intimate to passengers that they were burying places, that they might not pollute themselves by touchiug them. With the same intention, as Lightfoot informs us, they whitened them every year on the 15th of February.

The Egyptians also buried their dead in caves, called *catacombs*. See CATACOMB. The pyramids, as some think, were also employed for the same purpose. Sometimes also, after embalming their dead, they placed them in niches in some magnificent apartment in their houses.

The Greeks and Romans burned their dead, and deposited their ashes in a tomb. The Greeks interred the ashes without the cities, by the sides of their highways. Sometimes indeed, by way of particular honour, they were buried in an elevated part of the town; and the Lacedemonians were allowed by Lycurgus to bury in the city and round their temples: But this was forbidden among the Romans by the law of the twelve tables, *In urbe ne sepelito, ne-ve urito;* yet Valerius Publicola, Posthumus Tubertius, and the family of the Claudii, were buried in the Capitol. To bury by the sides of public roads was common among the Romans also; hence their epitaphs frequently began with *siste viator*. Highways were made choice of probably for two reasons; 1. That the dead might not be offensive or injure the health of the living, which they certainly would if buried in towns or populous places; and, 2dly, That they might hold out to travellers a lesson of mortality, and teach the rustic moralist to die.

As it would swell this article to too great a size to describe all the different kinds of tombs which have been used by different nations and ages, we must content ourselves with shortly describing the tombs of a few nations, and adding a few concomitant circumstances.

The tombs of the Parsees are singular. The defunct, after lying a proper time in his own house, for the purposes of mourning, is carried, followed by his relations and friends, the females chanting a requiem, and deposited in a tomb of the following construction. It is a circular building, open at top, about 55 feet diameter, and 25 feet in height, filled to within 5 feet of the top, excepting a well of 15 feet diameter in the centre. The part so filled is terraced, with a slight declivity toward the well. Two circular grooves three inches deep are raised round the well; the first at the distance

distance of four, the second at ten, feet from the well. Grooves of the like depth or height, and four feet distant from each other at the outer part of the outer circle, are carried straight from the wall to the well, communicating with the circular ones, for the purpose of carrying off the water, &c. The tomb, by this means, is divided into three circles of partitions: the outer, about seven feet by four; the middle, six by three; the inner, four by two: the outer for the men, the middle for the women, the inner for the children; in which the bodies are respectively placed, wrapped loosely in a piece of cloth, and left to be devoured by the vultures; which is very soon done, as numbers of those animals are always seen hovering and watching about these charnel houses, in expectation of their prey. The friends of the deceased, or the persons who have charge of the tomb, come at the proper time, and throw the bones into their receptacle, the well in the centre; for which purpose, iron rakes and tongs are deposited in the tomb. The entrance is closed by an iron door, four feet square, on the eastern side, as high up as the terrace, to which a road is raised. Upon the wall, above the door, an additional wall is raised, to prevent people from looking into the tomb, which the Parsees are particularly careful to prevent. A Persian inscription is on a stone inserted over the door, which we once copied, but have forgotten its tenor. From the bottom of the wall subterraneous passages lead to receive the bones, &c. and prevent the well from filling.

Of the ancient sepulchres found in Russia and Siberia, some are perfect tumuli, raised to an enormous height, while others are almost level with the ground. Some of them are encompassed with a square wall of large quarry stones placed in an erect position; others are covered only with a small heap of stones, or they are tumuli adorned with stones at top. Some are mured with brick within, and vaulted over; others are no more than pits or common graves. In some the earth is excavated several fathoms deep; others, and especially those which are topped by a lofty tumulus, are only dug of a sufficient depth for covering the carcase. In many of these sepulchres the bones of men, and frequently of horses, are found, and in a condition that renders it probable the bodies were not burnt before they were inhumed. Other bones show clearly that they have been previously burnt; because a part of them is unconsumed, and because they lie in a disordered manner, and some of them are wanting. Urns, in which other nations of antiquity have deposited the ashes of their dead, are never met with here. But sometimes what remained of the bodies after the combustion, and even whole carcases, are found wrapped up in thin plates of gold. Many dead bodies are frequently seen deposited together in one tomb; a certain indication that either a battle had been fought in the neighbourhood of the place, or that some families buried their relations in an hereditary tomb.

The Moors, like all other Mahometans, hold it a thing irreverent, and contrary to the spirit of religion, to bury their dead in mosques, and to profane the temple of the Most High by the putrefaction of dead bodies. In the infancy of the church the Christians had the like piety, and gave example of the respect in which they held temples dedicated to religious worship; but ill-guided devotion, mingled with superstitious vanities, and that contagious spirit of self-interest which pervades all human affairs, without respecting the altar of God, have, together, insensibly perverted mens ideas. The burial grounds of the Mahometans are most of them without the city; the emperors have their sepulchres distinct and distant from the mosque, in sanctuaries, built by themselves, or in places which they have indicated: their tombs are exceedingly simple; the Moors do not imitate the ostentation of Europeans, where superb monuments are raised rather to gratify the pride of the living than the merit of the dead.

All Mahometans inter the dead at the hour set apart for prayer. The defunct is not kept in the house, except he expires after sun-set; but the body is transported to the mosque, whither it is carried by those who are going to prayer. Each, from a spirit of devotion, is desirous to carry in his turn. The Moors sing at their burial service; which usage perhaps they have imitated after the Christians of Spain, for the oriental Mahometans do not sing. They have no particular colour appropriated to mourning; their grief for the loss of relations is a sensation of the heart they do not attempt to express by outward symbols. Women regularly go on the Friday to weep over and pray at the sepulchres of the dead, whose memory they hold dear.

Among the northern nations it was customary to bury their dead under heaps of stones called *cairns*, or under barrows: (See the articles CAIRNS and BARROW). The inhabitants of Tibet, it is said, neither bury nor burn their dead, but expose them on the tops of the mountains. See TIBET.

TOMPION, a sort of bung or cork used to stop the mouth of a cannon. At sea this is carefully encircled with tallow or putty, to prevent the penetration of the water into the bore, whereby the powder contained in the chamber might be damaged or rendered incapable of service.

TON, a measure or weight. See TUN.

TONE, or TUNE, in music, a property of sound, whereby it comes under the relation of *grave* and *acute*; or the degree of elevation any sound has, from the degree of swiftness of the vibrations of the parts of the sonorous body.

The variety of tones in human voices arises partly from the dimensions of the windpipe, which, like a flute, the longer and narrower it is, the sharper the tone it gives; but principally from the head of the larynx or knot of the throat: the tone of the voice being more or less grave as the rima or cleft thereof is more or less open.

The word *tone* is taken in four different senses among the ancients: 1. For any sound; 2. For a certain interval, as when it is said the difference between the diapente and diatessaron is a tone; 3. For a certain locus or compass of the voice, in which sense they used the Dorian, Phrygian, Lydian tones; 4. For tension, as when they speak of an acute, grave, or a middle tone.

TONE is more particularly used, in music, for a certain degree or interval of tune, whereby a sound may be either raised or lowered from one extreme of a concord to the other, so as still to produce true melody.

TONGUE. See ANATOMY, n° 102.

TONIC, in music, signifies a certain degree of tension, or the sound produced by a vocal string in a given degree of tension, or by any sonorous body when put in vibration.

Tonic, says Rousseau, is likewise the name given by Aristoxenus to one of the three kinds of chromatic music, whose divisions he explains, and which was the ordinary chromatic of the Greeks, proceeding by two semitones in succession, and afterwards a third minor.

Tonic Dominant. See DOMINANT.

TONNAGE *and* POUNDAGE, an ancient duty on wine and other goods, the origin of which seems to have been this: About the 21st of Edward III. complaint was made that merchants were robbed and murdered on the seas. The king thereupon, with the consent of the peers, levied a duty of 2 s. on every ton of wine, and 12 d. in the pound on all goods imported; which was treated as illegal by the commons. About 25 years after, the king, when the knights of shires were returned home, obtained a like grant from the citizens

citizens and burgesses, and the year after it was regularly granted in parliament. These duties were diminished sometimes, and sometimes increased; at length they seem to have been fixed at 3s. tonnage and 1 s. poundage. They were at first usually granted only for a stated term of years, as, for two years in 5 Ric. II.; but in Henry VI.'s time they were granted him for life by a statute in the 31st year of his reign; and again to Edward IV. for the term of his life also: since which time they were regularly granted to all his successors for life, sometimes at the first, sometimes at other subsequent parliaments, till the reign of Charles I.; when, as the noble historian expresses it, his ministers were not sufficiently solicitous for a renewal of this legal grant. And yet these imposts were imprudently and unconstitutionally levied and taken, without consent of parliament, for 15 years together; which was one of the causes of those unhappy discontents, justifiable at first in too many instances, but which degenerated at last into causeless rebellion and murder. For, as in every other, so in this particular case, the king (previous to the commencement of hostilities) gave the nation ample satisfaction for the errors of his former conduct, by passing an act, whereby he renounced all power in the crown of levying the duty of tonnage and poundage, without the express consent of parliament; and also all power of imposition upon any merchandises whatever. Upon the restoration this duty was granted to King Charles II. for life, and so it was to his two immediate successors; but now, by three several statutes, 9 Ann. c. 6. 1 Geo. I. c. 12. and 3 Geo. I. c. 7. it is made perpetual, and mortgaged for the debt of the public.

Blackst. Comment. vol. i.

TONQUIN, a kingdom of Asia, in the East Indies, beyond the Ganges; bounded on the north by the province of Yunnan in China, on the east by the province of Canton and the bay of Tonquin, on the south by Cochin China, and on the west by the kingdom of Laos. It is about 1200 miles in length and 500 in breadth; and is one of the finest and most considerable kingdoms of the East, as well on account of the number of inhabitants as the riches it contains and the trade it carries on. The country is thick set with villages; and the natives in general are of a middle stature and clean limbed, with a tawny complexion. Their faces are oval and flattish, and their noses and lips well proportioned. Their hair is black, long, lank, and coarse; and they let it hang down their shoulders. They are generally dexterous, nimble, active, and ingenious in mechanic arts. They weave a multitude of fine silks, and make curious lacker-works, which are transported to other countries. There is such a number of people, that many want employment; for they seldom go to work but when foreign ships arrive. The money and goods brought hither by the English and Dutch put them in action; for they have not money of their own sufficient to employ themselves; and therefore one-third at least must be advanced beforehand by the merchants: and the ships must stay here till the goods are finished, which is generally five or six months. They are so addicted to gaming, that when every thing else is lost, they will stake their wives and children. The garments of the Tonquinese are made either of silk or cotton; but the poor people and soldiers wear only cotton of a dark tawny colour. Their houses are small and low; and the walls either of mud, or hurdles daubed over with clay. They have only a ground-floor, with two or three partitions; and each room has a square hole to let in the light. The villages consist of 30 or 40 houses, surrounded with trees; and in some places there are banks to keep the water from overflowing their gardens, where they have oranges, betels, melons, and salad-herbs. In the rainy season they cannot pass from one house to another without wading through the water; they sometimes have boats. In the capital city called *Cacho* there are about 20,000 houses with mud-walls, and covered with thatch; a few are built with brick, and roofed with pan-tiles. In each yard is a small arched building like an oven, about six feet high, made of brick, which serves to secure their goods in case of fire. The principal streets are very wide, and paved with small stones. The king of Tonquin has three palaces in it, such as they are; and near them are stables for his horses and elephants. The house of the English factory is seated at the north end of the city, fronting the river, and is the best in the city. The people in general are courteous, and civil to strangers; but the great men are proud, haughty, and ambitious; the soldiers insolent, and the poor thievish. They buy all their wives, of which the great men have several; but the poor are stinted for want of money. In hard times the men will sell both their wives and children to buy rice to maintain themselves. The women offer themselves to strangers as wives while they stay, and agree with them for a certain price. Even the great men will offer their daughters to the merchants and officers who are likely to stay six months in the country. They are not afraid of being with child; for if they are girls they can sell them well when they are young, because they are fairer than the other inhabitants. These women are said to be very faithful; and are trusted with money and goods by the Europeans during their absence, and will make great advantage with them. The first new moon in the year that happens after the middle of January, is a great festival; when they rejoice for 10 or 12 days together, and spend their time in all manner of sports. Their common drink is tea, but they make themselves merry with arrack. The language is spoken very much in the throat; and some of the words are pronounced through the teeth, and has a great resemblance to the Chinese. They have several mechanic arts or trades; such as smiths, carpenters, joiners, turners, weavers, taylors, potters, painters, money-changers, paper-makers, workers in lacker, and bell-founders. Their commodities are gold, musk, silks, callicoes, drugs of many sorts, woods for dyeing, lacquered wares, earthen wares, salt, aniseeds, and worm-seeds. The lacquered ware is not inferior to that of Japan, which is accounted the best in the world. With all these merchandises, one would expect the people to be very rich, but they are in general very poor; the chief trade being carried on by the Chinese, English, and Dutch. The goods imported, besides silver, are saltpetre, sulphur, English broad-cloth, pepper, spices, and great guns.

TONSILS. See ANATOMY, nº 102.

TONSURE, in ecclesiastical history, a particular manner of shaving or clipping the hair of ecclesiastics or monks. The ancient tonsure of the clergy was nothing more than polling the head, and cutting the hair to a moderate degree, for the sake of decency and gravity: and the same observation is true with respect to the tonsure of the ancient monks. But the Romans have carried the affair of tonsure much farther; the candidate for it kneeling before the bishop, who cuts the hair in five different parts of the head, *viz.* before, behind, on each side, and on the crown.

TONTINE, a loan given for life annuities with benefit of survivorship; so called from the inventor Laurence Tonti, a Neapolitan. He proposed his scheme in 1653 to reconcile the people to cardinal Mazarine's government, by amusing them with the hope of becoming suddenly rich. He obtained the consent of the court, but the parliament would not register the edict. He made attempts afterwards, but without success.

It was not till Louis XIV. was distressed by the league of Augsburg, and by his own immense expences, that he had

had recourse to the plans of Tonti, which, though long laid aside, were not forgotten. By an edict in 1689 he created a Tontine royale of 1,400,000 livres annual rent, divided into 14 classes. The actions were 300 livres apiece, and the proprietors were to receive 10l. *per cent.* with benefit of survivorship in every class. This scheme was executed but very imperfectly; for none of the classes rose to above 25,000 livres, instead of 100,000, according to the original institution; though the annuities were very regularly paid. A few years after, the people seeming in better humour for projects of this kind, another tontine was erected upon nearly the same terms, but this was never above half full. They both subsisted in the year 1726, when the French king united the 13th class of the first tontine with the 14th of the second; all the actions of which were possessed by Charlotte Bonnemay, widow of Lewis Barbier, a surgeon of Paris, who died at the age of 96. This gentlewoman had ventured 300 livres in each tontine; and in the last year of her life she had for her annuity 73,500 livres, or about 3600l. a-year, for about 30l.

The nature of the tontine is this; there is an annuity, after a certain rate of interest, granted to a number of people; divided into classes, according to their respective ages; so that annually the whole fund of each class is divided among the survivors of that class; till at last it falls to one, and upon the extinction of that life, reverts to the power by which the tontine was erected, and which becomes thereby security for the due payment of the annuities.

TOOL, among mechanics, denotes in general any small instrument used as well for making other complex instruments and machines, as in most other operations in the mechanic arts.

TOOTH, for a description of, see ANATOMY, nº 27.

TOOTHACH. See MEDICINE, nº 210, SURGERY, nº 236, TEETH, and ELECTRICITY, p. 535.

Toothach-Tree. See ZANTHOXYLUM.

TOOTHWORT. See PLUMBAGO.

TOP, a sort of platform, surrounding the lower mast-head, from which it projects on all sides like a scaffold.

The principal intention of the top is to extend the topmast shrouds, so as to form a greater angle with the mast, and thereby give additional support to the latter. It is sustained by certain timbers fixed across the hounds or shoulders of the mast, and called the *trestle-trees* and *cross-trees*.

Besides the use above-mentioned, the top is otherwise extremely convenient to contain the materials necessary for extending the small sails, and for fixing or repairing the rigging and machinery with more facility and expedition. In ships of war it is used as a kind of redoubt, and is accordingly fortified for attack or defence; being furnished with swivels, musketry, and other fire-arms, and guarded by a thick fence of corded hammocs. Finally, it is employed as a place for looking out, either in the day or night.

Top-Mast, the second division of a mast, or that part which stands between the upper and lower pieces. See the article MAST.

Top-Sails, certain large sails extended across the topmasts by the topsail-yard above, and by the yard attached to the lower mast beneath; being fastened to the former by robands, and to the latter by means of two great blocks fixed on its extremities, through which the topsail-sheets are inserted, passing from thence to two other blocks fixed on the inner part of the yard close by the mast; and from these latter the sheets lead downwards to the deck, where they may be slackened or extended at pleasure. See the article SAIL.

TOPAZ, in natural history, a gem called by the ancients *chrysolite*, as being of a gold colour; its texture foliaceous; its form cubic, parallelopipedal, or prismatic; its specific gravity from 3,46 to 4,56; it loses its colour only in a very strong heat, and of the usual fluxes it yields only to borax and microcosmic salt. According to Bergman, 100 parts of it contain 46 of argill, 39 of siliceous earth, 8 of mild calcareous, and 6 of iron. Its great specific gravity shews these earths to be very perfectly united.

The finest topazes in the world are found in the East Indies; but they are very rare there of any great size: the Great Mogul, however, at this time, possesses one which is said to weigh 157 carats, and to be worth more than 20,000 pounds. The topazes of Peru come next after these in beauty and in value. The European are principally found in Silesia and Bohemia, and are generally full of cracks and flaws, and of a brownish yellow.

TOPE, in ichthyology, a species of SQUALUS.

TOPHET. See HINNOM and MOLOCH.

TOPHUS, in medicine, denotes a chalky or stony concretion in any part of the body; as the bladder, kidney, &c. but especially in the joints.

TOPIC, a general head or subject of discourse.

TOPICS, in oratory. See ORATORY, nº 10—13.

TOPICS, or *Topical Medicines*, are the same with external ones, or those applied outwardly to some diseased and painful part: such are plasters, cataplasms, unguents, &c.

TOPOGRAPHY, a description or draught of some particular place, or small tract of land, as that of a city or town, manor or tenement, field, garden, house, castle, or the like; such as surveyors set out in their plots, or make draughts of, for the information and satisfaction of the proprietors.

TOPSHAM, a town in Devonshire, in England, seated on the river Exmouth, five miles south-east of Exeter, to which place the river was formerly navigable; but in time of war was choaked up designedly, so that ships are now obliged to load and unload at Topsham. W. Long. 3. 26. N. Lat. 50. 39.

TORBAY, a fine bay of the English channel, on the coast of Devonshire, a little to the east of Dartmouth, formed by two capes, called *Bury Points*, and *Bob's Nose*.

TORDA, or RASOR-BILL. See ALCA, nº 4.

TORDYLIUM, HART-WORT, in botany: A genus of plants belonging to the class of *pentandria*, and order of *digynia*; and in the natural system arranged under the 45th order, *Umbellatæ*. The corollets are radiated, and all hermaphrodite; the fruit is roundish, and crenated on the margin; the involucra long and undivided. There are seven species; of which two are British, the *nodosum* and *officinale*.

1. The *nodosum*, or knotted parsley, has simple sessile umbels, the exterior seeds being rough. It grows in the borders of corn fields, and in dry stony places. 2. The *officinale*, official hart-wort, has partial involucra, as long as the flowers; leaflets oval and jagged; the seeds are large and flat, and their edges notched.

TORIES, a political faction in Britain, opposed to the Whigs.

The name of *Tories* was given to a sort of banditti in Ireland, and was thence transferred to the adherents of Charles I. by his enemies, under the pretence that he favoured the rebels in Ireland. His partisans, to be even with the republicans, gave them the name of *Whigs*, from a word which signifies *whey*, in derision of their poor fare. The Tories, or *cavaliers*, as they were also called, had then principally in view the political interests of the king, the crown, and the church of England; and the round-heads, or Whigs, proposed chiefly the maintaining of the rights and interests of the people, and of Protestantism. This is the most popular account; and yet it is certain the names *Whig* and

Tormentilla || Torpor.

Tory were but little known till about the middle of the reign of king Charles II. M. de Cize relates, that it was in the year 1678 that the whole nation was firſt obſerved to be divided into Whigs and Tories; and that on occaſion of the famous depoſition of Titus Oates, who accuſed the Catholics of having conſpired againſt the king and the ſtate, the appellation of *Whig* was given to ſuch as believed the plot real; and *Tory* to thoſe who held it fictitious.

Theſe parties may be conſidered either with regard to the ſtate or to religion. The ſtate Tories are either violent or moderate: the firſt would have the king to be abſolute, and therefore plead for paſſive obedience, non-reſiſtance, and the hereditary right of the houſe of Stuart. The moderate Tories would not ſuffer the king to loſe any of his prerogative; but then they would not ſacrifice thoſe of the people. The ſtate Whigs are either ſtrong republicans or moderate ones. "The firſt (ſays Rapin) are the remains of the party of the long parliament, who attempted to change monarchy to a commonwealth: but theſe make ſo ſlender a figure, that they only ſerve to ſtrengthen the party of other Whigs. The Tories would perſuade the world, that all the Whigs are of this kind; as the Whigs would make us believe that all the Tories are violent. The moderate ſtate Whigs are much in the ſame ſentiments with the moderate Tories, and deſire that the government may be maintained on the ancient foundation: all the difference is, that the firſt bear a little more to the parliament and people, and the latter to that of the king. In ſhort, the old Whigs were always jealous of the encroachments of the royal prerogative, and watchful over the preſervation of the liberties and properties of the people.

TORMENTILLA, Tormentil, in botany: A genus of plants belonging to the claſs of *icoſandria*, and order of *polygynia*; and in the natural ſyſtem ranging under the 35th order, *Senticoſæ*. The calyx is octofid; the petals are four; the ſeeds round, naked, and affixed to a juiceleſs receptacle. There are two ſpecies; the *erecta* and *repens*, both indigenous.

1. The *erecta*, common tormentil, or ſeptfoil, has a ſtalk ſomewhat erect, and ſeſſile leaves. The roots conſiſt of thick tubercles, an inch or more in diameter, replete with a red juice of an aſtringent quality. They are uſed in moſt of the Weſtern Iſles, and in the Orkneys, for tanning of leather; in which intention they are proved by ſome late experiments to be ſuperior even to the oak bark. They are firſt of all boiled in water, and the leather is afterwards ſteeped in the liquor. In the iſlands of Tirey and Col the inhabitants have deſtroyed ſo much ground by digging them up, that they have lately been prohibited the uſe of them. A decoction of theſe roots in milk is alſo frequently adminiſtered by the inhabitants of the ſame iſlands in diarrhœas and dyſenteries, with good ſucceſs; but perhaps it would be moſt proper not to give it in dyſenteries till the morbid matter be firſt evacuated. A ſpirituous extract of the plant ſtands recommended in the ſea-ſcurvy, to ſtrengthen the gums and faſten the teeth. Linnæus informs us, that the Laplanders paint their leather of a red colour with the juice of the roots.

2. The *reptans*, or creeping tormentil, has reddiſh ſtalks, ſlender and creeping. The leaves are ſharply ſerrated, grow on ſhort footſtalks, and are five-lobed. The flowers are numerous and yellow, bloſſom in July, and are frequent in woods and barren paſtures.

TORNADO, a ſudden and vehement guſt of wind from all points of the compaſs, frequent on the coaſt of Guinea.

TORPEDO, the Cramp-fish. See Raja, and Electricity, nº 258—261.

TORPOR, a numbneſs, or defect of feeling and motion. Galen ſays it is a ſort of intermediate diſorder between palſy and health.

Torrefaction || Torricelli.

TORREFACTION, in chemiſtry, is the roaſting or ſcorching of a body by the fire, in order to diſcharge a part either unneceſſary or hurtful in another operation. Sulphur is thus diſcharged from an ore before it can be wrought to advantage.

TORRENT, denotes a temporary ſtream of water falling ſuddenly from mountains, whereon there have been great rains, or an extraordinary thaw of ſnow.

TORRICELLI (Evangeliſte), an illuſtrious Italian mathematician and philoſopher, born at Faenza in 1608. He was trained in Latin literature by his uncle a monk; and after cultivating mathematical knowledge for ſome time without a maſter, he ſtudied it under father Benedict Caſtelli, profeſſor of mathematics at Rome. Having read Galileo's dialogues, he compoſed a treatiſe on motion, on his principles, which brought him acquainted with Galileo, who took him home as an aſſiſtant: but Galileo died in three months after. He became profeſſor of mathematics at Florence, and greatly improved the art of making teleſcopes and microſcopes: but he is beſt known for finding out a method of aſcertaining the weight of the atmoſphere by quickſilver; the barometer being called, from him, the *Torricellian tube*. He publiſhed *Opera Geometrica*, 4to, 1644; and died in 1647.

TORRICELLIAN experiment, a famous experiment made by Torricelli, by which he demonſtrated the preſſure of the atmoſphere in oppoſition to the doctrines of ſuction, &c. finding that preſſure able to ſupport only a certain length of mercury, or any other fluid, in an inverted glaſs tube. See Barometer.

TORSK, or Tusk, in ichthyology. See Gadus.

TORTOISE, in zoology. See Testudo.

Tortoise-ſhell, the ſhell, or rather ſcales, of the teſtaceous animal called a *tortoiſe*; uſed in inlaying, and in various other works, as for ſnuff-boxes, combs, &c. Mr Cateſby obſerves, that the hard ſtrong covering which incloſes all ſorts of tortoiſes, is very improperly called a *ſhell*; being of a perfect bony contexture; but covered on the outſide with ſcales, or rather plates, of a horny ſubſtance; which are what the workmen call *tortoiſe-ſhell*. *Phil. Trans.* nº 438, p. 117.

There are two general kinds of tortoiſes, *viz.* the *land* and *ſea tortoiſe*, *teſtudo terreſtris* and *marina*. The ſea-tortoiſe, again, is of ſeveral kinds; but it is the caret, or teſtudo imbricata of Linnæus, alone which furniſhes that beautiful ſhell ſo much admired in Europe.

The ſhell of the caretta, or hawkſbill tortoiſe, is thick; and conſiſts of two parts, the upper, which covers the back, and the lower the belly: the two are joined together at the ſides by ſtrong ligaments, which yet allow of a little motion. In the fore part is an aperture for the head and fore-legs, and behind for the hind-legs and tail. It is the under ſhell alone that is uſed: to ſeparate it, they make a little fire beneath it, and as ſoon as ever it is warm, the under ſhell becomes eaſily ſeparable with the point of a knife, and is taken off in laminæ or leaves.

The whole ſpoils of the caret conſiſt in 13 leaves or ſcales, eight of them flat, and five a little bent. Of the flat ones, there are four large ones, ſometimes a foot long, and ſeven inches broad. The beſt tortoiſe-ſhell is thick, clear, tranſparent, of the colour of antimony, ſprinkled with brown and white. When uſed in marquetry, &c. the workmen give it what colour they pleaſe by means of coloured leaves, which they put underneath it.

Working and joining of Tortoise-*ſhell*.—Tortoiſe ſhell and horn become ſoft in a moderate heat, as that of boiling water, ſo as to be preſſed, in a mould, into any form, the ſhell or horn

horn being previously cut into plates of a proper size. Plumier informs us, in his *Art de Tourner*, that two plates are likewise united into one by heating and pressing them; the edges being thoroughly cleaned, and made to fit close to one another. The tortoise-shell is conveniently heated for this purpose by applying a hot iron above and beneath the juncture, with the interposition of a wet cloth to prevent the shell from being scorched by the irons: these irons should be pretty thick, that they may not lose their heat before the union is effected. Both tortoise-shell and horns may be stained of a variety of colours, by means of the colouring drugs commonly used in dyeing, and by certain metallic solutions.

TORTURE, a violent pain inflicted on persons to force them to confess the crimes laid to their charge, or as a punishment for crimes committed.

Torture was never permitted among the Romans except in the examination of slaves: it would therefore appear, that it was a general opinion among them, that a slave had such a tendency to falsehood, that the truth could only be extorted from him. To the disgrace of the professors of Christianity, torture was long practised by those who called themselves Catholics, against those whom they termed *heretics*; that is, those who differed in opinion from themselves. Finding that they could not bring over others to adopt their sentiments by the force of argument, they judge it proper to compel them by the force of punishment. This practice was very general among orthodox Christians, but especially among Roman Catholics. See INQUISITION.

By the law of England, torture was at one period employed to compel those criminals who stood obstinately mute when brought to trial, and refused either to plead guilty or not guilty; but it is now abolished (see ARRAIGNMENT, RACK). A history of the machines which have been invented to torture men, and an account of the instances in which these have been employed, would exhibit a dismal picture of the human character.

TORUS, in architecture, a large round moulding used in the bases of columns. See Plate XXXVIII. fig. 3.

TOUCAN, in ichthyology. See RHAMPHASTOS.

TOUCH-NEEDLE, among assayers, refiners, &c. little bars of gold, silver, and copper, combined together, in all the different proportions and degrees of mixture; the use of which is to discover the degree of purity of any piece of gold or silver, by comparing the mark it leaves on the touchstone with those of the bars.

The metals usually tried by the touch-stone are gold, silver, and copper, either pure, or mixed with one another in different degrees and proportions, by fusion. In order to find out the purity or quantity of baser metal in these various admixtures, when they are to be examined they are compared with these needles, which are mixed in a known proportion, and prepared for this use. The metals of these needles, both pure and mixed, are all made into laminæ or plates, one twelfth of an inch broad, and of a fourth part of their breadth in thickness, and an inch and half long; these being thus prepared, you are to engrave on each a mark indicating its purity, or the nature and quantity of the admixture in it. The black rough marbles, the basaltes, or the softer kinds of black pebbles, are the most proper for touch-stones.

The method of using the needles and stone is this: The piece of metal to be tried ought first to be wiped well with a clean towel or piece of soft leather, that you may the better see its true colour; for from this alone an experienced person will, in some degree, judge beforehand what the principal metal is, and how and with what debased.

Then choose a convenient, not over large, part of the surface of the metal, and rub it several times very hardly and strongly against the touch-stone, that in case a deceitful coat or crust should have been laid upon it, it may be worn off by that friction: this, however, is more readily done by a grindstone or small file. Then wipe a flat and very clean part of the touchstone, and rub against it, over and over, the just mentioned part of the surface of the piece of metal, till you have, on the flat surface of the stone, a thin metallic crust, an inch long, and about an eighth of an inch broad: this done, look out the needle that seems most like to the metal under trial, wipe the lower part of this needle very clean, and then rub it against the touchstone, as you did the metal, by the side of the other line, and in a direction parallel to it.

When this is done, if you find no difference between the colours of the two marks made by your needle and the metal under trial, you may with great probability pronounce that metal and your needle to be of the same alloy, which is immediately known by the mark engraved on your needle. But if you find a difference between the colour of the mark given by the metal, and that by the needle you have tried, choose out another needle, either of a darker or lighter colour than the former, as the difference of the tinge on the touchstone directs; and by one or more trials of this kind you will be able to determine which of your needles the metal answers, and thence what alloy it is of, by the mark of the needle; or else you will find that the alloy is extraordinary, and not to be determined by the comparison of your needles.

TOUCH-Stone, a black, smooth, glossy stone, used to examine the purity of metals. The ancients called it *lapis Lydius*, the Lydian stone, from the name of the country whence it was originally brought.

Any piece of pebble or black flint will answer the purposes of the best lapis lydius of Asia. Even a piece of glass made rough with emery is used with success, to distinguish true gold from such as is counterfeit; both by the metallic colour and the test of aquafortis. The true touchstone is of a black colour, and is met with in several parts of Sweden. See TRAPP.

TOUCHWOOD. See BOLETUS.

TOULON, a celebrated city and seaport of France, in that part of the late province of Provence which is now denominated the department of the *Var*. It is a very ancient place, having been founded, according to the common opinion, by a Roman general. It is the chief town of the department, and before the great revolution in 1789 was an episcopal see. The inhabitants are computed at [illegible]. It is divided into the Old Quarter and the New Quarter. The first, which is very ill built, has nothing remarkable in it but the *Rue aux Arbres*, the Tree Street, which is a kind of course or mall, and the town-house; the gate of this is surrounded by a balcony, which is supported by two termini, the masterpieces of the famous Puget. The New Quarter, which seems as it were a second city, contains, beside the magnificent works constructed in the reign of Louis XIV. many fine houses (among which that of the late seminary merits beyond comparison the preference) and a grand oblong square, lined with trees, and serving as a parade.

The Merchants Haven, along which extends a noble quay, on which stands the townhouse, is protected by two moles, begun by Henry IV. The New Haven was constructed by Louis XIV. as were the fortifications of the city. In the front of this haven is an arsenal, containing all the places necessary for the construction and fitting out of vessels: the first object that appears is a rope-walk, entirely arched, extending as far as the eye can reach, and built after

ter the defigns of Vauban: here cables are made, and above is a place for the preparation of hemp. Here likewife is the armoury for mufkets, piftols, halberds, &c. In the park of artillery are cannons placed in piles, bombs, grenades, mortars, and balls of various kinds, ranged in wonderful order. The long fail room, the foundry for cannon, the dock-yards, the bafons, &c. are all worthy of obfervation.

Both the old and New Port have an outlet into the fpacious outer road or harbour, which is furrounded by hills, and formed by nature almoft circular. Its circuit is of very great extent, and the entrance is defended on both fides by a fort with ftrong batteries. In a word, the bafons, docks, and arfenal, at Toulon, warranted the remark of a foreigner that vifited them in the late reign, that "the king of France was greater there than at Verfailles." Toulon is the only mart in the Mediterranean for the re-exportation of the products of the Eaft Indies.

This place was deftroyed toward the end of the tenth century, and pillaged by the African pirates almoft as foon as rebuilt. The conftable of Bourbon, at the head of the Imperial troops, obtained poffeffion of it in 1524, as did Charles V. in 1536; but in the next century Charles Emanuel duke of Savoy could not enter it, and Prince Eugene in 1707 ineffectually laid fiege to it. This city was furrendered by the inhabitants in September 1793 to the British admiral Lord Hood, as a condition and means of enabling them to effect the re-eftablifhment of monarchy in France, according to the conftitution of 1789. Lord Hood accordingly, in conjunction with the Spanifh land and naval forces, took poffeffion of the harbour and forts in truft for Louis XVII. It was garrifoned for fome time by the Britifh troops, and their allies the Spaniards, Neapolitans, and Sardinians; but the French having laid fiege to it, the garrifon was obliged to evacuate the place in the month of December following, after having deftroyed the grand arfenal, two fhips of 84 guns, eight of 74, and two frigates; and carried off the Commerce de Marfeilles, a fhip of 120 guns, with an 80 and 74 gun fhip. This exploit was moft gallantly performed, after it was found impoffible to defend the town, or to carry off the fhips. Lord Hood entrufted the management of the affair to Sir Sydney Smith, fo diftinguifhed for his intrepidity. Captain Hare commanded the firefhip which was towed into the grand arfenal; and fo eager was he to execute his orders, that inftead of fetting fire to the train in the ufual cautious manner, he fired a piftol loaded with powder into the bowl of the train, compofed of 36 pounds of powder, and other combuftibles. The confequence was, he was blown into the water with fuch violence, as to knock a lieutenant of the Victory's boat overboard, and narrowly efcaped with his life. A Spanifh captain was appointed to fet fire to the fmall arfenal, but cowardice prevented him from executing his orders; and this is the reafon why the whole French fhips were not deftroyed. We have been favoured with this account by an officer of the Britifh fleet.

Toulon is feated on a bay of the Mediterranean, 17 leagues fouth-eaft of Aix, 15 fouth-eaft of Marfeilles, and 217 fouth-eaft of Paris. E. Long. 5. 37. N. Lat. 43. 7.

TOULOUSE, a very ancient city of France, in the department of Upper Garonne, and late province of Languedoc, with an archbifhop's fee. It is the moft confiderable city in France next to Paris and Lyons, although its population bears no proportion to its extent. According to Mr Neckar's calculation, it contains 56,000 inhabitants. The ftreets are very handfome, and the walls of the city, as well as the houfes, are built with bricks. The townhoufe, a modern ftructure, forms a perfect fquare, 324 feet long and 66 high. The principal front occupies an entire fide of the grand fquare, lately called the *Place Royale*. In the great hall, called the *Hall of Illuftrious Men*, is the ftatue of the Chevalier Ifaure, and the bufts of all the great men to whom Touloufe has given birth. Communicating with the ocean on one fide by the river Garonne, and with the Mediterranean on the other, by the canal of Languedoc, Touloufe might have been a very commercial city; but the tafte of the inhabitants has been principally for the fciences and belles-lettres. Of courfe, there are two colleges, two public libraries, and three academies. The little commerce of Touloufe confifts in leather, drapery, blankets, mignionets, oil, iron, mercery, hardware, and books. The bridge over the Garonne is at leaft equal to thofe of Tours and Orleans: it forms the communication between the fuburb of St Cyprian and the city. The quays extend along the banks of the Garonne; and it has been in contemplation to line them with new and uniform houfes. Touloufe is 37 miles eaft of Auch, 125 fouth-eaft of Bourdeaux, and 350 fouth-by-weft of Paris. E. Long. 1. 27. N. Lat. 43. 36.

TOUP (the Reverend Jonathan), was defcended from a family formerly fettled in Dorfetfhire. His grandfather, Onefiphorus Toup, had been a man of good property, and patron as well as incumbent of Bridport, in that county; but he appears to have been embarraffed in his circumftances before his death, as he parted with the advowfon, and left a numerous family very flenderly provided for. His fecond fon Jonathan was bred to the church, and was curate and lecturer of St Ives in Cornwall. He married Prudence, daughter of John Bufvargus, Efq; of Bufvargus in Cornwall, and by her had iffue Jonathan, the fubject of this article, and one daughter.

Mr Toup loft his father while he was a child; and his mother fome time after marrying Mr Keigwyn, vicar of Landrake in Cornwall, his uncle Bufvargus (the laft male of that family) took him under his care, and confidered him as his own child. He bore the whole charge of his education both at fchool and at college, and procured for him the rectory of St Martin's near Looe.

Mr Toup was born at St Ives in Cornwall in the year 1713. He received the firft rudiments of his education in a grammar fchool in that town; and was afterwards placed under the care of Mr Gurney, mafter of a private fchool in the parifh of St Merryn. Thence he was removed to Exeter College in Oxford, where he took his degree of Bachelor of Arts. His mafter's degree he took at Cambridge in the year 1756. He obtained the rectory of St Martin's in 1750; was inftalled prebendary of Exeter in 1774; and inftituted to the vicarage of St Merryn in 1776: the two laft preferments he owed to the patronage of Bifhop Keppel of Exeter. By the death of his uncle Bufvargus without iffue in 1751, Mrs Keigwyn (fifter to Mr Bufvargus, and mother to Mr Toup) fucceeded as heir at law to his eftate and effects. She died in 1773, and left a will bequeathing the whole of her eftates to her fon Mr Jonathan Toup.

In the year 1760 Mr Toup publifhed the firft part of his *Emendationes in Suidam*, and in 1764 the fecond part of the fame work. Thefe books procured him the notice of Bifhop Warburton, who from the time of their publication honoured him with his correfpondence and patronage. The Bifhop, in one of his letters, laments his having a fee without any preferment on it; "had it been otherwife, he fhould have been too felfifh to invite any of his brethren to fhare with him in the honour of properly diftinguifhing fuch merit as Mr Toup's. All, however, that the Bifhop could do, he did with the warmth and earneftnefs of fincere friendfhip. He repeatedly recommended Mr Toup to Archbifhop

Secker,

Secker, to the Trustees for disposing of his Options, to Lord Shelburne, and to Bishop Keppel; and the favours this prelate bestowed on Mr Toup were owing to the solicitations of Bishop Warburton. The third part of the *Emendationes in Suidam* was published in 1766. In the following year Archbishop Secker expressed a desire that Mr Toup would lend his assistance towards a new edition of Polybius, which was then in contemplation. Bishop Warburton strongly pressed his compliance with this wish, and that he would lay by for a while the Notes he was preparing for Mr Warton's edition of Theocritus. In the year 1767 Mr Toup's *Epistola Critica ad virum celeberrimum Gul. Episcop. Gloc.* made its appearance. In the year 1770, Mr Warton's edition of Theocritus was printed at the university press in Oxford. Mr Toup was a large contributor towards the corrections and annotations of this edition. A note of his on Idyll. xiv. 37. gave such offence to some persons, that the vice-chancellor of Oxford prevailed on the editor to cancel the leaf on which it was printed, and substitute another in its room. In 1772 Mr Toup published his *Appendiculum Notarum in Theocritum*, in which the substance (A) of the cancelled note was inserted. He concludes his preface to this work with these words: "*Quod vero scripsimus ad* xiv. 37. *verum est et honestum. Sed rem pro singulari sua sagacitate minus ceperunt nonnulli Oxonienses; qui et me sugillare haud erubuerunt; homunculi eruditione mediocri, ingenio nullo; qui in Hebraicis per omnem fere vitam turpiter volutati, in literis elegantioribus plane hospites sunt.*" Mr Toup's next work was the *Appendiculum Notarum in Suidam*, published in 1775. In 1778 his Longinus was published from the Oxford press in quarto. A second edition has since been printed in octavo.

As a writer of great learning, and of singular critical sagacity, Mr Toup needs no encomiast. The testimonies of Mr T. Warton, of Bishop Warburton, and of every person in any way distinguished for classical learning at home; of Ernestus, Hemsterhusius, Ruhkhenius, Valckenaer, Brunck, Kluit, D'Ansse de Villoison, L'Archer, &c. &c. in all parts of Europe, sufficiently establish his reputation as an author. To most or all of these he was assisting in the several works they published.

As his whole life was past in literary retirement, his character as a man was known but to few. It will appear from his works that he was not wholly untinctured with that self complacency which is the almost inseparable companion of too much solitude; and by those who best knew him, he is said to have been unhappy in his disposition. His virtues, however, were respectable, and his learning was confessedly great. His theological studies were well directed: he sought for the truths of religion where only they can be found, in the Scriptures; not in the glosses and comments of men: it will be needless to add, that he was a liberal and a tolerant divine. He was punctual and serious in the discharge of the duties of his profession; and in his preaching singularly plain and forcible. He died on the 19th of January 1785, just entering into the 72d year of his age, and was buried under the communion-table in his church of St Martin's.

Mr Toup was a Christian from conviction; not merely from the accident of having been born in a country where Christianity was professed. He fulfilled the duties of life conscientiously, and from principle, without parade or ostentation. In his pursuit of learning he was actuated by the most honourable motives; by the desire of improving his own mind, and of amusing himself and others. If in Bishop Warburton he found a patron, capable of distinguishing merit, and zealous to reward it, let it be remembered, to the honour of both parties, that the Bishop's patronage was offered, not solicited. In the year 1764 he was repeatedly pressed by another prelate to quit his retirement at St Martin's, and to settle either in London or in Oxford, where he might have access to books, and might place himself in the way of notice and preferment. He was assured, at the same time, that the bishop of his diocese would himself make a tender of his connivance at his non-residence, without any application from Mr Toup on the subject. But every proposal of this nature he constantly rejected; for he considered the non-residence of the parochial clergy as a neglect of duty, for which no apology can be made. He was never married, and rather capriciously left his fortune, amounting, it has been said, to L. 12,000, to a niece whose mother was his half-sister, taking not the least notice in his will of his other nephews and nieces, whose mother was his full sister.

TOUR (Henry de la), viscount Turenne, a celebrated French general, was the second son of Henry de la Tour duke of Bouillon, and was born at Sedan in 1611. He made his first campaigns in Holland, under Maurice and Frederic Henry princes of Orange; who were his uncles by the mother's side; and even then distinguished himself by his bravery. In 1634 he marched with his regiment into Lorraine; and having contributed to the taking of La Mothe, was, though very young, made mareschal de camp. In 1636 he took Saverne, and the year following the castles of Hirson and Sole; on which occasion he performed an action like that of Scipio's, with respect to a very beautiful woman whom he sent back to her husband. The viscount Turenne continued to distinguish himself in several sieges and battles, and in 1644 was made marshal of France; but had the misfortune to be defeated at the battle of Mariendal in 1645. However, he gained the battle of Nortlingen three months after; restored the elector of Treves to his dominions; and the following year made the famous junction of the French army with that of Sweden commanded by general Wrangel, which obliged the duke of Bavaria to demand a peace. Afterwards that duke breaking the treaty he had concluded with France, he was defeated by the viscount Turenne at the battle of Zumarshausen, and in 1648 driven entirely out of his dominions. During the civil wars in France he sided with the princes, and was defeated at the battle of Rhetel in 1650; but soon after was restored to the favour of the king, who in 1652 gave him the command of his army. He acquired great honour at the battles of Jergeau, Gien, and the suburbs of St Anthony, and by the retreat he made before the army commanded by the princes at Ville Neuve St George. In 1654 he made the Spaniards raise the siege of Arras: the next year he took Condé, St Guilian, and several other places; gained the famous battle of Dunes; and made himself master of Dunkirk, Oudenarde, and almost all Flanders: this obliged the Spaniards to conclude the peace of the Pyrenees in 1660. These important services occasioned his being made marshal-general of the king's camps and armies. The war being renewed with Spain in 1667, Turenne commanded in Flanders; and took so many places, that in 1668 the Spaniards were obliged to sue for peace. He commanded the French army in the war against the Dutch in 1672; took 40 towns in 22 days; pursued the elector of Brandenburg even to Berlin; gained the battles of Sintzheim, Ladenburg, Ensheim, Mulhausen, and Turkeim; and obliged the Imperial army, which

(A) Not improbably all of that note which was omitted in the substituted leaf.

which consisted of 20,000 men, to repass the Rhine. By this campaign the viscount Turenne acquired immortal honour. He passed the Rhine to give battle to general Montecuculi, whom he followed as far as Saspach; but mounting upon an eminence to discover the enemy's camp, he was killed by a cannon-ball in 1675. All France regretted the loss of this great man, who by his military exploits had raised the admiration of Europe.

TOURAINE, a province of France, bounded on the north by Maine, on the east by Orleanois, on the south by Berris, and on the west by Anjou and Poitou. It is about 5[illegible] miles in length, and 55 in breadth where it is broadest. This country is watered by 17 rivers, besides many brooks, which not only render it delightful, but keep up a communication with the neighbouring provinces. The air is temperate, and the soil is so fruitful that it is called the *garden of France.* It now forms the department of Indre and Loire, of which Tours is the capital.

TOURMALINE, in mineralogy, a species of siliceous earth.

It has been found only in Ceylon, Brazil, and Tyrol. That of Ceylon is of a dark brown or yellowish colour; its specific gravity 3,065, or 3,295; that of Brazil is green, blue, red, or yellow, and its specific gravity 3,075 or 3,180; that of Tyrol by reflected light is of a blackish brown, but by refracted light yellowish, or in thin pieces green; its specific gravity 3,050; mostly crystallized in polygon prisms, but sometimes amorphous. The thickest parts are opake: the thin more or less transparent.

The proportion of their constituent parts has been found by Bergman,

	Tourmaline of Tyrol.	of Ceylon.	of Brazil.
Argill, -	42	39	50
Silex, -	40	37	34
Calcareous earth,	12	15	11
Iron, -	6	9	5
	100	100	100

For the electrical qualities of tourmaline, see ELECTRICITY, n° 54.

TOURNAMENT, a martial sport or exercise which the ancient cavaliers used to perform, to show their bravery and address. It is derived from the French word *tourner*, i. e. "to turn round," because to be expert in these exercises, much agility both of horse and man was requisite, they riding round a ring in imitation of the ancient Circi.

The first tournaments were only courses on horseback, wherein the cavaliers tilted at each other with canes in manner of lances; and were distinguished from justs, which were courses or careers, accompanied with attacks and combats, with blunted lances and swords. See JUST.

The prince who published the tournament, used to send a king at arms, with a safe-conduct, and a sword, to all the princes, knights, &c. signifying that he intended a tournament and a clashing of swords, in the presence of ladies and damsels; which was the usual formula of invitation.

The first engaged man against man, then troop against troop; and after the combat, the judges allotted the prize to the best cavalier, and the best striker of swords; who was accordingly conducted in pomp to the lady of the tournament; where, after thanking her very reverently, he saluted her and likewise her two attendants.

These tournaments made the principal diversion of the 13th and 14th centuries. Munster says, it was Henry the Fowler, duke of Saxony, and afterwards emperor, who died in 936, that first introduced them; but it appears from the chronicle of Tours, that the true inventor of this famous sport, at least in France, was one Geoffry, lord of Preuilli, about the year 1066. Tour

Instances of them occur among the English in the reign of king Stephen, about the year 1140; but they were not much in use till Richard's time, towards the year 1149. After which period these diversions were performed with extraordinary magnificence in the Tilt-yard near St James's, Smithfield, and other places.

The following account of a tournament, from Maitland, is curious. King Richard II. designing to hold a tournament at London on the Sunday after Michaelmas, sent divers heralds to make proclamations of it in all the principal courts of Europe; and accordingly not a few princes, and great numbers of the prime nobility, resorted hither from France, Germany, the Netherlands, &c. This solemnity began on Sunday afternoon, from the Tower of London, with a pompous cavalcade of 60 ladies, each leading an armed knight by a silver chain, being attended by their 'squires of honour, and, passing through Cheapside, rode to Smithfield, where the justs and tournaments continued several days with magnificent variety of entertainments; on which occasion the king kept open house at the bishop of London's palace for all persons of distinction, and every night concluded with a ball.

At last, however, they were found to be productive of bad effects, and the occasions of several fatal misfortunes—as in the instance of Henry II. of France, and of the tilt exhibited at Chalons, which, from the numbers killed on both sides, was called the *little war of Chalons.* These and other inconveniences, resulting from those dangerous pastimes, gave the popes occasion to forbid them, and the princes of Europe gradually concurred in discouraging and suppressing them.

TOURNAY, a town of the Austrian Netherlands in Flanders, and capital of a district called *Tournaysis*, with a bishop's see. It is divided into two parts by the river Scheld; and is large, populous, well built, and carries on a great trade in woollen stuffs and stockings. The cathedral is a very handsome structure, and contains a great many chapels, with rich ornaments, and several magnificent tombs of marble and brass. The town was taken by the allies in 1709; but was ceded to the house of Austria by the treaty of Utrecht, though the Dutch had a right to put in a garrison. It was taken by the French in June 1745, who demolished the fortifications. In 1781 the emperor Joseph II. obliged the Dutch to withdraw their garrison. It was taken by the French in 1791, abandoned by them in 1793, and again conquered by them in 1794. It is 14 miles south-east of Lisle, 30 south-west of Ghent, and 135 north by east from Paris. E. Long. 3. 28. N. Lat. 50. 33.

TOURNEFORT (Joseph Pitton de), a famous French botanist, born at Aix in Provence in 1656. He had a passion for plants from his childhood, which overcame his father's views in putting him to study philosophy and divinity; therefore on his death he quitted theology, and gave himself up entirely to physic, natural history, and botany. He wandered over the mountains of Dauphiny, Savoy, Catalonia, the Pyrenees, and the Alps, in search of new species of plants, which he acquired with much fatigue and danger. His fame in 1683 procured him the employment of botanic professor, in the king's garden; and by the king's order, he travelled into Spain, Portugal, Holland, and England, where he made prodigious collections of plants. In 1700, Mr Tournefort, in obedience to another order, simpled over all the isles of the Archipelago, upon the coasts of the Black Sea, in Bithynia, Pontus, Cappadocia, Armenia,

nia, and Georgia; making observations on natural history at large, ancient and modern geography, religion, manners, and commerce. He spent three years in this learned voyage; and then resuming his profession, was made professor of physic in the college royal. He died in consequence of an accidental crush of his breast by a cart wheel, which brought on a spitting of blood and hydrothorax, that carried him off in 1708. He wrote Elements of botany, both in French and Latin; A Relation of his Voyage into the Levant; with other pieces of less consideration.

TOURNIQUET, in surgery, an instrument formed with screws, for compressing any part with rollers, &c. for the stopping of hæmorrhagies. See SURGERY, n° 160.

TOWER, a tall building consisting of several stories, usually of a round form, though some are square or polygonal. Towers are built for fortresses, &c. as the Tower of London. See LONDON, n° 46.

TOWN, a place inhabited by a considerable number of people, being of a middle size between a city and a village.

TOXICODENDRON, in botany. See RHUS.

TRAAS. See TERRAS.

TRACHEA. See ANATOMY, n° 116.

TRACHINUS, the WEEVER, a genus of fishes belonging to the order of jugulares. There is but one species, viz. the *draco*, or common weever. The qualities of this fish were well known to the ancients, who take notice of them without any exaggeration: the wounds inflicted by its spines are exceedingly painful, attended with a violent burning and most pungent shooting, and sometimes with an inflammation that will extend from the arm to the shoulder.

It is a common notion, that these symptoms proceed from something more than the small wound this fish is capable of inflicting; and that there is a venom infused at least into the wounds made by the spines that form the first dorsal fin, which is dyed with black, and has a most suspicious aspect; though it is possible, that the malignity of the symptoms arises from the habit of body the person is in, or the part in which the wound is given. The remedy used by some fishermen is the sea sand, with which they rub the place affected for a considerable time. At Scarborough, stale urine warmed is used with success. In the Universal Museum for November 1765, is an instance of a person who was reduced to great danger by a wound from this fish, and who was cured by the application of sweet oil, and taking opium and Venice treacle.

This fish buries itself in the sands, leaving only its nose out, and if trod on immediately strikes with great force; and they have been seen directing their blows with as much judgment as fighting cocks. Notwithstanding this noxious property of the spines, it is exceeding good meat.

The English name seems to have no meaning, being corrupted from the French *vive*, so called as being capable of living long out of the water, according to the interpretation of Belon. It grows to the length of 12 inches, but is commonly found much less: the irides are yellow: the under jaw is longer than the upper, and slopes very much towards the belly; the teeth are small; the back is straight, the sides are flat, the belly is prominent, the lateral line straight: the covers of the gills are armed with a very strong spine: the first dorsal fin consists of five very strong spines, which, as well as the intervening membranes, are tinged with black; this fin, when quiescent, is lodged in a small hollow: the second consists of several soft rays, commences just at the end of the first, and continues almost to the tail: the pectoral fins are broad and angular; the ventral fins small: the vent is placed remarkably forward, very near the throat: the anal fin extends to a small distance from the tail, is a little hollowed in the middle, but not so much as to be called forked: the sides are marked lengthways with two or three dusky yellow lines, and transversely by numbers of small ones: the belly silvery.

TRACT, in geography, an extent of ground, or a portion of the earth's surface.

TRACT, in matters of literature, denotes a small treatise or written discourse upon any subject.

TRADE, in general, denotes the same with commerce, consisting in buying, selling, and exchanging of commodities, bills, money, &c. See COMMERCE, COIN, MONEY, COMPANY, &c.

TRADE-Winds, denote certain regular winds at sea, blowing either constantly the same way, or alternately this way and that; thus called from their use in navigation, and the Indian commerce. See WIND.

TRADESMEN's TOKENS, a term synonymous among medallists with provincial coins.

This is a subject curious enough to deserve attention, though we will not go so far as Mr Pinkerton does, who says that it is a subject in which the perpetual glory of the nation is interested. Since the year 1789 provincial halfpence have been made and circulated in considerable quantity. As ancient medals and coins have been frequently of use to historians, it is to be regretted that many of these provincial halfpence are rendered useless in this respect by unmeaning figures and puerile devices. Utility and elegance ought to be studied: for this view it has been proposed by a gentleman of taste on this subject, that all coins should be distinguished by one of the following characteristics. 1. Fac similes of magnificent beautiful buildings. 2. Representations of great and useful undertakings. 3. Emblems of the industry and commerce of the age. 4. The illustrious men, &c. to which the nation has given birth. 5. Important historical events.

For these hints we acknowledge ourselves indebted to the papers of an ingenious gentleman published in the periodical works of the time. Those who wish to see more upon the subject, may consult the Universal Magazine for August 179

TRADITION, something handed down from one generation to another without being written. Thus the Jews pretended, that besides their written law contained in the Old Testament, Moses had delivered an oral law which had been conveyed down from father to son; and thus the Roman Catholics are said to value particular doctrines supposed to have descended from the apostolic times by tradition.

TRAGACANTH. See ASTRAGALUS, PHARMACOPŒIA.

TRAGEDY, a dramatic poem, representing some signal action performed by illustrious persons, and which has frequently a fatal issue or end. See POETRY, Part II. sect. I.

TRAGI-COMEDY, a dramatic piece, partaking both of the nature of tragedy and comedy; in which a mixture of merry and serious events is admitted.

[illegible]

Trajan

Transactions.

roots are conical and esculent, and are sometimes boiled and served up at table like asparagus. It grows on meadows. 2. The *porrifolium*, or purple goat's beard, has the calyx longer than the radius of the floret; the flowers are large, purple, single, and terminal; and the leaves long, pointed, and blunt. The root is long, thick, and esculent. It grows in meadows, and is cultivated in gardens under the name of *salsify*.

TRAJAN (Marcus Ulpius), a celebrated Roman emperor, who gained many victories over the Parthians and Germans, pushing the empire to its utmost extent on the east and north sides. He died at Selinunte, a city of Cilicia, which from him was called *Trajanopolis*, in the year 117.

Trajan's Column, a famous historical column erected in Rome, in honour of the emperor Trajan. It is of the Tuscan order, though somewhat irregular: its height is eight diameters, and its pedestal Corinthian: it was built in a large square called *Forum Romanum*. Its base consists of 12 stones of an enormous size, and is raised on a socle, or foot, of eight steps: withinside is a staircase illuminated with 44 windows. It is 140 feet high, which is 35 feet short of the Antonine column, but the workmanship of the former is much more valued. It is adorned from top to bottom with basso relievos, representing the great actions of the emperor against the Dacians.

TRAIN, a line of gunpowder laid to give fire to a quantity thereof, in order to do execution by blowing up earth, works, buildings, &c.

Train of Artillery, includes the great guns and other pieces of ordnance belonging to an army in the field.

Train-Oil, the oil procured from the blubber of a whale by boiling.

TRALLIAN (Alexander), a Greek writer on physic, a native of Tralles in Lydia, who lived about the middle of the sixth century. His works are divided into 12 books; in which he treats of distempers as they occur, from head to foot. He was the first who opened the jugular vein, and that used cantharides as a blister for the gout. Dr Freind, in his History of Physic, styles him one of the most valuable authors since the time of Hippocrates. Though he appears on the whole to have been a rational physician, yet there are things in his writings that savour of enthusiasm and superstition.

TRA-LOS-MONTES, a province of Portugal, called in Latin *Transmontana*, because situated on the east side of a chain of hills that separate it from Entre Duero-e-Mintio. It is bounded on the north by Galicia; on the south by the provinces of Beira and Leon; by the last of which it is bounded also to the east. Its length from north to south is upwards of 120 miles, and its breadth about 80. It is full of mountains, and produces little corn, but plenty of wine, fruits of several sorts, and abundance of game.

TRANSACTIONS, a name generally given to a collection of the papers read before literary or philosophical societies. The name of *Philosophical Transactions* was first adopted by the Royal Society of London. See an account of the Royal Society, Vol. XVII. p. 582.

The Philosophical Transactions to the end of the year 1700 were abridged in three volumes by Mr John Lowthorp: those from the year 1700 to 1720 were abridged in two volumes by Mr Henry Jones: those from 1719 to 1733 were abridged in two volumes by Mr John Eames and Mr John Martyn; Mr Martyn continued the abridgement of those from 1732 to 1744 in two volumes, and of those from 1743 to 1750 in two volumes.

They were for many years published in numbers, and the printing of them was always, from time to time, the single act of the respective secretaries, till the year 1752, when the society thought fit that a committee should be appointed to reconsider the papers read before them, and to select out of them such as they should judge most proper for publication in the future Transactions. They are published annually in two parts at the expence of the society, and each fellow is entitled to receive one copy *gratis* of every volume published after his admission into the society.

They were first set on foot in 1665, by Mr Oldenburg, secretary of the society, and were continued by him till the year 1677. Upon his death, they were discontinued till January 1678, when Dr Grew resumed the publication of them, and continued it for the months of December 1678, and January and February 1679, after which they were intermitted till January 1683. During this last interval they were supplied in some measure by Dr Hooke's Philosophical Collections. They were also interrupted for three years, from December 1687 to January 1691, beside other smaller interruptions amounting to near one year and a half more, before October 1695, since which time the Transactions have been regularly carried on.

Transcendental

Transfusion.

TRANSCENDENTAL, or TRANSCENDENT, something elevated, or raised above other things; which passes and transcends the nature of other inferior things.

TRANSCRIPT, a copy of any original writing, particularly that of an act or instrument inserted in the body of another.

TRANSFER, in commerce, an act whereby a person surrenders his right, interest, or property, in any thing moveable or immoveable to another.

TRANSFORMATION, in general, denotes a change of form, or the assuming a new form different from a former one.

TRANSFUSION, the act of pouring a liquor out of one vessel into another.

Transfusion of Blood, an operation by which it was some time ago imagined that the age of animals would be renewed, and immortality, or the next thing to it, conferred on those who had undergone it.

The method of transfusing Dr Lower gives us to the following effect: take up the carotid artery of the dog, or other animal, whose blood is to be transfused into another of the same, or a different kind; separate it from the nerve of the eighth pair, and lay it bare above an inch. Make a strong ligature on the upper part of the artery; and an inch nearer the heart another ligature with a running knot, to be loosened and fastened as occasion requires. Draw two threads between the two ligatures, open the artery, put in a quill, and tie up the artery again upon the quill by the two threads, and stop the quill by a stick.

Then make bare the jugular vein of the other animal for about an inch and half in length, and at each end make a ligature with a running knot; and in the space between the two knots draw under the veins two threads, as in the other. Open the vein, and put into it two quills, one into the descending part of the vein, to receive the blood from the other dog, and carry it to the heart; the other quill put into the other part of the jugular, towards the head, through which the second animal's own blood is to run into dishes. The quills thus tied fast, stop them up with sticks till there be occasion to open them.

Things thus disposed, fasten the dogs on their sides towards one another, in such manner as that the quills may go into each other; then unstop the quill that goes down into the second dog's jugular vein, as also that coming out of the other dog's artery; and by the help of two or three other

other quills put into each other, as there shall be occasion, insert them into one another. Then slip the running knots, and immediately the blood runs through the quills as through an artery, very impetuously. As the blood runs into the dog, unstop the quill in the upper part of his jugular, for his own blood to run out at, though not constantly, but as you perceive him able to bear it, till the other dog begins to cry and faint, and at last die. *Lastly*, take both quills out of the jugular, tie the running knot fast, and cut the vein asunder, and sew up the skin: the dog, thus dismissed, will run away as if nothing ailed him.

In the Philosophical Transactions we have accounts of the success of various transfusions practised at London, Paris, in Italy, &c. Sir Edmund King transfused forty-nine ounces of blood out of a calf into a sheep; the sheep, after the operation, appearing as well and as strong as before.

M. Denis transfused the blood of three calves into three dogs, which all continued brisk, and eat as well as before. The same person transfused the blood of four wethers into a horse twenty-six years old, which thence received much strength, and a more than ordinary appetite.

Soon after this operation was introduced at Paris, *viz.* in 1667 and 1668, M. Denis performed it on five human subjects, two of whom recovered of disorders under which they laboured, one being in perfect health suffered no inconvenience from it; and two persons who were ill, and submitted to the operation, died: in consequence of which the magistrates issued a sentence, prohibiting the transfusion on human bodies under pain of imprisonment.

Mr John Hunter, we are told, made many ingenious experiments to determine the effects of transfusing blood, some of which are sufficient to attract attention. But whether such experiments can ever be made with safety on the human body, is a point not easily determined. They might be allowed in desperate cases proceeding from a corruption of the blood, from poison, &c. as in hydrophobia.

TRANSIT, from *transit*, "it passes over," signifies the passage of any planet over the sun, moon, or stars.

TRANSITION, the passage of any thing from one place to another.

TRANSITION, in oratory. See ORATORY, n° 39.

TRANSITIVE, in grammar, an epithet applied to such verbs as signify an action which passes from the subject that does it, to or upon another subject which receives it. Under the head of verbs transitive come what we usually call *verbs active* and *passive*; other verbs, whose action does not pass out of themselves, are called *neuters*.

TRANSLATION, the act of transferring or removing a thing from one place to another; as we say, the translation of a bishop's see, a council, a seat of justice, &c.

TRANSLATION is also used for the version of a book or writing out of one language into another.

The principles of translation have been clearly and accurately laid down by Dr Campbell of Aberdeen in his invaluable Preliminary Dissertations to his excellent translations of the gospels. The fundamental rules which he establishes are three: 1. That the translation should give a complete transcript of the ideas of the original. 2. That the style and manner of the original should be preserved in the translation. 3. That the translation should have all the ease of original composition. The rules deducible from these general laws are explained and illustrated with much judgment and taste, in a late Essay on the Principles of Translation, by Mr Tytler, judge-advocate of Scotland.

TRANSMARINE, something that comes from or belongs to the parts beyond sea.

TRANSMIGRATION, the removal or translation of a whole people into another country, by the power of a conqueror.

TRANSMIGRATION is particularly used for the passage of the soul out of one body into another. See METEMPSYCHOSIS.

TRANSMUTATION, the act of changing one substance into another.

Nature, says Sir Isaac Newton, is delighted with transmutation: water, which is a fluid, volatile, tasteless salt, by heat, transmuted into vapour, which is a kind of air; and by cold into ice, which is a cold, transparent, brittle stone, easily dissoluble; and this stone is converted again into water by heat, as vapour is by cold.—Earth, by heat, becomes fire, and, by cold, is turned into earth again: dense bodies, by fermentation, are rarefied into various kinds of air; and that air, by fermentation also, and sometimes without it, reverts into gross bodies. All bodies, beasts, fishes, insects, plants, &c. with all their various parts, grow and increase out of water and aqueous and saline tinctures; and, by putrefaction, all of them revert into water, or an aqueous liquor again.

TRANSMUTATION, in alchemy, denotes the act of changing imperfect metals into gold or silver. This is also called the *grand operation*; and, they say, is to be effected with the philosopher's stone.

The trick of transmuting cinnabar into silver is thus: the cinnabar, being bruised grossly, is stratified in a crucible with granulated silver, and the crucible placed in a great fire; and, after due time for calcination, taken off; then the matter, being poured out, is found to be cinnabar turned into real silver, though the silver grains appear in the same number and form as when they were put into the crucible; but the mischief is, coming to handle the grains of silver, you find them nothing but light friable bladders, which will crumble to pieces between the fingers.

The transmutability of water into earth seems to have been believed by Mr Boyle; and Bishop Watson thinks that it has not yet been disproved. See his *Chemical Essays*.

TRANSMUTATION of Acids. See CHEMISTRY *Index*.

TRANSMUTATION of Metals. See CHEMISTRY-*Index*.

TRANSOM, among builders, denotes the piece that is framed across a double-light window.

TRANSOMS, in a ship, certain beams or timbers extended across the sternpost of a ship, to fortify her after-part, and give it the figure most suitable to the service for which she is calculated.

TRANSPARENCY, in physics, a quality in certain bodies, whereby they give passage to the rays of light; in contradistinction to opacity, or that quality of bodies which renders them impervious to the rays of light.

It has been generally supposed by philosophers, that transparent bodies have their pores disposed in straight lines, by which means the rays of light have an opportunity of penetrating them in all directions; but some experiments in electricity have made it apparent, that by the action of this fluid the most opaque bodies, such as sulphur, pitch, and sealing wax, may be rendered transparent as glass, while yet we cannot suppose the direction of their pores to be anyway altered from what it originally was (see ELECTRICITY, n° 4.) A curious instance of an increase of transparency we have in rubbing a piece of white paper over one that has been written upon or printed: while the white paper is at rest, the writing or print will perhaps scarce appear through it; but when in motion, will be very easily legible, and continue so till the motion is discontinued.

TRANSPOSITION, in grammar, a disturbing or dislo-

Tranfubftantiation. Trapp.

cating the words of a difcourfe, or a changing their natural order of conftruction, to pleafe the ear by rendering the contexture more fmooth, eafy, and harmonious.

TRANSUBSTANTIATION, in theology, the converfion or change of the fubftance of the bread and wine in the eucharift, into the body and blood of Jefus Chrift; which the Romifh church fuppofe to be wrought by the confecration of the prieft. See *Supper of the Lord*, n° 5.

TRANSVERSALIS, in anatomy, a name given to feveral mufcles. See Anatomy, Part II.

TRANSVERSE, fomething that goes acrofs another from corner to corner: thus bends and bars in heraldry are tranfverfe pieces or bearings; the diagonals of a parallelogram or a fquare are tranfverfe lines.

TRANSYLVANIA, a province of Europe, annexed to Hungary, and bounded on the north by Upper Hungary and Poland, on the eaft by Moldavia and Walachia, on the fouth by Walachia, and on the weft by Upper and Lower Hungary. It is furrounded on all parts by high mountains, which, however, are not barren. The inhabitants have as much corn and wine as they want themfelves; and there are rich mines of gold, filver, lead, copper, quickfilver, and alum. It has undergone various revolutions; but it now belongs to the houfe of Auftria. The inhabitants are of feveral forts of religions; as Papifts, Lutherans, Calvinifts, Socinians, Photinians, Arians, Greeks, and Mahometans. It is about 162 miles in length, and 150 in breadth. The adminiftration of affairs is conducted by 12 perfons; namely, three Roman Catholics, three Lutherans, three Calvinifts, and three Socinians. The militia is commanded by the governor, whofe commiffion is the more important, as Tranfylvania is the bulwark of Chriftendom. It is divided into feveral fmall diftricts, called *palatinates* and *counties*; and is inhabited by three different nations, Saxons, Sicilians, and Hungarians. Hermanftadt is the capital town.

TRAPEZIUM, in geometry, a plane figure contained under four unequal right lines.

TRAPEZIUS, a mufcle. See Anatomy, Part II.

TRAPP (Dr Jofeph), an Englifh divine of excellent parts and learning, was born at Cherington in Gloucefterfhire, of which place his father was rector in 1579. He was the firft perfon chofen to the profefforfhip of poetry founded at Oxford by Dr Birkhead; and publifhed his lectures under the title of *Prælectiones Poeticæ*, in which he laid down excellent rules for every fpecies of poetry in very elegant Latin. He fhowed afterwards, however, by his tranflation of Virgil, that a man may be able to direct who cannot execute, and may have the critic's judgment without the poet's fire. In the early part of his life Dr Trapp is faid to have been chaplain to the father of the famous Lord Bolingbroke: he obtained the living of Chrift-church in Newgate Street, and St Leonard's, Fofter-lane, London; and his very high-church principles probably obftructed his farther preferment. He publifhed feveral occafional poems, a tragedy called *Abramule*, tranflated Milton's Paradife Loft into Latin verfe, and died in 1747.

Trapp, in mineralogy, a fpecies of filiceous earth. It is defcribed by Dr Kirwan as nearly the fame with bafaltes: a dark grey or black ftone, generally invefted with a ferruginous cruft, and cryftallized in opake, triangular, or polyangular columns, is called *bafaltes*; that which is amorphous, or breaks in large, thick, fquare pieces, is called *trapp*. Their conftituent principles, and relation to acids and fluxes, are exactly the fame. The texture of this ftone is either coarfe, rough, and diftinct, or fine and indifcernible. It is often reddifh; it is always opake, and moulders by expofure to the air; fome fpecimens give fire with fteel very difficultly, though it is always very compact; fometimes it is fprinkled over with a few minute fhining particles: its fpecific gravity is 30 0.

When heated red hot, and quenched in water, it becomes by degrees of a reddifh brown colour: it melts per fe in a ftrong heat into a compact flag. Borax alfo diffolves it in fufion, but mineral alkali not entirely.

According to Sir Bergman, 100 parts of the bafaltes contain 52 of filiceous earth, 15 of argil, 8 of calcareous, 2 of magnefia, and 25 of iron; and with this Mr Meyer very nearly agrees.

For a more complete account of this fpecies of ftone, fee M Faujas de St Fond on the *Nat. Hift. of Trapp*.

TRAVELLERS joy. See Clematis.

TRAVERSE, or Transverse, in general, denotes fomething that goes athwart another; that is, croffes and cuts it obliquely.

Traverse, in navigation, implies a compound courfe, or an affemblage of various courfes, lying at different angles with the meridian. See Navigation, p. 688.

Traverse Board, a thin circular piece of board, marked with all the points of the compafs, and having eight holes bored in each, and eight fmall pegs hanging from the centre of the board. It is ufed to determine the different courfes run by a fhip during the period of the watch, and to afcertain the diftance of each courfe.

TRAVESTY, a name given to an humorous tranflation of any author. The word is derived from the French *travefter* "to difguife."

TRAUMATIC balsam. See Pharmacy, n° 428.

TREACLE. See Theriaca.—Some alfo give the name *treacle* to melaffes. See Pharmacy, n° 625.

Treacle Beer. See Spruce.

Treacle Muftard. See Clypeola.

Treafon.

TREASON, a general appellation, made ufe of by the law, to denote not only offences againft the king and government, but alfo that accumulation of guilt which arifes whenever a fuperior repofes a confidence in a fubject or inferior, between whom and himfelf there fubfifts a natural, a civil, or even a fpiritual relation; and the inferior fo abufes that confidence, fo forgets the obligations of duty, fubjection, and allegiance, as to deftroy the life of any fuch fuperior or lord. Hence treafon is of two kinds, *high* and *petty*.

High Treafon, or *Treafon Paramount* (which is equivalent to the *crimen læfæ majeftatis* of the Romans, as Glanvil denominates it alfo in our Englifh law), is an offence committed againft the fecurity of the king or kingdom, whether by imagination, word, or deed. In order to prevent the inconveniences which arofe in England from a multitude of conftructive treafons, the ftatute 25 Edw. III. c. 2. was made; which defines what offences only for the future fhould be held to be treafon; and this ftatute comprehends all kinds of high-treafon under feven diftinct branches.

"1. When a man doth compafs or imagine the death of our lord the king, of our lady his queen, or of their eldeft fon and heir." Under this defcription it is held that a queen-regnant (fuch as Queen Elizabeth and Queen Anne) is within the words of the act, being invefted with royal power, and intitled to the allegiance of her fubject: but the hufband of fuch a queen is not comprifed within thefe words; and therefore no treafon can be committed againft him.

Let us next fee what is a *compaffing* or *imagining* the death of the king, &c. Thefe are fynonymous terms: the word *compafs* fignifying the purpofe or defign of the mind or will; and not, as in common fpeech, the carrying fuch defign to effect. And therefore an accidental ftroke, which

may mortally wound the ſovereign, *per infortunium*, without any traitorous intent, is no treaſon: as was the caſe of Sir Walter Tyrrel, who, by the command of King William Rufus, ſhooting at a hart, the arrow glanced againſt a tree, and killed the king upon the ſpot. But as this compaſſing or imagination is an act of the mind, it cannot poſſibly fall under any judicial cognizance, unleſs it be demonſtrated by ſome open or overt act. The ſtatute expreſsly requires, that the accuſed "be thereof upon ſufficient proof attainted of ſome open act by men of his own condition." Thus, to provide weapons or ammunition for the purpoſe of killing the king, is held to be a palpable overt act of treaſon in imagining his death. To conſpire to impriſon the king by force, and move towards it by aſſembling company, is an overt act of compaſſing the king's death; for all force, uſed to the perſon of the king, in its conſequence may tend to his death, and is a ſtrong preſumption of ſomething worſe intended than the preſent force, by ſuch as have ſo far thrown off their bounden duty to their ſovereign: it being an old obſervation, that there is generally but a ſhort interval between the priſons and the graves of princes. It ſeems clearly to be agreed, that by the common law and the ſtatute of Edw. III. words ſpoken amount only to a high miſdemeanor, and no treaſon. For they may be ſpoken in heat, without any intention; or be miſtaken, perverted, or miſremembered by the hearers; their meaning depends always on their connection with other words and things; they may ſignify differently even according to the tone of voice with which they are delivered; and ſometimes ſilence itſelf is more expreſſive than any diſcourſe. As therefore there can be nothing more equivocal and ambiguous than words, it would indeed be unreaſonable to make them amount to high treaſon. And accordingly, in 4 Car. I. on a reference to all the judges, concerning ſome very atrocious words ſpoken by one Pyne, they certified to the king, "that though the words were as wicked as might be, yet they were no treaſon; for unleſs it be by ſome particular ſtatute, no words will be treaſon." If the words be ſet down in writing, it argues more deliberate intention; and it has been held, that writing is an overt act of treaſon; for *ſcribere eſt agere*. But even in this caſe the bare words are not the treaſon, but the deliberate act of writing them.

2. The ſecond ſpecies of treaſon is, "if a man do violate the king's companion, or the king's eldeſt daughter unmarried, or the wife of the king's eldeſt ſon and heir." By the king's companion is meant his wife; and by violation is underſtood carnal knowledge, as well without force as with it: and this is high treaſon in both parties if both be conſenting; as ſome of the wives of Henry VIII. by fatal experience evinced.

3. The third ſpecies of treaſon is, "if a man do levy war againſt our lord the king in his realm." And this may be done by taking arms, not only to dethrone the king, but under pretence to reform religion, or the laws, or to remove evil counſellors, or other grievances whether real or pretended. For the law does not, neither can it, permit any private man, or ſet of men, to interfere forcibly in matters of ſuch high importance; eſpecially as it has eſtabliſhed a ſufficient power for theſe purpoſes in the high court of parliament: neither does the conſtitution juſtify any private or particular reſiſtance for private or particular grievances; though, in caſes of national oppreſſion, the nation has very juſtifiably riſen as one man, to vindicate the original contract ſubſiſting between the king and his people.

4. "If a man be adherent to the king's enemies in his realm, giving to them aid and comfort in the realm or elſewhere," he is alſo declared guilty of high-treaſon. This muſt likewiſe be proved by ſome overt act; as by giving them intelligence, by ſending them proviſions, by ſelling them arms, by treacherouſly ſurrendering a fortreſs, or the like.

5. "If a man counterfeit the king's great or privy ſeal." this is alſo high-treaſon. But if a man takes wax bearing the impreſſion of the great ſeal off from one patent and fixes it to another, this is held to be only an abuſe of the ſeal, and not a counterfeiting of it: as was the caſe of a certain chaplain, who in ſuch a manner framed a diſpenſation for non-reſidence. But the knaviſh artifice of a lawyer much exceeded this of the divine. One of the clerks in chancery glued together two pieces of parchment; on the uppermoſt of which he wrote a patent, to which he regularly obtained the great ſeal, the label going through both the ſkins. He then diſſolved the cement, and taking off the written patent, on the blank ſkin, wrote a freſh patent of a different import from the former, and publiſhed it as true. This was held no counterfeiting of the great ſeal, but only a great miſpriſion; and Sir Edward Coke mentions it with ſome indignation that the party was living at that day.

6. The ſixth ſpecies of treaſon under this ſtatute is, "if a man counterfeit the king's money; and if a man bring falſe money into the realm counterfeit to the money of England, knowing the money to be falſe, to merchandiſe and make payment withal." As to the firſt branch, counterfeiting the king's money; this is treaſon, whether the falſe money be uttered in payment or not. Alſo if the king's own minters alter the ſtandard or alloy eſtabliſhed by law, it is treaſon. But gold and ſilver money only are held to be within this ſtatute. With regard likewiſe to the ſecond branch, importing foreign counterfeit money in order to utter it here; it is held that uttering it, without importing it, is not within the ſtatute.

7. The laſt ſpecies of treaſon aſcertained by this ſtatute is, "if a man ſlay the chancellor, treaſurer, or the king's juſtices of the one bench or the other, juſtices in eyre, or juſtices of aſſize, and all other juſtices aſſigned to hear and determine, being in their places doing their offices." Theſe high magiſtrates, as they repreſent the king's majeſty during the execution of their offices, are therefore for the time equally regarded by the law. But this ſtatute extends only to the actual killing of them; and not to wounding, or a bare attempt to kill them. It extends alſo only to the officers therein ſpecified; and therefore the barons of the exchequer, as ſuch, are not within the protection of this act; but the lord keeper or commiſſioners of the great ſeal now ſeem to be within it, by virtue of the ſtatutes 5 Eliz. c. 18. and 1 W. and M. c. 21.

The new treaſons, created ſince the ſtatute 1 Mar. c. 1. and not comprehended under the deſcription of ſtatute 25 Edw. III. may be compriſed under three heads. The firſt ſpecies relates to Papiſts; the ſecond to falſifying the coin or other royal ſignatures, as falſifying the king's ſign manual, privy ſignet, or privy ſeal, which ſhall be deemed high treaſon (1 M. ſtat. ii. c. 6.) The third new ſpecies of high treaſon is ſuch as was created for the ſecurity of the Proteſtant ſucceſſion in the houſe of Hanover. For this purpoſe, after the act of ſettlement was made, it was enacted by ſtatute 13 and 14 W. III. c. 3. that the pretended prince of Wales, aſſuming the title of King James III. ſhould be attainted of high treaſon; and it was made high-treaſon for any of the king's ſubjects to hold correſpondence with him or any perſon employed by him, or to remit money for his uſe. And by 17 Geo. II. c. 39. it is enacted, that if any of the ſons of the pretender ſhall land or attempt to land in this kingdom, or be found in the kingdom or any of its dominions, he ſhall be adjudged attainted of high-treaſon and ſuf-

Treason. corresponding with them or remitting money to their use is made high treason. By 1 Ann. stat. 2. c. 17. the offence of hindering the next in succession from succeeding to the crown is high treason: and by 6 Ann. c. 7. if any person shall maliciously, advisedly, and directly, by writing or printing, maintain, that any other person hath any right to the crown of this realm, otherwise then according to the act of settlement, or that the kings of this realm with the authority of parliament are not able to make laws to bind the crown and its descent; such person shall be guilty of high-treason.

The punishment of high treason in general is very solemn and terrible. 1. That the offender be drawn to the gallows, and not be carried or walk; though usually (by connivance, at length ripened by humanity into law) a sledge or hurdle is allowed, to preserve the offender from the extreme torment of being dragged on the ground or pavement. 2. That he be hanged by the neck, and then cut down alive. 3. That his entrails be taken out, and burned while he is yet alive. 4. That his head be cut off. 5. That his body be divided into four parts. 6. That his head and quarters be at the king's disposal.

The king may, and often doth, discharge all the punishment except beheading, especially where any of noble blood are attainted. For beheading being part of the judgment, that may be executed, though all the rest be omitted by the king's command. But where beheading is no part of the judgment, as in murder or other felonies, it hath been said that the king cannot change the judgment, although at the request of the party, from one species of death to another.

In the case of coining, which is a treason of a different complexion from the rest, the punishment is milder for male offenders; being only to be drawn and hanged by the neck till dead. But in treasons of every kind the punishment of women is the same, and different from that of men. For as the natural modesty of the sex forbids the exposing and publicly mangling their bodies, their sentence (which is to the full as terrible to sense as the other) is to be drawn to the gallows, and there to be burned alive.

For the consequences of this judgment, see ATTAINDER, FORFEITURE, and *CORRUPTION of Blood*.

Petty or *Petit Treason*, according to the statute 25 Edward III. c. 2. may happen three ways: by a servant killing his master, a wife her husband, or an ecclesiastical person (either secular or regular) his superior, to whom he owes faith and obedience. A servant who kills his master whom he has left, upon a grudge conceived against him during his service, is guilty of petty treason: for the traiterous intention was hatched while the relation subsisted between them, and this is only an execution of that intention. So if a wife be divorced *a mense et thoro*, still the *vinculum matrimonii* subsists; and if she kills such divorced husband, she is a traitress. And a clergyman is understood to owe canonical obedience to the bishop who ordained him, to him in whose diocese he is beneficed, and also to the metropolitan of such suffragan or diocesan bishop; and therefore to kill any of these is petit treason. As to the rest, whatever has been said with respect to wilful MURDER, is also applicable to the crime of petit treason, which is no other than murder in its most odious degree; except that the trial shall be as in cases of high treason, before the improvements therein made by the statutes of William III. But a person indicted of petit treason may be acquitted thereof, and found guilty of manslaughter or murder: and in such case it should seem that two witnesses are not necessary, as in cases of petit treason they are. Which crime is also distinguished from murder in its punishment.

The punishment of petit treason in a man, is to be drawn and hanged, and in a woman to be drawn and burned: the idea of which latter punishment seems to have been handed down to us from the laws of the ancient Druids, which condemned a woman to be burned for murdering her husband; and it is now the usual punishment for all sorts of treasons committed by those of the female sex. Persons guilty of petit treason were first debarred the benefit of clergy by statute 12 Henry VII. c. 7. which has since been extended to their aiders, abettors, and counsellors, by statutes 23 Henry VIII. c. 1. and 4 & 5 P. and M. c. 4,

TREASURE, in general, denotes a store or stock of money in reserve.

TREASURE-Trove, in law, derived from the French word *trover*, "to find." called in Latin *thesaurus inventus*, is where any money or coin, gold, silver, plate, or bullion, is found hidden in the earth or other private place, the owner thereof being unknown; in which case the treasure belongs to the king: but if he that hid it be known, or afterwards found out, the owner and not the king is intitled to it.

TREASURER, an officer to whom the treasure of a prince or corporation is committed to be kept and duly disposed of, in payment of officers and other expences. See TREASURY.

Of these there is a great variety. His majesty of Great Britain, in quality of elector of Brunswick, is arch-treasurer of the Roman empire. In England, the principal officers under this denomination are, the lord high-treasurer, the treasurer of the houshold, treasurer of the navy, of the king's chamber, &c.

The lord high-treasurer of Great Britain, or first commissioner of the treasury, when in commission, has under his charge and government all the king's revenue which is kept in the exchequer. He holds his place during the king's pleasure; being instituted by the delivery of a white staff to him. He has the check of all the officers employed in collecting the customs and royal revenues: and in his gift and disposition are all the offices of the customs in the several ports of the kingdom; escheators in every county are nominated by him; he also makes leases of the lands belonging to the crown.

The office of lord-treasurer is now in commission. The number of lords-commissioners is five; one of whom is the first lord, whose annual salary was formerly L. 383, but is now L. 4000; and who, unless he be a peer, is also chancellor of the exchequer, and prime minister in the government of this country; the other lords commissioners have an annual salary of L. 1600 each.

TREASURER of the Houshold, is an officer who, in the absence of the lord-steward, has power, with the comptroller and other officers of the green-cloth and the steward of the Marshalsea, to hear and determine treasons, felonies, and other crimes committed within the king's palace. See HOUSHOLD.

There is also a treasurer belonging to the establishment of her majesty's houshold, &c.

TREASURER of the Navy, is an officer who receives money out of the exchequer, by warrant from the lord high-treasurer, or the lords commissioners executing that place; and pays all charges of the navy, by warrant from the principal officers of the navy.

TREASURER of the County, he that keeps the county stock. There are two of them in each county, chosen by the major part of the justices of the peace, &c. at their general quarter session; under previous security given for the money entrusted with them, and the faithful execution of the trusts reposed in them.

TREASURY, the place wherein the revenues of a prince are

are received, preferred, and difburfed. In England the treafury is a part of the exchequer; by fome called the *lower exchequer*. The officers of his majefty's treafury, or the lower exchequer, are the lords commiffioners, one of whom is chancellor, two joint fecretaries, private fecretary to the firft lord, two chamberlains, an auditor, four tellers, a clerk of the pells, ufhers of the receipt, a tally-cutter, &c. See each officer under his proper article, CHANCELLOR, TELLER, TALLY, &c.

Lords of the TREASURY. In lieu of one fingle director and adminiftrator of his majefty's revenues under the title of *lord high treafurer*, it is at prefent thought proper to put that office in commiffion, *i. e.* to appoint feveral perfons to difcharge it with equal authority, under the title of *lords commiffioners of the treafury*.

TREATISE, a fet difcourfe in writing on any fubject.

TREATY, a covenant between two or more nations; or the feveral articles or conditions ftipulated and agreed upon between fovereign powers.

TREBLE, in mufic, the higheft or moft acute of the four parts in fymphony, or that which is heard the cleareft and fhrilleft in a concert.

TREBUCHET, TREBUCKET, *Tribuch* (*Terbichetum*), a tumbrel or cucking ftool. Alfo a great engine to caft ftones to batter walls.

TREE, a large vegetable rifing with one woody ftem to a confiderable height.

Trees may be divided into two claffes, *timber* and *fruit-trees*; the firft including all thofe trees which are ufed in machinery, fhip-building, &c. or, in general, for purpofes of utility; and the fecond comprehending thofe trees valued only, or chiefly, for their fruit. It is not neceffary to form a third clafs to include trees ufed for fuel, as timber is ufed for this purpofe where it is abundant; and where it is not abundant the branches of the timber trees, or fuch of them as are dwarfifh, unhealthy, or too fmall for mechanical purpofes, are ufed as fuel.

The anatomy and phyfiology of trees have already been given under the generic name PLANT and SAP. For an account of their natural hiftory, fee NATURAL HISTORY, fect. iii.

Certain trees, it is well known, are natives of particular diftricts; but many of them have been tranfplanted from their native foil, and now flourifh luxuriantly in diftant countries, fo that it becomes a matter of very confiderable difficulty to afcertain their original foil. The following rules are given for this purpofe by the Honourable Daines Barrington.

1. They muft grow in large maffes, and cover confiderable tracts of ground, the woods not ending abruptly, by a change to other trees, except the fituation and ftrata become totally different. 2. They muft grow kindly in copfes, and fhoot from the ftool, fo as to continue for ever, if not very carefully grubbed up. 3. The feed muft ripen kindly; nature never plants, but where a fucceffion in the greateft profufion will continue. Laftly, trees that give names to many places are probably indigenous.

The growth of trees is a curious and interefting fubject; yet few experiments have been made to determine what the additions are which a tree receives annually in different periods of its age. The only obfervations which we have feen on this fubject worth repeating were made by the ingenious Mr Barker, to whom the Philofophical Tranfactions are much indebted for papers containing an accurate regifter of the weather, which he has kept for many years. He has drawn up a table to point out the growth of three kinds of trees, oaks, afhes, and elms; which may be feen in the Philofophical Tranfactions for 1788. We fhall give his conclufions.

"I find (fays he) the growth of oak and afh to be nearly the fame. I have fome of both forts planted at the fame time, and in the fame hedges, of which the oaks are the largeft; but there is no certain rule as to that. The common growth of an oak or an afh is about an inch in girth in a year: fome thriving ones will grow an inch and a half; the unthriving ones not fo much. Great trees grow more timber in a year than fmall ones; for if the annual growth be an inch, a coat of one-fixth of an inch is laid on all round, and the timber added to the body every year is its length multiplied into the thicknefs of the coat and into the girth, and therefore the thicker the tree is, the more timber is added."

We will prefent our readers with a table, fhowing the growth of 17 kinds of trees for two years. The trees grew at Cavenham in Suffolk.

N°		July 1755. F.	In.		July 1756. F.	In.		July 1757. F.	In.
1	Oak	0	10½	—	0	11½	—	1	0½
2	Larch	1	0½	—	1	3	—	1	4
3	Scotch fir	1	3½	—	1	5½	—	1	7½
4	Spruce fir	0	5½	—	0	6½	—	0	7½
5	Spanifh chefnut	0	7½	—	0	7½	—	0	8
6	Elm	2	7½	—	2	9	—	2	11
7	Pinafter	2	3½	—	2	4½	—	2	7½
8	Larch	1	5½	—	1	6	—	1	7
9	Weymouth pine	0	5	—	0	6	—	0	7½
10	Acacia	1	2½	—	1	5¾	—	1	6½
11	Beech	0	6½	—	0	6½	—	0	7½
12	Plane occidental	0	6½	—	0	7¼	—	0	8½
13	Lombardy poplar	1	8	—	2	0	—	2	3½
14	Black poplar	1	2½	—	1	4½	—	1	5½
15	Willow	2	9½	—	3	2	—	3	3
16	Silver fir	0	7½	—	0	8½	—	0	9½
17	Lime	1	8½	—	1	10¾	—	2	0

See HUSBANDRY, n° 165, where the growth of 11 kinds of trees in 21 years is given.

Trees fometimes attain a very great fize: this muft depend in a great meafure on the richnefs of foil, but no lefs on the degree of heat. Indeed heat is fo effential to the growth of trees, that as we go from the place within the polar circles where vegetation begins, and advance to the equator, we find the trees increafe in fize. Greenland, Iceland, and other places in the fame latitude, yield no trees at all; and the fhrubs which they produce are dwarfifh; whereas, in warm climates, they often grow to an immenfe fize. Mr Marfham faw fpruce and filver-firs in the dockyard in Venice above 40 yards long, and one of 39 yards was 18 inches diameter at the fmall end. He was informed that they came from Switzerland.

The largeft tree in Europe, mentioned by travellers, is the chefnut tree on mount Etna, already defcribed under the article ETNA, n° 18. It is a certain fact that trees acquire a very great fize in volcanic countries. Befide the multitude of fine groves in the neighbourhood of Albano in Italy, there are many detached oaks 20 feet in circumference, and many elms of the fame fize, efpecially in the romantic way to Nemi, called the *Galleria*. In travelling by the fide of the lake of Bolfena, the road leads us through an immenfe number of oaks, fpread upon beautiful hills. Where the lava has been fufficiently foftened, they are clean and ftraight, and of a confiderable fize; but where the lava has not been converted into a foil proper for ftrong vegetation, they are round-headed, and of lefs bignefs; however, taken all together, they make a magnificent appearance.

Tree

Tree.

ance; and the spot itself ought to ranked among the fine parts of Italy. The same may be observed of the small lake of Vico, encompassed with gentle risings, that are all clothed with forest trees.

Some yews have been found in Britain 60 feet round. Palms in Jamaica attain the height of 200 feet; and some of the pines in Norfolk Island are [illegible] feet high.

Of all the different kinds known in Europe, oak is best for building; and even when it lies exposed to air and water, there is none equal to it. Fir-timber is the next in degree of goodness for building, especially in England, where they build upon leases. It differs from oak in this, that it requires not much seasoning, and therefore no great stock is required beforehand. Fir is used for flooring, wainscoting, and the ornamental parts of building within doors. Elm is the next in use, especially in England and France: it is very tough and pliable, and therefore easily worked: it does not readily split; and it bears driving of bolts and nails better than any other wood; for which reason it is chiefly used by wheelwrights and coach makers, for shafts, naves, &c. Beech is also used for many purposes: it is very tough and white when young, and of great strength; but liable to warp very much when exposed to the weather, and to be worm-eaten when used within doors; its greatest use is for planks, bedsteads, chairs, and other household goods. Ash is likewise a very useful wood, but very scarce in most parts of Europe; it serves in buildings, or for any other use, when screened from the weather; handspikes and oars are chiefly made of it. Wild chesnut timber is by many esteemed to be as good as oak, and seems to have been much used in old buildings; but whether these trees are more scarce at present than formerly, or have been found not to answer so well as was imagined, it is certain that this timber is now but little used. Walnut-tree is excellent for the joiner's use, it being of a more curious brown colour than beech, and not so subject to the worms. The poplar, abel, and aspen trees, which are very little different from each other, are much used instead of fir; they look well, and are tougher and harder. See QUERCUS, OAK, PINUS, ULMUS, PLATANUS, POPULUS, &c.

The goodness of timber not only depends on the soil and situation in which it stands, but likewise on the season wherein it is felled. In this people disagree very much; some are for having it felled as soon as its fruit is ripe, others in the spring, and many in the autumn. But as the sap and moisture of timber is certainly the cause that it perishes much sooner than it otherwise would do, it seems evident, that timber should be felled when there is the least sap in it, *viz.* from the time that the leaves begin to fall till the trees begin to bud. This work usually commences about the end of April in England, because the bark then rises most freely; for where a quantity of timber is to be felled, the statute requires it to be done then, for the advantage of tanning. The ancients chiefly regarded the age of the moon in felling their timber; their rule was to fell it in the wane, or four days after the new moon, or sometimes in the last quarter. Pliny advises it to be in the very instant of the change; which happening to be in the last day of the winter solstice, the timber, says he, will be incorruptible.

Timber should likewise be cut when of a proper age; for when it is either too young or too old, it will not be so durable as when cut at a proper age. It is said that oak should not be cut under 60 years old, nor above 200. Timber, however, should be cut in its prime, when almost fully grown, and before it begins to decay; and this will be sooner or later according to the dryness and moistness of the soil where the timber grows, as also according to the bigness of the trees; for there are no fixed rules in felling of timber, experience and judgment must direct here as in most other cases.

Great attention is necessary in the seasoning of timber. Some advise the planks of timber to be laid for a few days in some pool or running stream, in order to extract the sap, and afterwards to dry them in the sun or air. By this means, it is said, they will be prevented from either chopping, casting, or cleaving; but against shrinking there is no remedy. Some again are for burying them in the earth, others in a heat; and some for scorching and seasoning them in fire, especially piles, posts, &c. which are to stand in water or earth. The Venetians first found out the method of seasoning by fire: which is done after this manner: they put the piece to be seasoned into a strong and violent flame; in this they continually turn it round by means of an engine, and take it out when it is everywhere covered with a black coaly crust; the internal part of the wood is thereby so hardened, that neither earth nor water can damage it for a long time afterwards.

Dr Plott says, it is found by long experience, that the trunk or body of the trees, when barked in the spring, and left standing naked all the summer exposed to the sun and wind, are so dried and hardened, that the sappy part in a manner becomes as firm and durable as the heart itself. This is confirmed by M. Buffon, who, in 1738, presented to the royal academy of sciences at Paris a memoir, intitled, "An easy method of increasing the solidity, strength, and duration of timber;" for which purpose he observes, "nothing more is necessary than to strip the tree entirely of its bark during the season of the rising of the sap, and to leave it to dry completely before it be cut down."

By many experiments, particularly described in that essay, it appears, that the tree should not be felled till the third year after it has been stripped of the bark; that it is then perfectly dry, and the sap become almost as strong as the rest of the timber, and stronger than the heart of any other oak tree which has not been so stripped; and the whole of the timber stronger, heavier, and harder; from which he thinks it fair to conclude, that it is also more durable. "It would no longer (he adds) be necessary, if this method were practised, to cut off the sap; the whole of the tree might be used as timber; one of 40 years growth would serve all the purposes for which one of 60 years is now required; and this practice would have the double advantage of increasing the quantity, as well as the strength and solidity, of the timber."

The navy board, in answer to the inquiries of the commissioners of the land revenue, in May 1789, informed them, thay they had then standing some trees stripped of their bark two years before, in order to try the experiment of building one half of a sloop of war with that timber, and the other half with timber felled and stripped in the common way. This very judicious mode of making the experiment, if it be properly executed, will undoubtedly go far to ascertain the effects of this practice. We are sorry that we are not able to inform our readers what was the result of the experiment.

After the planks of timber have been well seasoned and fixed in their places, care is to be taken to defend or preserve them; to which the smearing them with linseed oil, tar, or the like oleaginous matter, contributes much. The ancients, particularly Hesiod and Virgil, advise the smoke-drying of all instruments made of wood, by hanging them up in the chimneys where wood-fires are used. The Dutch preserve their gates, portcullices, drawbridges, sluices, &c. by coating them over with a mixture of pitch and tar, whereon they strew small pieces of cockle and other shells,

beaten

beaten almost to powder, and mixed with sea sand, which incrusts and arms them wonderfully against all attacks of wind and weather. When timber is felled before the sap is perfectly at rest, it is very subject to worms; but to prevent and cure this, Mr Evelyn recommends the following remedy as the most approved: Put common sulphur into a cucurbit, with as much aquafortis as will cover it three fingers deep; distil it to dryness, which is performed by two or three rectifications. Lay the sulphur that remains at bottom, being of a blackish or sandred colour, on a marble, or put it in a glass, and it will dissolve into an oil; with this oil anoint the timber which is infected with worms. This, he says, will not only prevent worms, but preserve all kinds of woods, and many other things, as ropes, nets, and masts, from putrefaction, either in water, air, or snow.

An experiment to determine the comparative durability of different kinds of timber, when exposed to the weather, was made by a nobleman in Norfolk; of which an account is given by Sir Thomas Beevor. This nobleman, in the year 1774, ordered three posts, forming two sides of a quadrangle, to be fixed in the earth on a rising ground in his park. Into these posts were mortised planks, an inch and an half thick, cut out of trees from 30 to 45 years growth. These, after standing 10 years, were examined, and found in the following state and condition:

The cedar was perfectly sound; larch, the heart sound, but the sap quite decayed; spruce fir, sound; silver fir, in decay; Scotch fir, much decayed; pinlaster, quite rotten; chesnut, perfectly sound; abele, sound; beech, sound; walnut, in decay; sycamore, much decayed; birch, quite rotten. Sir Thomas Beevor justly remarks, that the trees ought to have been of the same age; and Mr Arthur Young adds, they ought to have been cut out of the same plantation.

The immense quantity of timber consumed of late years in ship-building and other purposes has diminished in a very great degree the quantity produced in this country. On this account, many gentlemen who wish well to their country, alarmed with the fear of a scarcity, have strongly recommended it to government to pay some attention to the cultivation and preservation of timber.

We find, on the best authority, that of Mr Irving inspector general of imports and exports, that the shipping of England in 1760 amounted to 6,107 in number, the tonnage being 433,922; and the shipping in Scotland amounted to 976 in number, the tonnage being 52,818. In 1788 the whole shipping of Britain and Ireland and their colonies amounted to 13,800, being 1,359,752 tons burden, and employing 107,925 men. The tonnage of the royal navy in the same year was 413,667. We are informed also, on what we consider as the best authority (the report of the commissioners of the land revenue), that the quantity of oak timber, of English growth, delivered into the dockyards from 1760 to 1788 was no less than 768,676 loads, and that the quantity used in the merchants yards in the same time was 516,630 loads; in all 1,285,306 loads. The foreign oak used in the same period was only 137,766 loads. So that, after deducting the quantity remaining in the dockyards in 1760 and 1788, and the foreign oak, there will remain about 1,054,284 loads of English oak, consumed in 28 years, which is at an average 37,653 loads *per annum*, besides from 8,000 to 10,000 loads expended annually by the East India company within the same period (A). Tree.

The price of wood has risen in proportion to the demand and to its diminution. At the conquest, woods were valued, not by the quantity of timber which they contained, but the number of swine which the acorns could support. In 1608, oak in the forests was sold at 10s. *per* load, and fire-wood for 2s. *per* load. In 1663 or 1665, in navy contracts from L. 2 to 2l. 15s. 6d. *per* load was given. In 1756 it rose to 4l. 5s *per* load, and 3s. in addition, because no tops are received. Plank four inch sold in 1769 for L. 7 a load, three inch L. 6, which prices were the same in 1792.

So great an expenditure of valuable timber within so short a period, gives reason to fear that the forests of this country will soon be entirely dismantled, unless something is done to raise fresh supplies. The building of a 70 gun ship, it is said, would take 40 acres of timber. This calculation is indeed so excessive, that it is scarcely credible. This, however, is no exaggeration. According to the prevailing opinion of experienced surveyors, it will require a good soil and good management to produce 40 trees on an acre, which, in a hundred years, may, at an average, be computed at two loads each. Reckoning, therefore, two loads at 8l. 16s. one acre will be worth L. 350, and consequently 40 acres will only be worth L. 14,200. Now a 70 gun ship is generally supposed to cost L. 70,000; and as ships do not last a great many years, the navy continually requires new ships, so that the forests must be stripped in a century or two, unless young trees are planted to supply their place.

Many plans have been proposed for recruiting the forests. Premiums have been held forth to individuals; and it has been proposed that the crown-lands should be set a part for the special purpose of raising timber. With respect to individuals, as they must generally be disposed to sow or plant their lands with those vegetables which will best reward their labours, it is not to be expected that they will set apart their fields for planting trees unless they have a greater return from them than other crops. But bad must that land be which will not yield much more than L. 350 produce in 100 years. But though it be evident that good land will produce crops much more lucrative to the proprietor than timber, yet still there are lands or pieces of land which might be applied with very great advantage to the production of wood. Uneven ground, or the sides of fields where corn cannot be cultivated, might very properly be set apart for this purpose; barren lands, or such as cannot be cultivated without great labour and expence, might also be planted. Hedge-rows and clumps of trees, and little woods scattered up and down, would shelter and defend the fields from destructive winds, would beautify the face of the country, render the climate warmer, improve barren lands, and furnish wood for the arts and manufactures.

But to cultivate forest timber has also been thought of such national importance, that it has been deemed worthy of the attention of government. It has been proposed to appropriate such part of the crown-lands as are fit for the purpose solely for producing timber for the navy. This appears a very proper scheme in speculation: but it has been objected, that for government to attempt the farming of forests would be really to establish groups of officers to pocket salaries for doing what, it is well known, will never be

(A) A writer in the Bath Transactions says, that the aggregate of oaks felled in England and Wales for 30 years past hath amounted to 320,000 loads a-year; and affirms that he has documents in his possession founded on indisputable facts. The difference between this account, and that which we have given in the text from the report of the commissioners, we leave to be reconciled by those who have proper opportunities. We give the facts merely on the authority of others.

Tree

be done at all. But to this objection we reply, that such an agreement might be made with the inspectors of forests, as to make it their own interest to cultivate trees with as much care as possible. Their salary might be fixed very low, and raised in proportion to the number of trees which they could furnish of such a size in a certain number of years. After all, we must acknowledge, that we must depend greatly on Russia, Sweden, Norway, and America, for supplying us with timber; and while these countries take our manufactures in exchange, we have no reason to complain. Still, however, we ought surely not to neglect the cultivation of what is of so much importance to our existence as a nation, for it may often be impossible in time of war to obtain timber from foreign countries.

In the beginning of this article we mentioned the general division of trees into timber or forest-trees and fruit trees. We have already said all that our limits will permit respecting the former; we will now, therefore, say something of the latter. Our observations shall be confined to the methods of preserving fruit trees in blossom from the effects of frost, and from other diseases to which they are liable.

Journal de Physique, March 1791.

The chevalier de [illegible] of France, we are told, has discovered a method of effectually preserving trees in blossom from the fatal effects of those frosts which sometimes in the spring destroy the most promising hopes of a plentiful crop of fruit. His method is extremely simple. He surrounds the trunk of the tree in blossom with a wisp of straw or hemp. The end of this he sinks, by means of a stone tied to it, in a vessel of spring water, at a little distance from the tree. One vessel will conveniently serve two trees; or the cord may be lengthened so as to surround several, before its end is plunged into the water. It is necessary that the vessel be placed in an open situation, and by no means shaded by the branches of the neighbouring trees, that the frost may produce all its effect on the water, by means of the cord communicating with it.—This precaution is particularly necessary for those trees the flowers of which appear nearly at the same time as the leaves; which trees are peculiarly exposed to the ravages of the frost. The proofs of its efficacy, which he had an opportunity of observing in the spring of 1787, were remarkably striking. Seven apricot espaliers in his garden began to blossom in the month of March. Fearing that they would suffer from the late frosts, he surrounded them with cords as above directed. In effect, pretty sharp frosts took place six or eight nights: the apricot-trees in the neighbouring gardens were all frozen, and none of them produced any fruit, whilst each of the chevalier's produced fruit in abundance, which came to the greatest perfection.

The following is the method proposed by Mr William Forsyth for curing injuries and defects in trees; for which a reward was given to him by his majesty, on condition that he should make it public. It is equally applicable to forest as to fruit trees (B).

Take one bushel of fresh cow-dung, half a bushel of lime rubbish of old buildings (that from the ceilings of rooms is preferable); half a bushel of wood ashes; and a sixteenth part of a bushel of pit or river sand. The three last articles are to be sifted fine before they are mixed; then work them well together with a spade, and afterwards with a wooden beater, until the stuff is very smooth, like fine plaster used for the ceilings of rooms. The composition being thus made, care must be taken to prepare the tree properly for its application by cutting away all the dead, decayed, and injured parts, till you come to the fresh sound wood, leaving the surface of the wood very smooth, and rounding off the edges of the bark with a draw-knife, or other instrument, perfectly smooth, which must be particularly attended to. Then lay on the plaster about one-eighth of an inch thick all over the part where the wood or bark has been so cut away, finishing off the edges as thin as possible. Then take a quantity of dry powder of wood-ashes, mixed with a sixth part of the same quantity of the ashes of burnt bones; put it into a tin box, with holes in the top, and shake the powder on the surface of the plaster, till the whole is covered over with it, letting it remain for half an hour to absorb the moisture; then apply more powder, rubbing it on gently with the hand, and repeating the application of the powder, till the whole plaster becomes a dry smooth surface.

All trees cut down near the ground should have the surface made quite smooth, rounding it off in a small degree, as before mentioned; and the dry powder directed to be used afterwards should have an equal quantity of powder of alabaster mixed with it, in order the better to resist the dripping of trees and heavy rains. If any of the composition be left for a future occasion, it should be kept in a tub or other vessel, and urine of any kind poured on it, so as to cover the surface; otherwise the atmosphere will greatly hurt the efficacy of the application. Where lime-rubbish of old buildings cannot be easily got, take powdered chalk, or common lime, after having been slaked a month at least. As the growth of the tree will gradually affect the plaster, by raising up its edges next the bark, care should be taken, where that happens, to rub it over with the finger when occasion may require (which is best done when moistened by rain), that the plaster may be kept whole, to prevent the air and wet from penetrating into the wound.

By this process, some old worn-out pear trees, that bore only a few small, hard fruit, of a kernelly texture, were made to produce pears of the best quality and finest flavour the second summer after the operation; and in four or five years they bore such plenteous crops, as a young healthy tree would not have produced in four times that period.

By this process, too, some large ancient elms, in a most decayed state, having all their upper parts broken, and a small portion only of the bark remaining, shot out stems from their tops, above thirty feet in height, in six or seven years from the first application of the composition.

Thus may valuable fruits be renovated; and forest trees, which are useful or ornamental from their particular situation, be preserved in a flourishing state. But what is far more interesting, a perfect cure has been made, and sound timber produced, in oak trees, which had received very considerable damage from blows, bruises, cutting of deep letters, the rubbing off the bark by the ends of rollers, or wheels of carts, or from the breaking of branches by storms.

TREFOIL, in botany. See TRIFOLIUM.

TREMELLA, in botany; a genus of plants belonging to the class of *cryptogamia*, and natural order of *algæ*. It is

(B) A paste for covering the wounds of trees, and the place where grafts are inserted, was discovered long ago. It is recommended in a treatise on Fruit Trees, published by Thomas Hitt in 1755; a third edition of which, with additions, was published in 1768. It consists of a mixture of clay and cows-dung diluted with water. This paste he directs to be laid on the wound with a brush: it adheres firmly, lies on without cracking till the wound heals. We are informed by a gentleman, to whose opinion and experience we pay great respect, that this paste answers every purpose which Mr Forsyth's can serve.

is a gelatinous [illegible] substance; the parts of the fructification scarcely visible. There are 11 species; of which five are indigenous; the nostoc, lichenoides, verrucosa, hemisphærica, and purpurea.

1. The *nostoc*, or jelly rain tremella, is found in pastures and by the sides of gravel walks in gardens after rain; not uncommon in spring, summer, and autumn. It is a membranaceous, pellucid, and gelatinous substance, without any visible root; of a yellowish dull green colour; assuming various forms, either round, angular, plaited or folded together irregularly, like the intestines, or a pocket handkerchief, an inch or two or more in diameter: soft to the touch when moist; but thin, membranaceous, and brittle, when dry; and of a black fuscous colour.—The ancient alchemists called this vegetable *the flowers of heaven*, and imagined that from it they would procure the universal menstruum: but all their researches ended in discovering that by distillation it yielded some phlegm, volatile salt, and empyreumatic oil. It has been extolled in wounds, ulcers, &c. but no regard is ever paid to it by judicious practitioners. Dr Darwin says, he has been well informed that this tremella is a mucilage evolved by herons after they have eaten frogs!! 2. The *lichenoides*, or transparent tremella, is erect, plane, margin curled, laciniated, and brown. It grows on heaths and in woods, &c. 3. *Verrucosa*, or warty tremella, is tubercular, solid, wrinkled, roundish, and resembling a bladder: it is of a blackish yellow. It grows on stones in rivulets. 4. *Hemisphærica*, or sea tremella, is scattered among confervæ, fuci, &c. 5. *Purpurea*, or purple tremella, is globular, sessile, solitary, and smooth. It grows on ditch-banks about London.

TREMELLIUS (Emmanuel), a Jew by birth, was born at Ferrara in the year 1510. He was so carefully educated as to become a great master of the Hebrew tongue: he was converted to Christianity by the celebrated Peter Martyr. After travelling to Germany and England, he was made professor of Hebrew, first at Heidelberg, and then at Sedan, where he died in 1580. He translated the Hebrew Bible and Syriac Testament into Latin; in the former he was assisted by Junius, who afterwards corrected the second edition in 1587. This work was received by the Protestant churches with great approbation.

TREMOR, an involuntary shaking, chiefly of the hands and head, sometimes of the feet, and sometimes of the tongue and heart.—Tremors arising from a too free use of spirituous liquors require the same treatment as palsies.

TRENCHES, in fortification, are ditches cut by the besiegers, that they may approach the more securely to the place attacked; whence they are also called *lines of approach*.

TRENT (bishopric of), a province of Germany, in the circle of Austria, near the frontiers of Italy, is bounded on the north by Tirol; on the east, by the Feltrino and Bellunese; on the south, by Vicentino, the Veronese, Bresciano, and the lake de Garda; and on the west, by the Bresciano and the lake de Garda. The soil is said to be pretty fruitful, and to abound in wine and oil.

TRENT, a city of Germany, and capital of the bishopric of that name, is a very ancient place, and stands in a fertile and pleasant plain, in the midst of the high mountains of the Alps. The river Adige washes its walls, and creeping for some time among the hills, runs swiftly into Italy. Trent has three considerable churches, the principal of which is the cathedral: this is a very regular piece of architecture. The church of St Maria Major is all of red and white marble; and is remarkable for being the place where the famous council of Trent was held, whose decisions are now the [illegible] of the Romish church. [illegible]

TRENT, one of the [illegible] rivers in England, [illegible] in the Moorland of Staffordshire, [illegible] Newcastle-under-Line; and [illegible] in two parts, runs to Burton, [illegible] Newark; and so continues [illegible] Gainsborough on the confines of Lincolnshire, it joins several rivers, and falls into the Humber.

TRENT, council of, [illegible] council assembled by Paul III. in 15[illegible] 25 sessions till the year 1563, [illegible] in order to correct, illustrate, and fix with perspicuity, the doctrine of the church, to restore the vigour of its discipline, and to reform the [illegible] of its pastors. [illegible] this council, together with the creed of pope Pius IV. contain a summary of the doctrines of the Roman Catholics. These decrees were subscribed by 25[illegible] clergy, consisting of 4 legates, 2 other cardinals, 3 patriarchs, 25 archbishops, 1[illegible] bishops, besides inferior clergy. Of these [illegible] Italy; of course the council was entirely under the influence of the pope. For a more particular account of the council of Trent, see *Mosheim's Church History*, the *Modern Universal History*, Vol. XXIII. and *Father Paul's History of the Council of Trent*.

TRENTON. See *New Jersey*.

TREPANNING. See SURGERY, n° 156.

TRES TABERNÆ (anc. geog.), a place in Latium, lying on the Via Appia, on the left or south side of the river Astura, to the north of the Paludes Pomptinæ. Its ruins are now seen near Cisterna, a village in the Compagna di Roma, 21 miles from Rome, whence the Christians went out to meet St Paul.

TRESPASS, in law, signifies any transgression of the law, under treason, felony, or misprision of either: but it is commonly used for any wrong or damage that is done by one private person to another, or to the king in his forest.

TRESSLE-TREES, in ship-building, two strong bars of timber fixed horizontally on the opposite sides of the lower mast-head, to support the frame of the top and the weight of the top-mast.

TRESSURE, in heraldry, a diminutive of an orle, usually held to be half the breadth thereof.

TRET, in commerce, an allowance made for the waste or the dirt that may be mixed with any commodity; which is commonly four pounds in every 104 pounds weight.

TREVERI, or TREVIRI (anc. geog.), an ancient and a powerful people both in horse and foot, according to Cæsar; extending far and wide between the Meuse and the Rhine. Their chief town was called *Treveris*. Now *Triers* or *Treves*.

TREVES, or TRIERS (in Latin *Trevere*, *Trevers*, *Treveris*, or *Augusta Trevirorum*), the capital of a German archbishopric of the same name, stands [illegible] miles west of Mentz, 52 south of Cologne, and 82 north of Strasburg. This city vies with most in Europe for antiquity, having been a large and noted town before Augustus settled a colony in it. It was free and imperial till the year 15[illegible]0, when it was surprised and subjected by its archbishop James III. It stands on the Moselle, over which it has a fair stone bridge. The cathedral is a large building; and near it stands the elector's palace, which not long ago was rebuilt. Here are three collegiate and five parish churches, three colleges of Jesuits, thirteen monasteries and nunneries, an university founded in 1472, a house of the Teutonic order, and another of that of Malta, with some remains of the ancient Roman theatre. Roman coins and medals are often found in

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the ruins of the old city. In the cathedral they pretend to have our Saviour's coat and St Peter's staff, to which they ascribe miracles. The private houses here are mean; and the city is neither well fortified nor inhabited. E. Long. 6. 51. N. Lat. 49. 45.

TRIAL, in law, the examination of a cause according to the laws of the land before a proper judge; or it is the manner and order observed in the hearing and determining of causes.

Trials are either civil or criminal.

I. *Civil Trials*. The species of trials in civil cases are seven: By *record*; by *inspection*, or examination; by *certificate*; by *witnesses*; by wager of *battel*; by wager of *law*; and by *jury*. The first six are only had in certain special or eccentrical cases, where the trial by jury would not be so proper or effectual: (See them explained under their respective titles). The nature of the last, that principal criterion of truth in the law of England, shall be explained in this article.

As trial by jury is esteemed one of the most important privileges which members of society can enjoy, and the bulwark of the British constitution, every man of reflection must be stimulated by the desire of inquiring into its origin and history, as well as to be acquainted with the forms and advantages by which it is accompanied. We will therefore begin with tracing it to its origin. Its institution has been ascribed to our Saxon ancestors by Sir William Blackstone.

Blackstone's Commentaries, vol. iii. p. 349.

"Some authors (says that illustrious lawyer) have endeavoured to trace the original of juries up as high as the Britons themselves, the first inhabitants of our island; but certain it is, that they were in use among the earliest Saxon colonies, their institution being ascribed by bishop Nicholson to Woden himself, their great legislator and captain. Hence it is, that we may find traces of juries in the laws of all those nations which adopted the feodal system, as in Germany, France, and Italy; who had all of them a tribunal composed of twelve good men and true, *boni homines*, usually the vassals or tenants of the lord, being the equals or peers of the parties litigant; and, as the lord's vassals judged each other in the lord's courts, so the king's vassals, or the lords themselves, judged each other in the king's court. In England we find actual mention of them so early as the laws of king Ethelred, and that not as a new invention. Stiernhook ascribes the invention of the jury, which in the Teutonic language is denominated *nembda*, to Regner king of Sweden and Denmark, who was contemporary with our king Egbert. Just as we are apt to impute the invention of this, and some other pieces of juridical polity, to the superior genius of Alfred the Great; to whom, on account of his having done much, it is usual to attribute every thing: and as the tradition of ancient Greece placed to the account of their own Hercules whatever atchievement was performed superior to the ordinary prowess of mankind. Whereas the truth seems to be, that this tribunal was universally established among all the northern nations, and so interwoven in their very constitution, that the earliest accounts of the one give us also some traces of the other."

This opinion has been controverted with much learning and ingenuity by Dr Pettingal in his Enquiry into the Use and Practice of Juries among the Greeks and Romans, who deduces the origin of juries from these ancient nations.

He begins with determining the meaning of the word δικασαι in the Greek, and *judices* in the Roman, writers. "The common acceptation of these words (says he), and the idea generally annexed to them, is that of *presidents of courts*, or, as we call them, *judges*; as such they are understood by commentators, and rendered by critics. Dr Middleton, in his life of Cicero, expressly calls the judices, *judges of the bench*: and Archbishop Potter, and in short all modern writers upon the Greek or Roman orators, or authors in general, express δικασαι and *judices* by such terms as convey the idea of *presidents in courts of justice*. The propriety of this is doubted of, and hath given occasion for this inquiry; in which is shown, from the best Greek and Roman authorities, that neither the δικασαι of the Greeks, or the *judices* of the Romans, ever signified *presidents in courts of judicature*, or *judges of the bench*; but, on the contrary, they were distinguished from each other, and the difference of their duty and function was carefully and clearly pointed out by the orators in their pleadings, who were the best authorities in those cases, where the question related to forms of law, and methods of proceeding in judicial affairs and criminal process.

The presidents of the courts in criminal trials at Athens were the nine archons, or chief magistrates, of which whoever presided was called ηγεμον δικαστηριυ, or president of the court. These nine presided in different causes peculiar to each jurisdiction. The archon, properly so called, had belonging to his department all pupillary and heritable cases; the βασιλευς or *rex sacrorum*, the chief priest, all cases where religion was concerned; the polemarchus, or general, the affairs of the army and all military matters; and the six, the thesmothetæ, the other ordinary suits.

Wherever then the ανδρες δικασαι, or judicial men, are addressed by the Greek orators in their speeches, they are not to be understood to be the presiding magistrates, but another class of men, who were to inquire into the state of the cause before them, by witnesses and other methods of coming at truth; and after inquiry made and witnesses heard, to report their opinion and verdict to the president, who was to declare it.

The several steps and circumstances attending this judicial proceeding are so similar to the forms observed by our jury, that the learned reader, for such I must suppose him, cannot doubt but that the nature, intent, and proceedings of the δικασαι among the Greeks were the same with the English jury; namely, for the protection of the lower people from the power and oppression of the great, by administering equal law and justice to all ranks; and therefore when the Greek orators directed their speeches to the ανδρες δικασαι, as we see in Demosthenes, Æschines, and Lysias, we are to understand it in the same sense as when our lawyers at the bar say, *Gentlemen of the jury*.

So likewise among the Romans, the *judices*, in their pleadings at the bar, never signified judges of the bench, or presidents of the court, but a body or order of men, whose office in the courts of judicature was distinct from that of the prætor or *judex quæstionis*, which answered to our judge of the bench, and was the same with the archon, or ηγεμων δικαστηριυ, of the Greeks: whereas the duty of the judices consisted in being impannelled, as we call it, challenged, and swore to try uprightly the case before them; and when they had agreed upon their opinion or verdict, to deliver it to the president who was to pronounce it. This kind of judicial process was first introduced into the Athenian polity by Solon, and thence copied into the Roman republic, as probable means of procuring just judgment, and protecting the lower people from the oppression or arbitrary decisions of their superiors.

When the Romans were settled in Britain as a province, they carried with them their *jura* and *instituta*, their laws and customs, which was a practice essential to all colonies; hence the Britons, and other countries of Germany and Gaul, learned from them the Roman laws and customs; and upon the irruption of the northern nations into the southern kingdoms of Europe, the laws and institutions of the Romans remained, when the power that introduced them was with-

withdrawn: and Montesquieu tells us, that under the first race of kings in France, about the fifth century, the Romans that remained, and the Burgundians their new neighbours, lived together under the same Roman laws and police, and particularly the same forms of judicature. How reasonable then is it to conclude, that in the Roman courts of judicature continued among the Burgundians, the form of a jury remained in the same state it was used at Rome. It is certain, Montesquieu, speaking of those times, mentions the *paires* or *hommes de fief*, homagers or peers, which in the same chapter he calls *juges*, judges or jurymen: so that we hence see how at that time the *hommes de fief*, or "men of the fief," were called *peers*, and those peers were *juges* or jurymen. These were the same as are called in the laws of the confessor *pers de la tenure*, the "peers of the tenure, or homagers," out of whom the jury of peers were chosen, to try a matter in dispute between the lord and his tenant, or any other point of controversy in the manor. So likewise in all other parts of Europe, where the Roman colonies had been, the Goths succeeding them, continued to make use of the same laws and institutions, which they found to be established there by the first conquerors. This is a much more natural way of accounting for the origin of a jury in Europe, than having recourse to the fabulous story of Woden and his savage Scythian companions, as the first introducers of so humane and beneficent an institution."

Trials by jury in civil causes are of two kinds; *extraordinary* and *ordinary*.

1. The first species of *extraordinary* trial by jury is that of the grand assise, which was instituted by king Henry II. in parliament, by way of alternative offered to the choice of the tenant or defendant in a writ of right, instead of the barbarous and unchristian custom of duelling. For this purpose a writ *de magna assisa eligenda* is directed to the sheriff, to return four knights, who are to elect and choose 12 others to be joined with them; and these all together form the grand assise, or great jury, which is to try the matter of right, and must now consist of 16 jurors. Another species of extraordinary juries is the jury to try an attaint; which is a process commenced against a former jury for bringing a false verdict. See the article ATTAINT.

2. With regard to the *ordinary* trial by jury in civil cases, the most clear and perspicuous way of treating it will be by following the order and course of the proceedings themselves.

When therefore an issue is joined by these words, "And this the said A prays may be inquired of by the country;" or, "And of this he puts himself upon the country, and the said B does the like;" the court awards a writ of *venire facias* upon the roll or record, commanding the sheriff "that he cause to come here, on such a day, twelve free and lawful men, *liberos et legales homines*, of the body of his county, by whom the truth of the matter may be better known, and who are neither of kin to the aforesaid A nor the aforesaid B, to recognize the truth of the issue between the said parties." And such writ is accordingly issued to the sheriff. It is made returnable on the last return of the same term wherein issue is joined, *viz.* hilary or trinity terms; which, from the making up of the issues therein, are usually called *issuable terms*. And he returns the names of the jurors in a panel (a little pane or oblong piece of parchment) annexed to the writ. This jury is not summoned, and therefore not appearing at the day must unavoidably make default. For which reason a compulsive process is now awarded against the jurors, called in the common pleas a writ of *habeas corpora juratorum*, and in the King's Bench a *distringas*, commanding the sheriff to have their bodies, or to distrain them by their lands and goods, that they may appear upon the day appointed. The entry therefore on the roll or record is, "That the jury is respited, through defect of the jurors, till the first day of the next term, then to appear at Westminster; unless before that time, *viz.* on Wednesday the fourth of March, the justices of our lord the king appointed to take assises in that county shall have come to Oxford, that is, to the place assigned for holding the assizes. Therefore the sheriff is commanded to have their bodies at Westminster on the said first day of next term, or before the said justices of assize, if before that time they come to Oxford, *viz.* on the fourth of March aforesaid." And as the judges are sure to come and open the circuit commissions on the day mentioned in the writ, the sheriff returns and summons this jury to appear at the assizes; and there the trial is had before the justices of assize and *nisi prius*: among whom (as hath been said*) are usually two of the judges of the courts at Westminster, the whole kingdom being divided into six circuits for this purpose. And thus we may observe, that the trial of common issues, at *nisi prius*, was in its original only a collateral incident to the original business of the justices of assize; though now, by the various revolutions of practice, it is become their principal civil employment; hardly any thing remaining in use of the real assizes but the name.

If the sheriff be not an indifferent person, as if he be a party in the suit, or be related by either blood or affinity to either of the parties, he is not then trusted to return the jury; but the *venire* shall be directed to the coroners, who in this, as in many other instances, are the substitutes of the sheriff to execute process when he is deemed an improper person. If any exception lies to the coroners, the *venire* shall be directed to two clerks of the court, or two persons of the county named by the court, and sworn. And these two, who are called *elisors*, or electors, shall indifferently name the jury, and their return is final; no challenge being allowed to their array.

Let us now pause a while, and observe (with Sir Matthew Hale†), in these first preparatory stages of the trial, how admirably this constitution is adapted and framed for the investigation of truth beyond any other method of trial in the world. For, first, the person returning the jurors is a man of some fortune and consequence; that so he may be not only the less tempted to commit wilful errors, but likewise be responsible for the faults of either himself or his officers: and he is also bound by the obligation of an oath faithfully to execute his duty. Next, as to the time of their return: the panel is returned to the court upon the original *venire*, and the jurors are to be summoned and brought in many weeks afterwards to the trial, whereby the parties may have notice of the jurors, and of their sufficiency or insufficiency, characters, connections, and relations, that so they may be challenged upon just cause; while, at the same time, by means of the compulsory process (of *distringas*, or *habeas corpora*) the cause is not like to be retarded through defect of jurors. Thirdly, as to the place of their appearance: which in causes of weight and consequence is at the bar of the court; but in ordinary cases at the assizes, held in the county where the cause of action arises, and the witnesses and jurors live: a provision most excellently calculated for the saving of expence to the parties. For, though the preparation of the causes in point of pleading is transacted at Westminster, whereby the order and uniformity of proceeding is preserved throughout the kingdom, and multiplicity of forms is prevented; yet this is no great charge or trouble, one attorney being able to transact the business of 40 clients. But the troublesome and most expensive attendance is that of jurors and witnesses at the trial; which therefore is brought home to them, in the

county where moſt of them inhabit. Secondly, the perſons before whom they are to appear, and before whom the trial is to be held, are the judges of the ſuperior court, if it be a trial at bar; or the judges of aſſize, delegated from the courts at Weſtminſter by the king, if the trial be held in the country: perſons, whoſe learning and dignity ſecure their juriſdiction from contempt, and the novelty and very parade of whoſe appearance have no ſmall influence upon the multitude. The very point of their being ſtrangers in the county is of infinite ſervice, in preventing thoſe factions and parties which would intrude in every cauſe of moment, were it tried only before perſons reſident on the ſpot, as juſtices of the peace, and the like. And the better to remove all ſuſpicion of partiality, it was wiſely provided by the ſtatutes 4 Edw. III. c. 2. 8 Ric. II. c. 2. and 33 Hen. VIII. c. 24. that no judge of aſſize ſhould hold pleas in any county wherein he was born or inhabits. And as this conſtitution prevents party and faction from intermingling in the trial of right, ſo it keeps both the rule and the adminiſtration of the laws uniform. Theſe juſtices, though thus varied and ſhifted at every aſſizes, are all ſworn to the ſame laws, have had the ſame education, have purſued the ſame ſtudies, converſe and conſult together, communicate their deciſions and reſolutions, and preſide in thoſe courts which are mutually connected, and their judgments blended together, as they are interchangeably courts of appeal or advice to each other. And hence their adminiſtration of juſtice, and conduct of trials, are conſonant and uniform; whereby that confuſion and contrariety are avoided, which would naturally ariſe from a variety of uncommunicating judges, or from any provincial eſtabliſhment. But let us now return to the aſſizes.

When the general day of trial is fixed, the plaintiff or his attorney muſt bring down the record to the aſſizes, and enter it with the proper officer, in order to its being called on in courſe.

Theſe ſteps being taken, and the cauſe called on in court, the record is then handed to the judge, to peruſe and obſerve the pleadings, and what iſſues the parties are to maintain and prove, while the jury is called and ſworn. To this end the ſheriff returns his compulſive proceſs, the writ of *habeas corpora*, or *diſtringas*, with the panel of jurors annexed, to the judge's officer in court.

The jurors contained in the panel are either ſpecial or common jurors. Special juries were originally introduced in trials at bar, when the cauſes were of too great nicety for the diſcuſſion of ordinary freeholders; or where the ſheriff was ſuſpected of partiality, though not upon ſuch apparent cauſe as to warrant an exception to him. He is in ſuch caſes, upon motion in court, and a rule granted thereupon, to attend the prothonotary or other proper officer with his freeholder's book; and the officer is to take indifferently 48 of the principal freeholders, in the preſence of the attorneys on both ſides: who are each of them to ſtrike off 12, and the remaining 24 are returned upon the panel. By the ſtatute 3 Geo. II. c. 25. either party is entitled upon motion to have a ſpecial jury ſtruck upon the trial of any iſſue, as well at the aſſizes as at bar, he paying the extraordinary expence, unleſs the judge will certify (in purſuance of the ſtatute 24 Geo. II. c. 18.) that the cauſe required ſuch ſpecial jury.

A common jury is one returned by the ſheriff according to the directions of the ſtatute 3 Geo. II. c. 25. which appoints, that the ſheriff or officer ſhall not return a ſeparate panel for every ſeparate cauſe, as formerly; but one and the ſame panel for every cauſe to be tried at the ſame aſſizes, containing not leſs than 48, nor more than 72, jurors: and that their names being written on tickets, ſhall be put into a box or glaſs, and when each cauſe is called, 12 of theſe perſons whoſe names ſhall be firſt drawn out of the box, ſhall be ſworn upon the jury, unleſs abſent, challenged, or excuſed; or unleſs a previous view of the meſſuages, lands, or place in queſtion, ſhall have been thought neceſſary by the court; in which caſe ſix or more of the jurors returned, to be agreed on by the parties, or named by a judge or other proper officer of the court, ſhall be appointed by ſpecial writ of *habeas corpora* or *diſtringas*, to have the matters in queſtion ſhewn to them by two perſons named in the writ; and then ſuch of the jury as have had the view, or ſo many of them as appear, ſhall be ſworn on the inqueſt previous to any other jurors. Theſe acts are well calculated to reſtrain any ſuſpicion of partiality in the ſheriff, or any tampering with the jurors when returned.

As the jurors appear when called, they ſhall be ſworn, unleſs challenged by either party. See the article Challenge.

If by means of challenges or other cauſe, a ſufficient number of unexceptionable jurors doth not appear at the trial, either party may pray a *tales*.

A *tales* is a ſupply of ſuch men as are ſummoned upon the firſt panel, in order to make up the deficiency. For this purpoſe a writ of *decem tales*, *octo tales*, and the like, was wont to be iſſued to the ſheriff at common law, and muſt be ſtill ſo done at a trial at bar, if the jurors make default. But at the aſſizes, or *niſi prius*, by virtue of the ſtatute 35 Hen. VIII. c. 6. and other ſubſequent ſtatutes, the judge is empowered at the prayer of either party to award a *tales de circumſtantibus* of perſons preſent in court, to be joined to the other jurors to try the cauſe; who are liable, however, to the ſame challenges as the principal jurors. This is uſually done till the legal number of 12 be completed; in which patriarchal and apoſtolical number Sir Edward Coke hath diſcovered abundance of myſtery.

When a ſufficient number of perſons impanelled, or talesmen appear, they are then ſeparately ſworn, well and truly to try the iſſue between the parties, and a true verdict to give according to the evidence; and hence they are denominated "the jury," *jurata*, and "jurors," *ſc. juratores*.

The jury are now ready to hear the merits; and to fix their attention the cloſer to the facts which they are impanelled and ſworn to try, the pleadings are opened to them by counſel on that ſide which holds the affirmative of the queſtion in iſſue. For the iſſue is ſaid to lie, and proof is always firſt required upon that ſide which affirms the matter in queſtion: in which our law agrees with the civil, *ei incumbit probatio qui dicit, non qui negat; cum per rerum naturam factum negantis probatio nulla ſit*. The opening counſel briefly informs them what has been tranſacted in the court above; the parties, the nature of the action, the declaration, the plea, replication, and other proceedings; and laſtly, upon what point the iſſue is joined, which is there ſent down to be determined. Inſtead of which, formerly the whole record and proceſs of the pleadings were read to them in Engliſh by the court, and the matter of iſſue clearly explained to their capacities. The nature of the caſe, and the evidence intended to be produced, are next laid before them by counſel alſo on the ſame ſide; and when their evidence is gone through, the advocate on the other ſide opens the adverſe caſe, and ſupports it by evidence; and then the party which began is heard by way of reply. See Pleadings.

Evidence in the trial by jury is of two kinds; either that which is given in proof, or that which the jury may receive by their own private knowledge. The former, or *proofs*, (to which in common ſpeech the name of evidence is uſually confined) are either written or parol; that is, by word of mouth.

mouth. Written proofs, or evidence, are, 1. Records; and 2. Ancient deeds of thirty years standing, which prove themselves; but, 3. Modern deeds, and, 4. Other writings, must be attested and verified by parol evidence of witnesses. With regard to parol evidence or witnesses; it must first be remembered, that there is a process to bring them in by writ of *subpoena ad testificandum*: which commands them, laying aside all pretences and excuses, to appear at the trial on pain of 100l. to be forfeited to the king: to which the statute 5 Eliz. c. 9. has added a penalty of 10l. to the party aggrieved, and damages equivalent to the loss sustained by want of his evidence. But no witness, unless his reasonable expences be tendered him, is bound to appear at all; nor, if he appears, is he bound to give evidence till such charges are actually paid him; except he resides within the bills of mortality, and is summoned to give evidence within the same. This compulsory process, to bring in unwilling witnesses, and the additional terrors of an attachment in case of disobedience, are of excellent use in the thorough investigation of truth: and, upon the same principle, in the Athenian courts, the witnesses who were summoned to attend the trial had their choice of three things: either to swear to the truth of the fact in question, to deny or abjure it, or else to pay a fine of 1000 drachmas.

All witnesses, of whatever religion or country, that have the use of their reason, are to be received and examined, except such as are infamous, or such as are interested in the event of the cause. All others are competent witnesses; though the jury from other circumstances will judge of their credibility. Infamous persons are such as may be challenged as jurors, *propter delictum*: and therefore never shall be admitted to give evidence to inform that jury, with whom they were too scandalous to associate. Interested witnesses may be examined upon a *voir dire*, if suspected to be secretly concerned in the event; or their interest may be proved in court. Which last is the only method of supporting an objection to the former class; for no man is to be examined to prove his own infamy. And no counsel, attorney, or other person, intrusted with the secrets of the cause by the party himself, shall be compelled, or perhaps allowed, to give evidence of such conversation or matters of privacy as came to his knowledge by virtue of such trust and confidence: but he may be examined as to mere matters of fact, as the execution of a deed or the like, which might have come to his knowledge without being intrusted in the cause.

One witness (if credible) is sufficient evidence to a jury of any single fact: though undoubtedly the concurrence of two or more corroborates the proof. Yet our law considers that there are many transactions to which only one person is privy; and therefore does not always demand the testimony of two. Positive proof is always required, where, from the nature of the case, it appears it might possibly have been had. But, next to positive proof, circumstantial evidence, or the doctrine of presumptions, must take place: for when the fact itself cannot be demonstratively evinced, that which comes nearest to the proof of the fact is the proof of such circumstances which either necessarily or usually attend such facts; and these are called *presumptions*, which are only to be relied upon till the contrary be actually proved.

The oath administered to the witness is not only that what he deposes shall be true, but that he shall also depose the whole truth: so that he is not to conceal any part of what he knows, whether interrogated particularly to that point or not. And all this evidence is to be given in open court, in the presence of the parties, their attorneys, the counsel, and all bystanders; and before the judge and jury: each party having liberty to except to its competency, which exceptions are publicly stated, and by the judge are openly and publicly allowed or disallowed, in the face of the country: which must curb any secret bias or partiality, that might arise in his own breast.

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When the evidence is gone through on both sides, the judge, in the presence of the parties, the counsel, and all others, sums up the whole to the jury; omitting all superfluous circumstances, observing wherein the main question and principal issue lies, stating what evidence has been given to support it, with such remarks as he thinks necessary for their direction, and giving them his opinion in matters of law arising upon that evidence.

The jury, after the proofs are summed up, unless the case be very clear, withdraw from the bar to consider of their verdict; and in order to avoid intemperance and causeless delay, are to be kept without meat, drink, fire, or candle, unless by permission of the judge, till they are unanimously agreed. A method of accelerating unanimity not wholly unknown in other constitutions of Europe, and in matters of greater concern. For by the golden bull of the empire, if, after the congress is opened, the electors delay the election of a king of the Romans for thirty days, they shall be fed only with bread and water till the same is accomplished. But if our juries eat or drink at all, or have any eatables about them, without consent of the court, and before verdict, it is fineable; and if they do so at his charge for whom they afterwards find, it will set aside the verdict. Also, if they speak with either of the parties or their agents after they are gone from the bar, or if they receive any fresh evidence in private, or if, to prevent disputes, they cast lots for whom they shall find, any of these circumstances will entirely vitiate the verdict. And it has been held, that if the jurors do not agree in their verdict before the judges are about to leave the town, though they are not to be threatened or imprisoned, the judges are not bound to wait for them, but may carry them round the circuit from town to town in a cart. This necessity of a total unanimity seems to be peculiar to our own constitution; or at least, in the *nembda* or jury of the ancient Goths, there was required (even in criminal cases) only the consent of the major part; and in case of an equality, the defendant was held to be acquitted.

When they are all unanimously agreed, the jury return back to the bar; and before they deliver their verdict, the plaintiff is bound to appear in court, by himself, attorney, or counsel, in order to answer the amercement to which by the old law he is liable, in case he fails in his suit, as a punishment for his false claim. To be amerced, or *a misericordia*, is to be at the king's mercy with regard to the fine to be imposed; *in misericordia domini regis pro falso clamore suo*. The amercement is disused, but the form still continues; and if the plaintiff does not appear, no verdict can be given; but the plaintiff is said to be nonsuit, *non sequitur clamorem suum*. Therefore it is usual for a plaintiff, when he or his counsel perceives that he has not given evidence sufficient to maintain his issue, to be voluntarily nonsuited, or withdraw himself: whereupon the crier is ordered to call the plaintiff; and if neither he, nor any body for him, appears, he is nonsuited, the jurors are discharged, the action is at an end, and the defendant shall recover his costs. The reason of this practice is, that a nonsuit is more eligible for the plaintiff, than a verdict against him: for after a nonsuit, which is only a default, he may commence the same suit again for the same cause of action; but after a verdict had, and judgment consequent thereupon, he is for ever barred from attacking the defendant upon the same ground of complaint. But in case the plaintiff appears, the jury by their foreman deliver in their verdict.

Trial.

A verdict, *vere dictum*, is either privy or public. A privy verdict is when the judge hath left or adjourned the court: and the jury, being agreed, in order to be delivered from their confinement, obtain leave to give their verdict privily to the judge out of court: which privy verdict is of no force, unless afterwards affirmed by a public verdict given openly in court; wherein the jury may, if they please, vary from their privy verdict. So that the privy verdict is indeed a mere nullity; and yet it is a dangerous practice, allowing time for the parties to tamper with the jury, and therefore very seldom indulged. But the only effectual and legal verdict is the public verdict: in which they openly declare to have found the issue for the plaintiff, or for the defendant; and if for the plaintiff, they assess the damages also sustained by the plaintiff, in consequence of the injury upon which the action is brought.

When the jury have delivered in their verdict, and it is recorded in court, they are then discharged; and so ends the trial by jury: a trial which ever has been, and it is hoped ever will be, looked upon as the glory of the English law. It is certainly the most transcendant privilege which any subject can enjoy or wish for, that he cannot be affected either in his property, his liberty, or his person, but by the unanimous consent of 12 of his neighbours and equals. A constitution that we may venture to affirm has, under providence, secured the just liberties of this nation for a long succession of ages. And therefore a celebrated French writer‡, who concludes, that because Rome, Sparta, and Carthage, have lost their liberties, therefore those of England in time must perish, should have recollected, that Rome, Sparta, and Carthage, at the time when their liberties were lost, were strangers to the trial by jury.

‡ Montesq. Sp. L. xi. 6.

Great as this eulogium may seem, it is no more than this admirable constitution, when traced to its principles, will be found in sober reason to deserve.

The impartial administration of justice, which secures both our persons and our properties, is the great end of civil society. But if that be entirely entrusted to the magistracy, a select body of men, and those generally selected by the prince or such as enjoy the highest offices in the state, their decisions, in spite of their own natural integrity, will have frequently an involuntary bias towards those of their own rank and dignity: it is not to be expected from human nature, that the few should be always attentive to the interests and good of the many. On the other hand, if the power of judicature were placed at random in the hands of the multitude, their decisions would be wild and capricious, and a new rule of action would be every day established in our courts. It is wisely therefore ordered, that the principles and axioms of law, which are general propositions flowing from abstracted reason, and not accommodated to times or to men, should be deposited in the breasts of the judges, to be occasionally applied to such facts as come properly ascertained before them. For here partiality can have little scope; the law is well known, and is the same for all ranks and degrees: it follows as a regular conclusion from the premisses of fact pre-established. But in settling and adjusting a question of fact, when intrusted to any single magistrate, partiality and injustice have an ample field to range in, either by boldly asserting that to be proved which is not so, or more artfully by suppressing some circumstances, stretching and warping others, and distinguishing away the remainder. Here therefore a competent number of sensible and upright jurymen, chosen by lot from among those of the middle rank, will be found the best investigators of truth, and the surest guardians of public justice. For the most powerful individual in the state will be cautious of committing any flagrant invasion of another's right, when he knows that the fact of his oppression must be examined and decided by 12 indifferent men not appointed till the hour of trial; and that when once the fact is ascertained, the law must of course redress it. This therefore preserves in the hands of the people that share which they ought to have in the administration of public justice, and prevents the encroachments of the more powerful and wealthy citizens.

Trial

Criminal TRIALS. The regular and ordinary method of proceeding in the courts of criminal jurisdiction may be distributed under 12 general heads, following each other in a progressive order: viz. 1. Arrest; 2. Commitment and bail; 3. Prosecution; 4. Process; 5. Arraignment, and its incidents; 6. Plea, and issue; 7. Trial, and conviction; 8. Clergy; 9. Judgment, and its consequences; 10. Reversal of judgment; 11. Reprieve, or pardon; 12. Execution. See ARREST, COMMITMENT, PRESENTMENT, INDICTMENT, INFORMATION, APPEAL, *PROCESS upon an Indictment*, ARRAIGNMENT, and PLEA; in which articles all the forms which precede the trial are described, and are here enumerated in the proper order.

The several methods of trial and conviction of offenders, established by the laws of England, were formerly more numerous than at present, through the superstition of our Saxon ancestors; who, like other northern nations, were extremely addicted to divination; a character which Tacitus observes of the ancient Germans. They therefore invented a considerable number of methods of purgation or trial, to preserve innocence from the danger of false witnesses, and in consequence of a notion that God would always interpose miraculously to vindicate the guiltless; as, 1. By ORDEAL; 2. By CORSNED; 3. By BATTEL. See these articles.

4. A fourth method is that by the *peers of Great Britain*, in the *Court of PARLIAMENT*; or the *Court of the Lord High STEWARD*, when a peer is capitally indicted; for in case of an appeal, a peer shall be tried by jury. This differs little from the trial *per patriam*, or by jury; except that the peers need not all agree in their verdict; and except also, that no special verdict can be given in the trial of a peer; because the lords of parliament, or the lord high steward (if the trial be had in his court), are judges sufficiently competent of the law that may arise from the fact; but the greater number, consisting of 12 at the least, will conclude, and bind the minority.

The trial by jury, or the country, *per patriam*, is also that trial by the peers of every Briton, which, as the great bulwark of his liberties, is secured to him by the great charter: *nullus liber homo capiatur, vel imprisonetur, aut exulet, aut aliquo alio modo destruatur, nisi per legale judicium parium suorum, vel per legem terræ*.

When therefore a prisoner on his ARRAIGNMENT has pleaded not guilty, and for his trial hath put himself upon the country, which country the jury are, the sheriff of the county must return a panel of jurors, *liberos et legales homines, de viceneto;* that is, freeholders without just exception, and of the *visne* or neighbourhood; which is interpreted to be of the county where the fact is committed. If the proceedings are before the court of king's bench, there is time allowed between the arraignment and the trial, for a jury to be impanelled by writ of *venire facias* to the sheriff, as in civil causes; and the trial in case of a misdemeanor is had at *nisi prius*, unless it be of such consequence as to merit a trial at bar; which is always invariably had when the prisoner is tried for any capital offence. But, before commissioners of oyer and terminer and gaol-delivery, the sheriff, by virtue of a general precept directed to him beforehand, returns to the court a panel of 48 jurors, to try all felons that may be called upon their trial at that session; and therefore it is there usual to try all felons immediately or soon after their ar-

arraignment. But it is not customary, nor agreeable to the general course of proceedings, unless by consent of parties, to try persons indicted of smaller misdemesnors at the same court in which they have pleaded not guilty, or traversed the indictment. But they usually give security to the court to appear at the next assises or session, and then and there to try the traverse, giving notice to the prosecutor of the same.

In cases of high-treason, whereby corruption of blood may ensue (except treason in counterfeiting the king's coin or seals), or misprision of such treason, it is enacted by statute 7 W. III. c. 3. first, that no person shall be tried for any such treason, except an attempt to assassinate the king, unless the indictment be found within three years after the offence committed: next, that the prisoner shall have a copy of the indictment (which includes the caption), but not the names of the witnesses, five days at least before the trial, that is, upon the true construction of the act, before his arraignment; for then is his time to take any exceptions thereto, by way of plea or demurrer: thirdly, that he shall also have a copy of the pannel of jurors two days before his trial: and, lastly, that he shall have the same compulsive process to bring in his witnesses for him, as was usual to compel their appearance against him. And by statute 7 Ann. c. 21. (which did not take place till after the decease of the late pretender) all persons indicted for high-treason, or misprisions thereof, shall have not only a copy of the indictment, but a list of all the witnesses to be produced, and of the jurors impanelled, with their professions and places of abode, delivered to him ten days before the trial, and in the presence of two witnesses, the better to prepare him to make his challenges and defence. And no person indicted for felony is, or (as the law stands) ever can be, entitled to such copies before the time of his trial.

When the trial is called on, the jurors are to be sworn as they appear, to the number of 12, unless they are challenged by the party.

Challenges may here be made, either on the part of the king, or on that of the prisoner; and either to the whole array, or to the separate polls, for the very same reasons that they may be made in civil causes. But in criminal cases, or at least in capital ones, there is, *in favorem vitæ*, allowed to the prisoner an arbitrary and capricious species of challenge, to a certain number of jurors, without showing any cause at all; which is called a *peremptory* challenge; a provision full of that tenderness and humanity to prisoners for which our English laws are justly famous. This is grounded on two reasons. 1. As every one must be sensible what sudden impressions and unaccountable prejudices we are apt to conceive upon the bare looks and gestures of another; and how necessary it is that a prisoner (when put to defend his life) should have a good opinion of his jury, the want of which might totally disconcert him; the law wills not that he should be tried by any one man against whom he has conceived a prejudice, even without being able to assign a reason for such his dislike. 2. Because, upon challenges for cause shown, if the reason assigned prove insufficient to set aside the juror, perhaps the bare questioning his indifference may sometimes provoke a resentment; to prevent all ill consequences from which, the prisoner is still at liberty, if he pleases, peremptorily to set him aside.

The peremptory challenges of the prisoner must, however, have some reasonable boundary; otherwise he might never be tried. This reasonable boundary is settled by the common law to be the number of 35; that is, one under the number of three full juries.

If by reason of challenges or the default of the jurors, a sufficient number cannot be had of the original pannel, a tales may be awarded as in civil causes, till the number of 12 is sworn, "well and truly to try, and true deliverance make, between our sovereign lord the king and the prisoner whom they have in charge; and a true verdict to give, according to their evidence."

Trial. ——

When the jury is sworn, if it be a cause of any consequence, the indictment is usually opened, and the evidence marshalled, examined, and enforced by the counsel for the crown or prosecution. But it is a settled rule at common law, that no counsel shall be allowed a prisoner upon his trial upon the general issue, in any capital crime, unless some point of law shall arise proper to be debated. A rule which (however it may be palliated under cover of that noble declaration of the law, when rightly understood, that the judge shall be counsel for the prisoner; that is, shall see that the proceedings against him are legal and strictly regular) seems to be not at all of a piece with the rest of the humane treatment of prisoners by the English law. For upon what face of reason can that assistance be denied to save the life of a man, which yet is allowed him in prosecutions for every petty trespass? Nor indeed is it, strictly speaking, a part of our ancient law; for the Mirrour, having observed the necessity of counsel in civil suits, "who know how to forward and defend the cause by the rules of law, and customs of the realm," immediately afterwards subjoins, "and more necessary are they for defence upon indictments and appeals of felony, than upon other venial causes." And, to say the truth, the judges themselves are so sensible of this defect in our modern practice, that they seldom scruple to allow a prisoner counsel to stand by him at the bar, and to instruct him what questions to ask, or even to ask questions for him, with regard to matters of fact; for as to matters of law arising on the trial, they are entitled to the assistance of counsel. But still this is a matter of too much importance to be left to the good pleasure of any judge, and is worthy the interposition of the legislature; which has shown its inclination to indulge prisoners with this reasonable assistance, by enacting, in statute 7 W. III. c. 3. that persons indicted for such high-treason as works a corruption of the blood or misprision thereof (except treason in counterfeiting the king's coins or seals), may make their full defence by counsel, not exceeding two, to be named by the prisoner, and assigned by the court or judge; and this indulgence, by statute 20 Geo. II. c. 30. is extended to parliamentary impeachments for high-treason, which were excepted in the former act.

When the evidence on both sides is closed, the jury cannot be discharged (unless in cases of evident necessity) till they have given in their VERDICT. If they find the prisoner not guilty, he is then for ever quit and discharged of the accusation, except he be appealed of felony within the time limited by law. And upon such his acquittal, or discharge for want of prosecution, he shall be immediately set at large without payment of any fee to the gaoler. But if the jury find him guilty, he is then said to be convicted of the crime whereof he stands indicted. See the articles CONVICTION; and, subsequent thereto, the articles JUDGMENT, ATTAINDER, FORFEITURE, [illegible], &c. [illegible], PARDON.

TRIAL, in Scotland. See Scots Law.

TRIANDRIA (from τρεῖς "three," and ἀνὴρ "a man or husband"), the name of the third class in Linnæus's sexual system, consisting of plants with hermaphrodite flowers, which have three stamina or male organs.

TRIANGLE, in Geometry, a figure of three sides and three angles.

TRIBE, in antiquity, a certain quantity or number of persons, when a division was made of a city or people into quarters or districts.

TRIBRACHYS, in ancient poetry, a foot consisting of three syllables, and these all short; as, *melius*.

TRIBUNAL, in general, denotes the seat of a judge, called in our courts *bench*.

TRIBUNE, among the ancient Romans, a magistrate chosen out of the commons, to protect them against the oppressions of the great, and to defend the liberty of the people against the attempts of the senate and consuls.

The tribunes of the people were first established in the year of Rome 250. The first design of their creation was to shelter the people from the cruelty of usurers, and to engage them to quit the Aventine mount, whither they had retired in displeasure.

Their number at first was but two; but the next year, under the consulate of A. Posthumius Aruncius and Cassius Viscellinus, there were three more added; and this number of five was afterwards increased by L. Trebonius to ten.

Military TRIBUNE, an officer in the Roman army, commander in chief over a body of forces, particularly the division of a legion; much the same with our colonel, or the French maitre de camp.

TRIBUTARY, one who pays tribute to another, in order to live in peace with him or share in his protection.

TRIBUTE, a tax or impost which one prince or state is obliged to pay to another as a token of dependence, or in virtue of a treaty, and as a purchase of peace.

TRICEPS, in anatomy. See there, *Table of the Muscles*.

TRICHECUS, WALRUS; a genus of aquatic animals belonging to the class of *mammalia*, and order of *bruta*. This genus has no fore-teeth, when full grown: has two great tusks in the upper jaw, which point downwards: has grinders on each side in both jaws, which are composed of furrowed bones. The body is oblong; the lips are doubled; and the hind legs are stretched backwards, and, as it were, bound together, forming a kind of tail fitted for swimming. There are three species; the rosmarus, dugon, and manatus.

1. The *rosmarus*, morse, or sea-horse, has a round head; small mouth; very thick lips, covered above and below with pellucid bristles as thick as a straw; small fiery eyes; two small orifices instead of ears; short neck; body thick in the middle, tapering towards the tail; skin thick, wrinkled, with short brownish hairs thinly dispersed; legs short, five toes on each, all connected by webs, and small nails on each: the hind feet are very broad; each leg loosely articulated; the hind legs generally extended on a line with the body: the tail is very short; penis long: length of the animal from nose to tail sometimes 18 feet, and 10 or 12 round in the thickest part: the teeth have been sometimes found of the weight of 30 lb. each. Teeth of this size are only found on the coast of the Icy Sea, where the animals are seldom molested, and have time to attain their full growth. See Plate DX. fig. 1.

They inhabit the coast of Spitzbergen, Nova Zembla, Hudson's Bay, and the gulph of St Lawrence; and the Icy Sea, as far as Cape Tschuktschi. They are gregarious; in some places appearing in herds of hundreds. They are shy animals, and avoid places which are much haunted by mankind; but are very fierce. If wounded in the water, they attempt to sink the boat, either by rising under it, or by striking their great teeth into the sides; they roar very loud, and will follow the boat till it gets out of sight. Numbers of them are often seen sleeping on an island of ice; if awaked, they fling themselves with great impetuosity into the sea; at which time it is dangerous to approach the ice, lest they should tumble into the boat and overset it. They do not go upon the land till the coast is clear of ice. At particular times they land in amazing numbers: the moment the first gets on shore, so as to lie dry, it will not stir till another comes and forces it forward by beating it with its great teeth; this is served in the same manner by the next; and so in succession till the whole is landed; continuing tumbling over one another, and forcing the foremost, for the sake of quiet, to remove farther up.

They are killed for the sake of their oil, one walrus producing about half a tun. The knowledge of this chace is of great antiquity; Octher the Norwegian, about the year 890, made a report of it to king Alfred, having, as he says, made the voyage beyond Norway, for *the more commoditie of fishing of horse-whales, which have in their teeth bones of great price and excellency, whereof he brought some at his return unto the king*. In fact, it was in the northern world, in early times, the substitute to ivory, being very white and very hard. Their skins, Octher says, were good to cut into cables. M. de Buffon says, he has seen braces for coaches made of the skin, which were both strong and elastic.

They bring one, or at most two, young at a time: they feed on sea herbs and fish; also on shells, which they dig out of the sand with their teeth: they are said also to make use of their teeth to ascend rocks or pieces of ice, fastening them to the cracks, and drawing their bodies up by that means. Besides mankind, they seem to have no other enemy than the white bear, with whom they have terrible combats; but generally come off victorious, by means of their great teeth.

In Captain Cook's Voyages we have the following affecting account of their parental attachment to their young. "On the approach of the boats towards the ice, they took their young ones under their fins, and attempted to escape with them into the sea. Some, whose cubs were killed or wounded, and left floating upon the surface of the water, rose again, and carried them down, sometimes just as our men were on the point of taking them into the boat; and could be traced bearing them to a considerable distance through the water, which was stained with their blood. They were afterwards observed bringing them, at intervals, above the surface, as if for air, and again plunging under it, with a horrid bellowing. The female, in particular, whose young one had been killed, and taken into the boat, became so furious, that she even struck her two tusks through the bottom of the cutter."

2. The *dugon*, or Indian walrus, is distinguished by the tusks which extend out of the mouth from the upper jaw being placed near each other. It inhabits the seas lying between the Cape of Good Hope and the Philippine islands. This animal, so far as can be known, resembles the morse very much: the head is, however, more lengthened and narrower; the nostrils are large, and placed higher; like the former species, there are no tusks in the under jaw, but those in the upper jaw, as has been already observed, are placed near each other, bent outwards, and resemble cutting teeth, only that they are near six inches long; there are four grinders on each side in the upper jaw, and three in the lower; these last are distant from the tusks, and are broader than those of the morse: the female has two teats on the breast: the chin has a bristly beard; the ears are short; the feet broad; and the legs so short that the belly trails on the ground. When full grown, the animal is six ells in length; the male being rather larger than the female, which has breasts like a woman: It feeds on a green sea moss or weed, which grows near the shore. The figure, manners, and

ecus and hiſtory, of this animal, are very imperfectly known; but we are informed that its fleſh eats like beef.

3. *Manatus*, fiſh-tailed walrus, or ſea-cow, has no tuſks, and no hind feet. Of this ſpecies there are two varieties; the auſtralis or lamantin, and the borealis or whale-tailed manati. The lamantin inhabits the African and American ſeas, particularly near the mouths of rivers, which they frequently enter, ſeldom going far from the ſhore. The lamantin varies in ſize from eight to ſeventeen feet long, is ſix or ſeven in circumference, and from 500 to 800 pounds weight: the ſkin is of a dark or black aſh colour; there are nine ſquare ſhaped grinders on each ſide in each jaw, which are covered with a glaſſy cruſt of enamel; the back bone has 50 joints or vertebræ: it is a thick clumſy animal, having no properly diſtinct neck, as the body continues almoſt of an equal thickneſs to the head. The female has two teats placed near the arm-pits. This animal never comes on ſhore, but frequents the mouths of large rivers, brouzing on the graſs which grows cloſe to the water. There ſeems to be two varieties, differing conſiderably in ſize. The larger frequents the ſeas near the mouths of large rivers; and the ſmaller is found higher up the ſame rivers, and in inland freſh water lakes, but never goes to the ſea.

We are told that this animal is often tamed by the native inhabitants of America, and that it delights in muſic; hence, according to ſome authors, it is probably the delphinus or dolphin of the ancients: and ſome believe, that what has been written concerning mermaids and ſirens muſt be referred to this animal. It has a voracious appetite, and is perpetually eating: it is monogamious, or lives in families of one male, one female, a half grown and a very ſmall young one; copulates in the ſpring, the female at firſt flying in various playful circles, and then throwing herſelf on her back to receive the male: When paſturing on the aquatic plants, the back is often above water; and, as the ſkin is full of a ſpecies of louſe, numbers of ſea fowls perch on them, to pick out the inſects. They bellow like bulls: their ſight is very weak, but their hearing extremely acute; the fore-feet are palmated and fin-ſhaped, almoſt like thoſe of a ſea-turtle; and inſtead of hind-feet they have a horizontal tail; they have no external ears; the noſtrils are diſtinct, and at a diſtance from each other; the females have two teats about the breaſt; the upper lip is full of ſharp, prickly, rigid briſtles. This animal has great affinity to the whale and ſeal tribes. The fleſh is very good eating.

The whale-tailed manati inhabits the north-weſt coaſt of America, the north-eaſt of Aſia, and the iſlands which lie between theſe two coaſts. This animal very often enters the mouths of the rivers; is ſometimes 23 feet long, and weighs 8000 pounds; the ſkin, while wet, is of a brown colour, but becomes black when dry. Inſtead of grinders, this ſpecies has, on each ſide of each jaw, a large rugged bone. The back-bone has 60 vertebræ or joints: the body is very clumſy, and much deformed; its circumference at the ſhoulders is 12 feet, at the belly 20, and near the tail only four; the neck is near ſeven feet round, and the head only 31 inches.

They live perpetually in the water, and frequent the edges of the ſhores; and in calm weather ſwim in droves near the mouths of rivers: in the time of flood they come ſo near the land, that a perſon may ſtroke them with his hand: if hurt, they ſwim out to ſea; but preſently return again. The females oblige the young to ſwim before them, while the other old ones ſurround, and as it were guard them on all ſides. The affection between the male and female is very great: for if ſhe is attacked, he will defend her to the utmoſt; and if ſhe is killed, will follow her corpſe to the very ſhore, and ſwim for ſome days near the place it has been landed at. They copulate in the ſpring, in the ſame manner as the human kind, eſpecially in calm weather, towards the evening. The female ſwims gently about; the male purſues; till, tired with wantoning, ſhe flings herſelf on her back, and admits his embraces. Steller thinks they go with young about a year; it is certain that they bring but one young at a time, which they ſuckle by two teats placed between the breaſt. They are vaſtly voracious and gluttonous; and feed not only on the fuci that grow in the ſea, but ſuch as are flung on the edges of the ſhore. When they are filled, they fall aſleep on their backs. During their meals, they are ſo intent on their food, that any one may go among them and chooſe which he likes beſt. Peter Martyr gives an inſtance of one that lived in a lake of Hiſpaniola for 25 years, and was ſo tame as to come to the edge of the ſhore on being called; and would even perform the part of a ferry, and carry ſeveral people at a time on its back to the oppoſite ſhore.—Their back and their ſides are generally above water.

They continue in the Kamtſchatkan and American ſeas the whole year; but in winter are very lean, ſo that you may count their ribs. They are taken by harpoons faſtened to a ſtrong cord; and after they are ſtruck, it requires the united force of 30 men to draw them on ſhore. Sometimes when they are transfixed, they will lay hold of the rocks with their paws, and ſtick ſo faſt as to leave the ſkin behind before they can be forced off. When a manati is ſtruck, its companions ſwim to its aſſiſtance; ſome will attempt to overturn the boat by getting under it; others will preſs down the rope, in order to break it; and others will ſtrike at the harpoons with their tails, with a view of getting it out, in which they often ſucceed. They have not any voice; but make a noiſe by hard breathing like the ſnorting of a horſe.

The ſkin is very thick, black, and full of inequalities, like the bark of oak, and ſo hard as ſcarce to be cut with an axe, and has no hair on it: beneath the hair is a thick blubber, which taſtes like oil of almonds. The fleſh is coarſer than beef, and will not ſoon putrify. The young ones taſte like veal. The ſkin is uſed for ſhoes, and for covering the ſides of boats.

TRICHOMANES, in botany: a genus of plants belonging to the claſs of *cryptogamia*, and order of *filices*. The parts of fructification are ſolitary, and terminated by a ſtyle like a briſtle, on the very edge of the leaf. There are 13 ſpecies; of which two are natives of Britain, the pixidiferum and tunbrigenſe.

1. *Pixidiferum*, or cup-trichomanes, has ſub bipinnated leaves, the pinnæ being alternate, cloſe-lobed, and linear. It is found among ſtones in wet grounds in England. 2. *Tunbrigenſe*, or Tunbridge trichomanes, has pinnated leaves, the pinnæ being oblong, dichotomous, decurrent, and dentated. It is found in the fiſſures of moiſt rocks in Wales, and in many rocky places in Scotland.

TRICOCCÆ [illegible] "three," and [illegible] "a grain"), the name of the 38th order in Linnæus's Fragments of a Natural Method, conſiſting of plants with a ſingle three-cornered capſule, having three cells, or internal diviſions, each containing a ſingle ſeed. See Botany, vol. iii. page 466.

TRICOSANTHES, in botany: A genus of plants belonging to the claſs of *monœcia*, and order of *ſyngeneſia*; and in the natural ſyſtem ranging under the 34th order, *Cucurbitaceæ*. There are four ſpecies; only one of which is cultivated in the Britiſh gardens, the *anguina* or ſnake-gourd, which is a native of China, an annual, and of the cucumber tribe.

TRIDENT, an attribute of Neptune, being a kind of ſceptre which the painters and poets put into the hands of

Trident | Triclum.

that god, in form of a ſpear or fork with three teeth; whence the word.

TRIENNIAL, an epithet applied chiefly to officers or employments which laſt for three years.

TRIENS, in antiquity, a copper money of the value of one third of an as, which on one ſide bore a Janus's head, and on the other a water rat.

TRIENTALIS, Chickweed winter-green, in botany: A genus of plants belonging to the claſs of *heptandria*, and order of *monogynia*; and in the natural ſyſtem ranging under the 20th order, *Rotaceæ*. The calyx is heptaphyllous; the corolla is equal and plane, and is divided into ſeven ſegments; the berry is unilocular and dry. There is only one ſpecies, the *europæa*; which is indigenous, and the only genus of heptandria that is ſo.

The ſtalk is ſingle, five or ſix inches high, terminated with five, ſix, or ſeven, oval pointed leaves; from the centre of which ariſe on long footſtalks commonly two white ſtarry flowers, each generally conſiſting of ſeven oval and equal petals, ſucceeded by a globular dry berry, covered with a thin white rind, having one cell, and containing ſeveral angular ſeeds.

TRIERS, or Treves. See Treves.

TRIFOLIUM, Trefoil, or *Clover*, in botany: A genus of plants belonging to the claſs of *diadelphia*, and order of *decandria*; and in the natural ſyſtem ranging under the 32d order, *Papilionaceæ*. The flowers are generally in round heads; the pod is ſcarcely longer than the calyx, univalve, not opening, deciduous. The leaves are three together. According to Murray's edition of Linnæus, there are 46 ſpecies; of which 17 are natives of Britain. We ſhall deſcribe ſome of the moſt remarkable of theſe:

1. *Melilotus officinalis*, or melilot, has naked racemous pods, diſpermous, wrinkly, and acute, with an erect ſtalk. It grows in corn-fields and by the way-ſides, but not common. The ſtalk is erect, firm, ſtriated, branched, and two or three feet high: the leaves ternate, ſmooth, obtuſely oval, and ſerrated: the flowers are ſmall, yellow, pendulous, and grow in long cloſe ſpikes at the tops of the branches: the pod is very ſhort, turgid, tranſverſely wrinkled, pendulous, and contains either one or two ſeeds. The plant has a very peculiar ſtrong ſcent, and diſagreeable, bitter, acrid taſte, but ſuch, however, as is not diſagreeable to cattle. The flowers are ſweet-ſcented. It has generally been eſteemed emollient and digeſtive, and been uſed in fomentations and cataplaſms, particularly in the plaſter employed in dreſſing bliſters; but is now laid aſide, as its quality is found to be rather acrid and irritating than emollient or reſolvent. It communicates a moſt loathſome flavour to wheat and other grain, ſo as to render it unfit for making bread. It grows in corn-fields.

2. *Trifolium repens*, white creeping trefoil, or Dutch clover, has a creeping ſtalk, its flower gathered into an umbellar head, and its pods tetraſpermous. It is very common in fields and paſtures. It is well known to be excellent fodder for cattle; and the leaves are a good ruſtic hygrometer, as they are always relaxed and flaccid in dry weather, but erect in moiſt or rainy.

3. *Trifolium pratenſe*, purple or red clover, is diſtinguiſhed by denſe ſpikes, unequal corollas, by bearded ſtipulas, aſcending ſtalks, and by the calyx having four equal teeth. This is the botanical deſcription of this ſpecies given by Mr Afzelius, who, in a paper of the firſt volume of the Linnæan Tranſactions, has been at much pains to remove three ſpecies of the trifolium from the confuſion in which they have been long involved; namely, the pratenſe, medium, and alpeſtre. The red clover is common in meadows and paſtures, and is the ſpecies which is generally cultivated as food for cattle. It abounds in every part of Europe, in North America, and even in Siberia. It delights moſt in rich, moiſt, and ſunny places; yet flouriſhes in dry, barren, and ſhady places. For an account of the mode of cultivating it, ſee Agriculture, n° 177.

4. *Alpeſtre*, long-leaved purple trefoil, or mountain clover, is thus characterized by Mr Afzelius. The ſpikes are denſe; the corollas ſomewhat equal; the ſtipulas are briſtly and divergent; the leaflets lanceolated; the ſtalks ſtiff, ſtraight, and very ſimple. It grows in dry, mountainous, woody places, in Hungary, Auſtria, and Bohemia, &c.; but is not ſaid by Mr Afzelius to be a native of Britain.

5. The *medium*, according to Mr Afzelius, has alſo been confounded with the two ſpecies laſt mentioned; but it is to be diſtinguiſhed from them by having looſe ſpikes, corollas ſomewhat equal, ſtipulas ſubulate and connivent, and ſtalks flexuoſe and branched. It is found in dry elevated ſituations, eſpecially among ſhrubs, or in woods where the ſoil is chalky or clay, in England, Scotland, Sweden, Denmark, &c.

For a botanical deſcription of the other ſpecies of the trifolium, ſee Lightfoot's *Flora Scotica*, Berkenhout's Synopſis of the Natural Hiſtory of Great Britain and Ireland, and Withering's Botanical Arrangements.

TRIGA, in antiquity, denotes a kind of carr or chariot drawn by three horſes; whence the name.

TRIGLA, in ichthyology, a genus of fiſhes belonging to the order of thoracici. The head is loricated with rough lines, and there are ſeven rays in the membranes of the gills. There are 11 ſpecies; of which the principal are the gurnardus, or grey gurnard; the cuculus, or red gurnard; the lyra, or piper; and the hirundo, or ſapphirine gurnard.

TRIGLOCHIN, in botany: A genus of plants belonging to the claſs of *hexandria*, and order of *trigynia*; and in the natural ſyſtem ranging under the fifth order, *Tripetaloideæ*. The calyx is triphyllous; the petals are three; there is no ſtyle; the capſule opens at the baſe. There are three ſpecies; of which the paluſtre and maritimum are Britiſh.

1. *Paluſtre*, or arrow-headed graſs, has an oblong trilocular capſule. The ſtalk is ſimple, eight or ten inches high; the leaves long and narrow; the flowers are greeniſh, and grow at the end of a long ſpike. It is frequent in moiſt ground.

2. *Maritimum*, or ſea-ſpiked graſs, has ovate ſexlocular capſules; the ſtalk is ſhort; the ſpike long, and flowers purpliſh. It is frequent on the ſea-coaſts. Linnæus ſays that cattle eat theſe two ſpecies with avidity.

TRIGLYPHS, in architecture, a ſort of ornaments repeated at equal intervals, in the Doric freeze.

Dialing Trigon. See Dialing.

TRIGONALIS. See Pila.

TRIGONELLA, Fenugreek, in botany: A genus of plants belonging to the claſs of *diadelphia*, and order of *decandria*; and in the natural ſyſtem arranged under the 32d order, *Papilionaceæ*. The vexillum and alæ are nearly equal and patent, reſembling a tripetalous corolla. There are 12 ſpecies; of which the moſt remarkable is the *fænumgræcum*, or fenugreek, a native of Montpelier in France.

Fenugreek is an annual plant, which riſes with a hollow, branching, herbaceous ſtalk, a foot and a half long, garniſhed with trifoliate leaves, placed alternately, whoſe lobes are oblong, oval, indented on their edges, and have broad furrowed footſtalks.

Fenugreek ſeeds have a ſtrong diſagreeable ſmell, and an unctuous farinaceous taſte accompanied with a ſlight bitteriſhneſs. The principal uſe of theſe ſeeds is in cataplaſms and fomentations, for ſoftening, maturating, and diſcuſſing tumors; and in emollient and carminative glyſters. They are an ingredient in the *oleum e mucilaginibus* of the ſhops, to which they communicate a conſiderable ſhare of their ſmell.

Plate DX.

White bear.

Gryphus.

Vampyre.

Walrus.

TRIGONOMETRY,

THE art of meafuring the fides and angles of triangles, either plane or fpherical, whence it is accordingly called either PLANE TRIGONOMETRY, or SPHERICAL TRIGONOMETRY.

Trigonometry is an art of the greateft ufe in the mathematical fciences, efpecially in aftronomy, navigation, furveying, dialing, geography, &c. &c. By it we come to know the magnitude of the earth, the planets and ftars, their diftances, motions, eclipfes, and almoft all other ufeful arts and fciences. Accordingly we find this art has been cultivated from the earlieft ages of mathematical knowledge.

Trigonometry, or the refolution of triangles, is founded on the mutual proportions which fubfift between the fides and angles of triangles; which proportions are known by finding the relations between the radius of a circle and certain other lines drawn in and about the circle, called *cords*, *fines*, *tangents*, and *fecants*. The ancients, Menelaus, Hipparchus, Ptolemy, &c. performed their trigonometry by means of the cords. As to the fines, and the common theorems relating to them, they were introduced into trigonometry by the Moors or Arabians, from whom this art paffed into Europe, with feveral other branches of fcience. The Europeans have introduced, fince the 15th century, the tangents and fecants, with the theorems relating to them.

The proportion of the fines, tangents, &c. to their radius, is fometimes expreffed in common or natural numbers, which conftitute what we call the *tables of natural fines, tangents, and fecants.* Sometimes it is expreffed in logarithms, being the logarithms of the faid natural fines, tangents, &c.; and thefe conftitute the table of *artificial fines*, &c. Laftly, fometimes the proportion is not expreffed in numbers; but the feveral fines, tangents, &c. are actually laid down upon lines of fcales; whence the *line of fines*, *of tangents*, &c.

In trigonometry, as angles are meafured by arcs of a circle defcribed about the angular point, fo the whole circumference of the circle is divided into a great number of parts; as 360 degrees, and each degree into 60 minutes, and each minute into 60 feconds, &c.; and then any angle is faid to confift of fo many degrees, minutes, and feconds, as are contained in the arc that meafures the angle, or that is intercepted between the legs or fides of the angle.

Now the fine, tangent, and fecant, &c. of every degree and minute, &c. of a quadrant, are calculated to the radius 1, and ranged in tables for ufe; as alfo the logarithms of the fame; forming the triangular canon. And thefe numbers, fo arranged in tables, form every fpecies of right-angled triangles; fo that no fuch triangle can be propofed, but one fimilar to it may be there found, by comparifon with which the propofed one may be computed by analogy or proportion.

PLANE TRIGONOMETRY.

THERE are ufually three methods of refolving triangles, or the cafes of trigonometry; viz. geometrical conftruction, arithmetical computation, and inftrumental operation. In the 1ft method, the triangle in queftion is conftructed by drawing and laying down the feveral parts of their magnitudes given, viz. the fides from a fcale of equal parts, and the angles from a fcale of cords or other inftrument; then the unknown parts are meafured by the fame fcales, and fo they become known.

In the 2d method, having ftated the terms of the proportion according to rule, which terms confift partly of the numbers of the given fides, and partly of the fines, &c. of angles taken from the tables, the proportion is then refolved like all other proportions, in which a 4th term is to be found from three given terms, by multiplying the 2d and 3d together, and dividing the product by the 1ft. Or, in working with the logarithms, adding the logarithm of the 2d and 3d terms together, and from the fum fubtracting the logarithm of the 1ft term; then the number anfwering to the remainder is the 4th term fought.

To work a cafe inftrumentally, as fuppofe by the logarithm lines on one fide of the two foot fcales: Extend the compaffes from the 1ft term to the 2d or 3d, which happens to be of the fame kind with it; then that extent will reach from the other term to the 4th. In this operation, for the fides of triangles, is ufed the line of numbers (marked Num.); and for the angles, the line of fines or tangents (marked fin. and tan.) according as the proportion refpects fines or tangents. See SECTOR.

In every cafe of plane triangles there muft be three parts, one at leaft of which muft be a fide. And then the different circumftances, as to the three parts that may be given, admit of three cafes or varieties only; viz.

1ft, When two of the three parts given are a fide and its oppofite angle. 2d, When there are given two fides and their contained angle. 3d, And, thirdly, when the three fides are given.

To each of thefe cafes there is a particular rule or proportion adapted for refolving it by.

1ft, *The Rule for the 1ft Cafe*, or that in which, of the three parts that are given, an angle and its oppofite fide are two of them, is this, viz. that the fides are proportional to the fines of their oppofite angles; that is,

As one fide given :
To the fine of its oppofite angle : :
So is another fide given :
To the fine of its oppofite angle.

Or,

As the fine of an angle given :
To its oppofite fide : :
So is the fine of another angle given :
To its oppofite fide.

So that, to find an angle, we muft begin the proportion with a given fide that is oppofite to a given angle; and to find a fide, we muft begin with an angle oppofite to a given fide.

Example. Suppofe in the triangle BDC (fig. 1.) there be given the fide BC = 126, DB = 65, and the angle BCD 31° 49′ given; to find the angle BDC obtufe and the fide CD. Plate DXI.

1. *Geometrically by Conftruction.*

Draw the line BC equal to 126, at C make an angle of 31° 49′ by drawing CD, take 65 in your compaffes, and with one foot in B lay the other upon the line CD in D; draw the line BD, and it is done; for the angle D will be [illegible] 43′, the angle B 27° 28′, and the fide DC [illegible] as was required.

2. *Arithmetically by Logarithms.*

As the fide BD 65	- - log.	1.81291
Is to fine angle C 31° 49′	. .	[illegible]
So is the fide BC 126	. .	[illegible]
		[illegible]
		[illegible]
To fine angle D [illegible]	-	[illegible]

Plate.

To find DC.

As fine ang. C 31 49	9.72198	The fupp.	180.0
Is to the fide BD 65	1.81291		59.17 of ang. D.
So is fine ang. B 27.28	9.66302		120.43 angle D.
	11.47683		31.49 angle C.
	9.72198		152.32 their fum.
To the fide DC 56.88	1.75485		180.0
			152.32 fum fubt.
			27.28 angle B.

Here it may be proper to obferve, that if the given angle be obtufe, the angle fought will be acute; but when the given angle is acute, and oppofite to a leffer given fide, then the required angle is doubtful, whether acute or obtufe; it ought therefore to be determined before the operation. For it is plain in the above proportion produces 59° 17' for the required angle; but as it is obtufe, its fupplement to 180 degrees muft be taken, viz. 120° 43'.

By Gunter.

"The extent from 65 to 106 on the line of numbers will reach from 31° 49 to 59° 17' on the line of fines."

2dly, "The extent from 31° 49' to 27° 28' on the line of fines will reach from 65 to 56.88 on the line of numbers."

Case II. When there are given two fides and their contained angle, to find the reft, the rule is this:

As the fum of the two given fides :
Is to the difference of the fides : :
So is the tangent of half the fum of the two oppofite angles or cotangent of half the given angle :
To tang. of half the diff. of thofe angles.

Then the half diff. added to the half fum, gives the greater of the two unknown angles; and fubtracted leaves the lefs of the two angles.

Hence, the angles being now all known, the remaining 3d fide will be found by the former cafe.

Example. The fide BC = 109, BD = 76 (fig. 2.), and the angle CBD 101° 30' given, to find the angle BDC or BCD, and the fide CD.

1. *Geometrically by Conftruction.*

Draw the line BC 109, and BD, fo as to make an angle with BC of 101° 30', and make BD equal to 76; join BC and BD with a right line, and it is done; for the angle D being meafured by the cord of 60°, will be 47° 32', angle C 30° 58', and the fide DC 144.8, as was required.

2. *Arithmetically by Logarithms.*

Side BC	109	-	109	-	180° 0'
BD	76	-	76	-	101 30
Their fum	185		33 their diff.		78 30 fum of the ang. D and C.

½ Sum 39 15 then

To find the angles D and C.

As the fum of the fides BC and BD = 185		2.26717
Is to their difference	33	1.51851
So is tang. of ½ the fum of the angles C and D	39° 15'	9.91224
		11.43075
		2.26717
To the tang of ½ the diff. of the angles C and D	8° 17'	9.16358

To half the fum of the angles D and C -	39° 15
Add half the difference of the angles C and D	8 17
Gives the greater angle D	47 32
Subtracted, gives the leffer angle C	30 58

To find DC.

As fine angle D 47° 32'	-	-	9.86786
Is to the fide BC 109	-	-	2.03743
So is fine angle B 101° 30'	-	-	9.99119
			12.02862
			9.86786
To the fide DC required 144.8		-	2.16076

3. *By Gunter.*

1ft, "The extent from 185 to 33 on the line of numbers will reach from 39° 15' to 8° 17' on the line of tangents. 2dly, The extent from angle D 47° 32' to 78° 30' (the fupplement of angle B) on the line of fines, will reach from the fide BC 109 to 144.8, the fide DC required, on the line of numbers."

Case III. Is when the three fides are given, to find the three angles; and the method of refolving this cafe is, to let a perpendicular fall from the greateft angle upon the oppofite fide or bafe, dividing it into two fegments, and the whole triangle into two fmaller right-angled triangles: then it will be,

As the bafe or fum of the two fegments :
Is to the fum of the other two fides : :
So is the difference of thofe fides :
To the difference of the fegments of the bafe.

Then half this difference of the two fegments added to the half fum, or half the bafe, gives the greater fegment, and fubtracted gives the lefs. Hence, in each of the two right-angled triangles, there are given the hypothenufe, and the bafe, befides the right angle, to find the other angles by the firft cafe.

Example. The fides BC (fig. 3) = 105, BD = 85, and CD = 50, given to find the angles BDC, BCD, or CBD.

1. *Geometrically by Conftruction.*

Draw the line BC equal to 105, take CD 50 in your compaffes, and with one foot in C defcribe an arch; then take BD 85 in your compaffes, and with one foot in B cut the former arch in D, join BD and DC, and it is done; for the angle B, being meafured, will be found 28° 4', angle C 53° 7', which being added together, is 81° 11', their fum fubtracted from 180, leaves angle D 98° 49' as was required.

2 *Arithmetically by Logarithms.*

The two fhorteft fides are BD (= 85) and CD (= 50), the fum of which is 135, and their difference 35. The fegments of the bafe BC are found in this manner:

As the fide BC	= 105	log. 2.02119
Is to the fum of the fides BD & DC	= 135	2.13033
So is their difference	= 35	1.54407
To the difference of the feg. of BC	= 45	1.65321

Thus the fum and difference of the fegments of the bafe BC being known, we have only to add half this fum = 52½ to half the difference = 22½, and we fhall obtain the greater fegment, which is = 75; which fubtracted from 105, gives 30 = the fmaller fegment. Then

To find the angle BDA.

As the hypothenufe BD	= 85	log. 1.92942
Is to radius	=	10.00000
So is the greater fegment	= 75	1.87506
To the fum of the angle BDA	=	9.94564

The angle BDA therefore is equal to 61° 56'

Let us now find the angle ADC, which is done thus.

As the hypothenufe DC	= 50	log. 1.69897
Is to radius	=	10.00000
So is the fmaller fegment	= 30	1.47712
To the fine of ADC	=	9.77815

The angle ADC therefore is equal to 36° 53', and the whole angle BDC = 98° 49'.

6 To

To find the angle at B, we have only to subtract the angle BDA (= 61° 56) from 90°, and the rem. 28° 4' is the angle sought. The angle at C is equal to 53° 7'.

3. *By Gunter.*

1st, 'The extent from 105 to 135, will reach from 35 to 45 on the line of numbers.' *2dly*, 'The extent from 85 to 75, on the line of numbers, will reach from radius to 61° 56', the angle BDA on the line of sines.' *3dly*, 'The extent from 50 to 30 on the line of numbers, will reach from radius to angle ADC 36° 53' on the line of sines.'

The foregoing three cases include all the varieties of plane triangles that can happen, both of right and oblique-angled triangles. But besides these, there are some other theorems that are useful upon many occasions, or suited to some particular forms of triangles, which are often more expeditious in use than the foregoing general ones; one of which, for right-angled triangles, as the case for which it serves so often occurs, may be here inserted, and is as follows.

Case IV. When, in a right-angled triangle, there are given the angles and one leg, to find the other leg, or the hypothenuse. Then it will,

As radius :
To given leg AB : :
So tang. adjacent the angle A :
To the opposite leg BC, and : :
So sec. of same angle A :
To hypot. AC :

Example. In the triangle ABC (fig. 4.), right-angled at B,

Given the leg AB = 162
and the angle A = 53° 7' 48''
conseq. the angle C = 36 52 12
} to find BC and AC.

1. *Geometrically.*—Draw the leg AB = 162: Erect the indefinite perpendicular BC: Make the angle A = $53°\frac{1}{8}$, and the side AC will cut BC in C, and form the triangle ABC. Then, by measuring, there will be found AC = 270, and BC = 216.

2. *Arithmetically.*

As radius	= 10	- -	log. 10·0000000
To AB	= 162	- -	2·2095150
So tang. A	= 53° 7' 48''	-	10·1249372
To BC	= 216	- -	2·3344522
So sec. A	= 53° 7' 48''	- -	10·2218477
To AC -	= 270	- -	2·4313627

3. *By Gunter.*

Extend the compasses from 45° at the end of the tangents (the radius) to the tangent of $53°\frac{1}{8}$; then that extent will reach, on the line of numbers, from 162 to 216, for BC. Again, extend the compasses from 36° 52 to 90 on the sines; then that extent will reach, on the line of numbers, from 162 to 270 for AC.

Note, Another method, by making every side radius, is often added by the authors on trigonometry, which is thus: The given right angled triangle being ABC, make first the hypothenuse AC radius, that is, with the extent of AC as a radius, and each of the centres A and C, describe arcs CD and AE (fig. 5.); then it is evident that each leg will represent the sine of its opposite angle, viz. the leg BC the sine of the arc CD or of the angle A, and the leg AB the sine of the arc AE or of the angle C. Again, making either leg radius, the other leg will represent the tangent of its opposite angle, and the hypothenuse the secant of the same angle; thus, with radius AB and centre A describing the arc BF, BC represents the tangent of that arc, or of the angle A, and the hypothenuse AC the secant of the same; or with the radius BC and centre C describing the arc BG, the other leg AB is the tangent of that arc BG or of the angle C, and the hypothenuse CA the secant of the same.

And then the general rule for all these cases is this, *viz.* that the sides bear to each other the same proportions as the parts or things which they represent. And this is called making every side radius.

SPHERICAL TRIGONOMETRY.

Spherical Trigonometry is the art whereby, from three given parts of a spherical triangle, we discover the rest; and, like plane trigonometry, is either right-angled or oblique angled. But before we give the analogies for the solution of the several cases in either, it will be proper to premise the following theorems:

Theorem I. In all right-angled spherical triangles, the sign of the hypothenuse : radius : : sine of a leg : sine of its opposite angle. And the sine of a leg : radius : : tangent of the other leg : tangent of its opposite angle.

Demonstration. Let EDAFG (*ibid.* fig. 6.) represent the eighth part of a sphere, where the quadrantal planes EDFG, EDBC, are both perpendicular to the quadrantal plane ADFB; and the quadrantal plane ADGC is perpendicular to the plane EDFG; and the spherical triangle ABC is right-angled at B, where CA is the hypothenuse, and BA, BC, are the legs.

To the arches GF, CB, draw the tangents HF, OB, and the sines GM, CI, on the radii DF, DB; also draw BL the sine of the arch AB, and CK the sine of AC; and then join IK and OL. Now HF, CB, GM, CI, are all perpendicular to the plane ADFB. And HD, GK, OL, lie all in the same plane ADGC. Also FD, IK, BL, lie all in the same plane ADGC. Therefore the right angled triangles HFD, CIK, ODL, having the equal angles HDF, CKI, OLB, are similar. And CK : DG : : CI : GM; that is, as the sine of the hypothenuse : rad. : : sine of a leg : sine of its opposite angle. For GM is the sine of the arc GF, which measures the angle CAB. Also, LB : DF : : BO : FH; that is, as the sine of a leg : radius : : tangent of the other leg : tangent of its opposite angle. Q. E. D.

Hence it follows, that the sines of the angles of any oblique spherical triangle ACD (fig. 7.) are to one another, directly, as the sines of the opposite sides. Hence it also follows, that, in right-angled spherical triangles, having the same perpendicular, the sines of the bases will be to each other, inversely, as the tangents of the angles at the bases.

Theorem II. In any right-angled spherical triangle ABC (fig. 8.) it will be, As radius is to the co-sine of one leg, so is the co-sine of the other leg to the co-sine of the hypothenuse.

Hence, if two right-angled spherical triangles ABC, CBD (fig. 7.) have the same perpendicular BC, the co-sines of their hypothenuses will be to each other, directly, as the co-sines of their bases.

Theorem III. In any spherical triangle it will be, As radius is to the sine of either angle, so is the co-sine of the adjacent leg to the co-sine of the opposite angle.

Hence, in right-angled spherical triangles, having the same perpendicular, the co-sines of the angles at the base will be to each other, directly, as the sines of the vertical angles.

Theorem IV. In any right-angled spherical triangle

it will be, As radius is to the co-fine of the hypothenufe, fo is the tangent of either angle to the co-tangent of the other angle.

As the fum of the fines of two unequal arches is to their difference, fo is the tangent of half the fum of thofe arches to the tangent of half their difference: and as the fum of the co-fines is to their difference, fo is the co-tangent of half the fum of the arches to the tangent of half the difference of the fame arches.

Theorem V. In any fpherical triangle ABC (fig. 9 and 10.) it will be, As the co-tangent of half the fum of half their difference, fo is the co-tangent of half the bafe to the tangent of the diftance (DE) of the perpendicular from the middle of the bafe.

Since the laft proportion, by permutation, becomes co-tang. $\frac{AC+BC}{2}$: co-tang. AE : : tang. $\frac{AC-BC}{2}$: tang. DE, and as the tangents of any two arches are, inverfely, as their co-tangents; it follows, therefore, that tang. AE : tang. $\frac{AC+BC}{2}$: : tang. $\frac{AC-BC}{2}$: tang. DE; or, that the tangent of half the bafe is to the tangent of half the fum of the fides, as the tangent of half the difference of the fides to the tangent of the diftance of the perpendicular from the middle of the bafe.

Theorem VI. In any fpherical triangle ABC (fig. 9.) it will be, As the co-tangent of half the fum of the angles at the bafe is to the tangent of half their difference, fo is the tangent of half the vertical angle to the tangent of the angle which the perpendicular CD makes with the line CF bifecting the vertical angle.

The Solution of the Cases of right-angled fpherical Triangles, (fig. 8.).

Cafe	Given	Sought	Solution
1	The hyp. AC and one angle A	The oppofite leg BC	As radius : fine hyp. AC : : fine A : fine BC (by the former part of theor. 1.)
2	The hyp. AC and one angle A	The adjacent leg AB	As radius : co-fine of A : : tang. AC : tang. AB (by the latter part of theor. 1.)
3	The hyp. AC and one angle A	The other angle C	As radius : co-fine of AC : : tang. A : co-tang. C (by theorem 4.)
4	The hyp. AC and one leg AB	The other leg BC	As co-fine AB : radius : : co-fine AC : co-fine BC (by theorem 2.)
5	The hyp. AC and one leg AB	The oppofite angle C	As fine AC : radius : : fine AB : fine C (by the former part of theorem 1.)
6	The hyp. AC and one leg AB	The adjacent angle A	As tang. AC : tang. AB : : radius : co-fine A (by theorem 1.)
7	One leg AB and the adjacent angle A	The other leg BC	As radius : fine AB : : tangent A : tangent BC (by theorem 4.)
8	One leg AB and the adjacent angle A	The oppofite angle C	As radius : fine A : : co-fine of AB : co-fine of C (by theorem 3.)
9	One leg AB and the adjacent angle A	The hyp. AC	As co-fine of A : radius : : tang. AB : tang. AC (by theorem 1.)
10	One leg BC and the oppofite angle A	The other leg AB	As tang. A : tang. BC : : radius : fine AB (by theorem 4.)
11	One leg BC and the oppofite angle A	The adjacent angle C	As co-fine BC : radius : : co-fine of A : fine C (by theorem 3.)
12	One leg BC and the oppofite angle A	The hyp. AC	As fine A : fine BC : : radius : fine AC (by theorem 1.)
13	Both legs AB and BC	The hyp. AC	As radius : co-fine AB : : co-fine BC : co-fine AC (by theorem 2.)
14	Both legs AB and BC	An angle, fuppofe A	As fine AB : radius : : tang. BC : tang. A (by theorem 4.)
15	Both angles A and C	A leg, fuppofe AB	As fine A : co-fine C : : radius : co-fine AB (by theorem 3.)
16	Both angles A and C	The hyp. AC	As tang. A : co-tang. C : : randius : co-fine AC (by theorem 4.)

Note, The 10th, 11th, and 12th cafes are ambiguous; fince it cannot be determined by the data, whether A, B, C, and AC, be greater or lefs than 90 degrees each.

Plane TRIGONOMETRY.

Fig. 1.

Fig. 3.

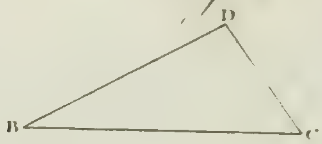


Fig. 5.

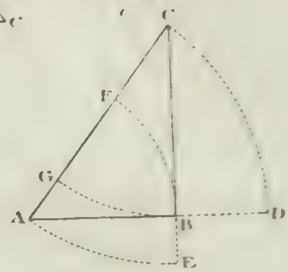


Fig. 2.

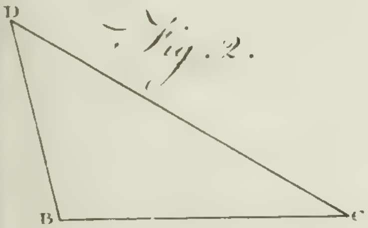
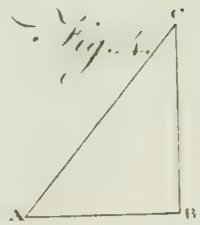


Fig. 4.



Spherical TRIGONOMETRY.

Fig. 6.

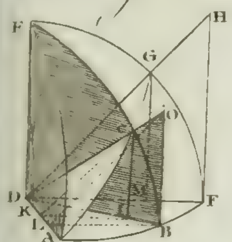


Fig. 7.

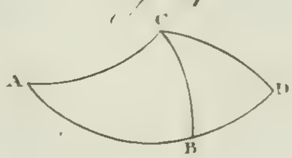


Fig. 9.

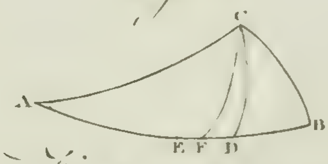


Fig. 10.

Fig. 11.

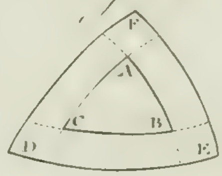


Fig. 12.

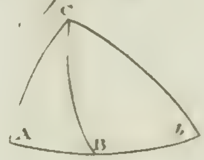
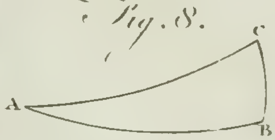


Fig. 8.



TURNING.

Fig. 1.

Fig. 2.

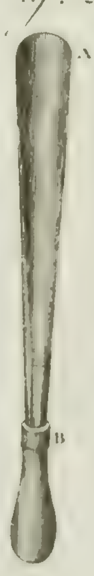


Fig. 3.

Fig. 4.

Fig. 5.

The Solution of the Cases of oblique spherical Triangles, (Fig. 9 and 10.)

Case	Given	Sought	Solution
1	Two sides AC, BC, and an angle A opposite to one of them.	The angle B opposite to the other	As sine BC : sine A : : sine AC : sine B (by theorem [illegible]) Note, this case is ambiguous when BC is less than AC; since it cannot be determined from the data whether B be acute or obtuse.
2	Two sides AC, BC, and an angle A opposite to one of them	The included angle ACB	Upon AB produced (if need be) let fall the perpendicular CD; then (by theorem 4.) rad. : co-sine AC : : tang. A : co-tang. ACD; but (by theorem 1.) as tang. BC : tang. AC : : co-sine ACD : co-sine BCD. Whence ACB = ACD ± BCD is known.
3	Two sides AC, BC, and an angle opposite to one of them	The other side AB	As rad. : co-sine A : : tang. AC : tang. AD (by theorem 1.) and (by theor. 2.) as co-sine AC : co sine BC : : co-sine AD : co-sine BD. Note, this and the last case are both ambiguous when the first is so.
4	Two sides AC, AB, and the included angle A	The other side BC	As rad. : co-sine A : : tang. AC : tang. AD (by theor. 1.) whence AD is also known; then (by theor. 2.) as co-sine AD : co-sine BD : : co-sine AC : co-sine BC.
5	Two sides AC, AB, and the included angle A	Either of the other angles, suppose B	As rad. : co-sine A : : tang. AC : tang. AD (by theor. 1.) whence BD is known; then (by theor. 4.) as sine BD : sine AD : : tang. A : tang. B.
6	Two angles A, ACB, and the side AC betwixt them	The other angle B	As rad. : co-sine AB : : tang. A : co-tang. ACD (by theorem 4.) whence BCD is also known; then (by theor. 3.) as sine ACD : sine BCD : : co-sine A : co-sine B.
7	Two angles A, ACB, and the side AC betwixt them	Either of the other sides, suppose BC	As rad. : co-sine AC : : tang. A : co-tang. ACD (by theorem 4.) whence BCD is also known : then, as co-sine BCD : co-sine ACD : : tang. AC : tang. BC (by theor. 1.)
8	Two angles A, B, and a side AC opposite to one of them	The side BC opposite the other	As sine B : sine AC : : sine A : sine BC (by theorem 5.)
9	Two angles A, B, and a side AC opposite to one of them	The side AB betwixt them	As rad. : co-sine A : : tang. AC : tang. AD (by theor. 1.) and as tang. B : tang. A : : sine AD : sine BD (by theorem 4.) whence AB is also known.
10	Two angles A, B, and a side AC opposite to one of them	The other angle ACB	As rad. : co-sine AC : : tang. A : co-tang. ACD (by theorem 4.) and as co-sine A : co-sine B : : sine ACD : sine BCD (by theor. 3.) whence ACB is also known.
11	All the three sides AB, AC, and BC	An angle, suppose A	As tang. ½AB : tang. $\frac{AC+BC}{2}$: : tang. $\frac{AC-BC}{2}$: tang. DE, the distance of the perpendicular from the middle of the base (by theorem 6.) whence AD is known : then, as tang. AC : tang. AD : : rad : co-sine A (by theorem 1.)
12	All the three angles A, B, and ACB	A side, suppose AC	As co-tang. $\frac{ACB+A}{2}$: tang. $\frac{ACB-A}{2}$: : tang. $\frac{ACB}{2}$: tan of the angle included by the perpendicular and a line bisecting the vertical angles; whence ACD is also known : then (by theorem 5.) tang. A : co-tang. ACD : : rad. co-sine AC.

The following propositions and remarks, concerning spherical triangles (selected and communicated to Dr Hutton by the reverend Nevil Maskelyne, D. D. Astronomer Royal, F. R. S.), will also render the calculation of them perspicuous, and free from ambiguity.

1. A spherical triangle is equilateral, isoscelar, or scalene, according as it has its three angles all equal, or two of them equal, or all three unequal; and *vice versa*.

2. The greatest side is always opposite the greatest angle, and the smallest side opposite the smallest angle.

3. Any two sides taken together are greater than the third.

4. If the three angles are all acute, or all right, or all obtuse; the three sides will be, accordingly, all less than 90°, or equal to 90°, or greater than 90°; and conversely.

5. If from the three angles A, B, C, of a triangle ABC, as poles, there be described upon the surface of the sphere, three arches of a great circle DE, DF, EF, forming by their intersection a new spherical triangle DEF; each side of the new triangle will be the supplement of the angle at its pole; and each angle of the same triangle will be the supplement of the side opposite to it in the triangle ABC. Fig. 11.

6. In any triangle ABC, or AbC, right-angled in A, Fig. 11.
The angles at the hypothenuse are always of the same kind

Spherical. as their opposite sides; 2*dly*, The hypothenuse is less or greater than a quadrant, according as the sides including the right angle are of the same or different kinds; that is to say, according as the same sides are either both acute or both obtuse, or as the one is acute and the other obtuse. And *vice versa*, 1*st*, The sides including the right angle are always of the same kind as their opposite angles: 2*dly*, The sides including the right angle will be of the same or different kinds, according as the hypothenuse is less or more than 90°; but one at least of them will be of 90°, if the hypothenuse is so.

TRIHILATÆ, from *tres* "three," and *hilum* "an external mark on the seed;" the name of the 23d class in Linnæus's Fragments of a Natural Method; consisting of plants with three seeds, which are marked with an external cicatrix or scar, where they are fastened within the fruit. See BOTANY, Sect. 6.

TRIM, implies in general the state or disposition by which a ship is best calculated for the several purposes of navigation.

Thus the trim of the hold denotes the most convenient and proper arrangement of the various materials contained therein relatively to the ship's motion or stability at sea. The trim of the masts and sails is also their most apposite situation with regard to the construction of the ship and the effort of the wind upon her sails. See SEAMANSHIP.

TRINGA, SANDPIPER; a genus of birds belonging to the order of *grallæ*. The bill is somewhat tapering, and of the length of the head; the nostrils are small; the toes are four in number and divided, the hind toe being frequently raised from the ground. According to Dr Latham there are 45 species, of which 18 are British. We shall describe some of the most remarkable.

1. *Vanellus*, lapwing, or tewit, is distinguished by having the bill, crown of the head, crest, and throat, of a black colour; there is also a black line under each eye; the back is of a purplish green; the wings and tail are black and white, and the legs red: the weight is 8 ounces and the length 13 inches. It lays four eggs, making a slight nest with a few bents. The eggs have an olive cast, and are spotted with black. The young, as soon as hatched, run like chickens: the parents show remarkable solicitude for them, flying with great anxiety and clamour near them, striking at either men or dogs that approach, and often fluttering along the ground like a wounded bird, to a considerable distance from their nest, to delude their pursuers; and to aid the deceit, they become more clamorous when most remote from it: the eggs are held in great esteem for their delicacy, and are sold by the London poulterers for three shillings the dozen. In winter, lapwings join in vast flocks; but at that season are very wild: their flesh is very good, their food being insects and worms. During October and November, they are taken in the fens in nets, in the same manner that ruffs are; but are not preserved for fattening, being killed as soon as caught.

2. *Pugnax*. The male of this species is called *ruff*, and the female *reeve*. The name *ruff* is given to the males because they are furnished with very long feathers, standing out in a remarkable manner, not unlike the ruff worn by our ancestors. The ruff is of as many different colours as there are males; but in general it is barred with black; the weight is six or seven ounces; the length, one foot. The female, or *reeve*, has no ruff; the common colour is brown; the feathers are edged with a very pale colour; the breast and belly white. Its weight is about four ounces.

These birds appear in the fens in the earliest spring, and disappear about Michaelmas. The reeves lay four eggs in a tuft of grass, the first week in May, and sit about a month. The eggs are white, marked with large rusty spots. Fowlers avoid in general the taking of the females; not only because they are smaller than the males, but that they may be left to breed.

Soon after their arrival, the males begin to hill, that is, to collect on some dry bank near a splash of water, in expectation of the females, who resort to them. Each male keeps possession of a small piece of ground, which it runs round till the grass is worn quite away, and nothing but a naked circle is left. When a female lights, the ruffs immediately fall to fighting. It is a vulgar error, that ruffs must be fed in the dark lest they should destroy each other by fighting on admission of light. The truth is, every bird takes its stand in the room as it would in the open fen. If another invades its circle, an attack is made, and a battle ensues. They make use of the same action in fighting as a cock, place their bills to the ground and spread their ruffs. Mr Pennant says, he has set a whole room-full a-fighting, by making them move their stations; and after quitting the place, by peeping through a crevice, seen them resume their circles and grow pacific.

When a fowler discovers one of those hills, he places his net over night, which is of the same kind as those that are called *clap* or *day nets*; only it is generally single, and is about 14 yards long and four broad. The fowler resorts to his stand at day-break, at the distance of one, two, three, or four hundred yards from the nets, according to the time of the season; for the later it is, the shyer the birds grow. He then makes his first pull, taking such birds as he finds within reach: after that he places his stuffed birds or stales to entice those that are continually traversing the fen. When the stales are set, seldom more than two or three are taken at a time. A fowler will take 40 or 50 dozen in a season. —These birds are found in Lincolnshire, the isle of Ely, and in the East Riding of York. They visit a place called *Martin-Mere* in Lancashire the latter end of March or beginning of April; but do not continue there above three weeks; where they are taken in nets, and fattened for the table with bread and milk, hempseed, and sometimes boiled wheat; but if expedition is required, sugar is added, which will make them in a fortnight's time a lump of fat: they then sell for two shillings or half a crown a-piece. They are dressed like the woodcock, with their intestines; and when killed at the critical time, say the Epicures, are the most delicious of all morsels.

3. *Canutus*, or knot, has the forehead, chin, and lower part of the neck, brown, inclining to ash-colour; the back and scapulars deep brown, edged with ash-colour; the coverts of the wings white, the edges of the lower order deeply so, forming a white bar; the breast, sides, and belly white, the two first streaked with brown; the coverts of the tail marked with white and dusky spots alternately; the tail ash coloured, the outmost feather on each side white; the legs of a bluish grey; and the toes, as a special mark, divided to the very bottom; the weight four ounces and a half.—

half.—These birds, when fattened, are preferred by some to the ruffs themselves. They are taken in great numbers on the coasts of Lincolnshire, in nets such as are employed in taking ruffs; with two or three dozens of stales of wood painted like the birds, placed within; 14 dozens have been taken at once. Their season is from the beginning of August to that of November. They disappear with the first frosts. Camden says they derive their name from king Canute, Knute, or Knout, as he is sometimes called; probably because they were a favourite dish with that monarch. We know that he kept the feast of the purification of the Virgin Mary with great pomp and magnificence at Ely; and this being one of the fen-birds, it is not unlikely but he met with it there.

4. The *hypoleucos*, or common sandpiper, except in pairing time, is a solitary bird: it is never found near the sea, but frequents rivers, lakes, and other fresh waters. Its head is brown, streaked with downward black lines; the neck an obscure ash-colour; the back and coverts of the wings brown, mixed with a glossy green, elegantly marked with transverse dusky lines; the breast and belly are of a pure white; the quill-feathers and the middle feathers of the tail are brown; the legs of a dull pale green.

5. The *alpina*, or dunling sandpiper, is at once distinguished from the others by the singularity of its colours. The back, head, and upper part of the neck, are ferruginous, marked with large black spots; the lower part of the neck white, marked with short dusky streaks; the coverts of the wings ash-colour; the belly white, marked with large black spots, or with a black crescent pointing towards the thighs; the tail is ash-coloured; legs black; toes divided to their origin. In size it is superior to that of a lark. These birds are found on our sea-coasts; but may be reckoned among the more rare kinds. They lay four eggs of a dirty white colour, blotched with brown round the thicker end, and marked with a few small spots of the same colour on the smaller end. They are common on the Yorkshire coasts, and esteemed a great delicacy.

6. The *cinclus*, purre, or stint, is in length $7\frac{1}{2}$ inches; the head and hind part of the neck are ash-coloured, marked with dusky lines; a white stroke divides the bill and eyes; the back is of a brownish ash-colour; the breast and belly white; the coverts of the wings and tail a dark brown, edged with light ash colour or white; the upper part of the quill-feathers dusky, the lower white; the legs of a dusky green; the toes divided to their origin. The bill an inch and a half long, slender, and black; irides dusky.—These birds come in prodigious flocks on our sea-coasts during the winter: in their flight they perform their evolutions with great regularity; appearing like a white or a dusky cloud, as they turn their backs or their breasts towards you. They leave our shores in spring, and retire to some unknown place to breed. They were formerly a well known dish at our tables.

TRINIDAD, an island in the gulf of Mexico, separated from New Andalusia, in Terra Firma, by a strait, about three miles over. The soil is fruitful, producing sugar, cotton, Indian corn, fine tobacco, and fruits; but the air is unhealthy. It was taken by Sir Walter Raleigh in 1595, and by the French in 1676, who plundered the island and then left it. It is about 62 miles in length, and 45 in breadth; and was discovered by Christopher Columbus in 1498. There is a bituminous lake in this island; for an account of which, see the article PETROLEUM, p. 252. note B

TRINITARIANS, those who believe in the Trinity; those who do not believe therein being called *Antitrinitarians*.

TRINITY, in theology, the ineffable mystery of three persons in one God; Father, Son, and Holy Spirit. See THEOLOGY. n° 61. Trinity

Trinity-House. See LONDON, n° 39.

Trinity-Sunday, a festival observed on the Sunday next after Whitsunday, in honour of the holy Trinity. The observation of this festival was first enjoined in the council of Arles, anno 1260.

TRINOBANTES, (anc. geog.) a people of Britain, supposed to have occupied Middlesex and Essex.

TRIO, in music, a part of a concert wherein three persons sing; or, more properly, a musical composition consisting of three parts.

TRIPHTHONG, in grammar, an assemblage or concourse of three vowels in one syllable; as *yea*.

TRIPLE, in music, is one of the species of measure or time. See MUSIC.

TRIPOD, in antiquity, a famed sacred seat or stool, supported by three feet, whereon the priests and sybils were placed to render oracles. It was on the tripod that the gods were said to inspire the Pythias with that divine fury and enthusiasm wherewith they were seized at the delivery of their predictions.

TRIPOLI, a country of Africa, in Barbary; bounded on the north by the Mediterranean sea; on the south, by the country of the Beriberies; on the west, by the kingdom of Tunis, Biledulgerid, and a territory of the Ga[illegible]; and on the east, by Egypt. It is about 925 miles along the sea coast; but the breadth is various. Some parts of it are pretty fruitful; but that towards Egypt is a sandy desert. It had the title of a *kingdom*; but is now a republic, governed by a dey. He is not absolute, for a Turkish bashaw resides here, who receives his authority from the grand seignior, and has a power of controling the dey, and levying taxes on the people. The dey is elected by the soldiers, who make no scruple of deposing him when they please.

TRIPOLI, a considerable town of Africa, and capital of a republic of the same name in Barbary, and under protection of the grand seignior, with a castle and a fort. It is pretty large, and the inhabitants are noted pirates. It was taken by Charles V. who settled the knights of Malta there; but they were driven away by the Turks in 1551. It was formerly very flourishing; and has now some trade in stuffs, saffron, corn, oil, wool, dates, ostrich feathers, and skins: but they make more of the Christian slaves which they take at sea; for they either set high ransoms upon them, or make them perform all sorts of work. It is seated on the coast of the Mediterranean, in a sandy soil, and surrounded by a wall, strengthened by other fortifications. E. Long. 13. 12. N. Lat. 32. 34.

TRIPOLI, called *Tripolis of Syria*, to distinguish it from Tripoli in *Barbary*, received its name from its being anciently formed of three cities at a small distance from each other, one of which belonged to the Aradians, or ancient kingdom of Arad, the second to the Sidonians, and the third to the Tyrians, perhaps as a common mart to those maritime powers. The present town of Tripoli is built at the distance of a mile and a half from the other, upon the declivity of a hill facing the sea, in 34° 20′ north latitude, and in 35° 50′ east longitude from Greenwich. It is surrounded with walls, fortified with seven high strong towers, and a castle, all of Gothic architecture; but the streets are narrow, and the houses low. The city contains about 8000 houses, and near 60,000 inhabitants, consisting of Turks, Christians, and Jews. The basha, or pacha, who resides in the castle, where there is a garrison of 2[illegible] janizaries, governs the adjacent territory, in which there is plenty of fruit, Tripoli

and a great number of mulberry-trees, which enable the inhabitants to carry on a silk manufacture, from which they draw considerable profit.

All the environs of Tripoli are laid out in orchards, where the mulberry trees grow plentifully, and the white mulberry is cultivated for the silk worms; the pomegranate, orange, and lemon trees for their fruit, which is here very fine. The country, though delightful to the eye, is unhealthy; from July to September, epidemic fevers, like those of Scanderoon and Cyprus, prevail, and are principally caused by the artificial inundations made for the purpose of watering the mulberry trees, to enable them to throw out their second leaves, and from a want of free circulation of air, the city being open only to the westward.

TRIPOLI, a genus of argillaceous earth, much used in the polishing of metals. It has its name from Tripoli in Barbary, from whence it was formerly brought to us, and has the following properties: 1. It does not effervesce with any of the acids. 2. It hardens in the fire; and by a considerable heat, its surface becomes vitrified. 3. Every kind of it, excepting that found in England, becomes red by calcination. 4. It is fusible by mixture with calcareous earth, as well as by means of borax and microcosmic salt. 5. Generally no salt can be extracted by washing, though sometimes the marine and vitriolic acid may be extracted by distillation. 6. When crude it imbibes water, but is not diffusible in it. 7. It tastes like common chalk, and feels sandy between the teeth, though no sand can by any means be extracted from it.

Tripoli is found of two different kinds: 1. Solid, and of a rough texture; brown, yellowish, and spotted like marble. 2. Friable and compact; granulated, brown, or yellowish; this last being the kind met with in England. This last kind has also been found in Scotland; but the rotten stone found in Derbyshire, and likewise much used in polishing, is quite another substance. According to Ferber, the rotten stone is tripoli mixed with a calcareous earth. In the memoirs of the academy at Paris, for 1769, it is asserted, that tripoli is a volcanic product. In proof of this, we are there informed, that a coal-mine at St Estienne having accidentally taken fire, and the fire having extended to some beds of schistus and bitumen, tripoli was found in the burnt parts of the strata, but nowhere else. Cronstedt is of opinion, that 100 parts of it contain 90 of siliceous earth, 7 of argill, and 3 of iron: but the red sort probably contains more iron.

TRIPTOLEMUS, laws of. See MYSTERIES, n° 7[illegible].

TRIQUETROUS, among botanists, expresses a fruit or leaf that has three sides or faces all flat.

TRIREMIS, in antiquity, a galley with three ranks of oars on a side.

TRISMEGISTUS, an epithet or surname given to one of the two Hermeses. See THOTH.

TRISMUS, the LOCKED JAW. See MEDICINE, n° 280.

TRISYLLABLE, in grammar, a word consisting of three syllables.

TRITICUM, WHEAT, in botany: A genus of plants belonging to the class of *triandria*, and order of *digynia*; and in the natural system ranging under the 4th order, *Gramina*. The calyx is bivalve, solitary, and generally containing three florets; the corolla is bivalve, one valve being bluntish, the other acute. There are 15 species; the *æstivum*, summer or spring wheat; *hybernum*, winter Lammas, or common wheat; compositum, *turgidum*, or cone-wheat; *polonicum*, or Polish wheat; *spelta*, or spelt wheat; *monococcum*, or one-grained wheat; *prostratum*, or trailing wheat-grass; *pumilum*, or dwarf wheat-grass; *junceum*, or rush wheat grass; *repens*, or couch-grass; *tenellum*, or tender wheat-grass; *maritimum*, or sea wheat-grass; *unilaterale*, or spiked sea-wheat; *unioloides*, or linear spiked wheat grass.—Of what country the first six species are natives, cannot now be determined: the prostratum is a native of Siberia; the junceum, repens, unilaterale, and maritimum, are natives of Britain; the tenellum is a native of Spain; and the unioloides is a native of Italy. It may also be observed, that the first nine are annuals, the rest are perennials. See AGRICULTURE, n° 122; and HUSBANDRY, Part I.

Linnæus comprehends the different kinds of wheat cultivated at present under six species; but cultivation has produced a great many varieties from these.

1. *Triticum æstivum*, or spring-wheat, hath four flowers in a calyx, three of which mostly bear grain. The calyces stand pretty distant from each other on both sides a flat smooth receptacle. The leaves of the calyx are keel shaped, smooth, and they terminate with a short arista. The glumes of the flowers are smooth and bellying, and the outer leaf of three of the glumes in every calyx is terminated by a long arista, but the three inner ones are beardless. The grain is rather longer and thinner than the common wheat. It is supposed to be a native of some part of Tartary. The farmers call it *Spring Wheat*, because it will come to the sickle with the common wheat, though it be sown in February or March. The varieties of it are: *Triticum æstivum spica et grana rubente*. Spring wheat, with a red spike and grain. *Triticum æstivum rubrum, spica alba*. Red spring wheat, with a white spike. *Triticum æstivum, spica et grana alba*. Spring wheat, with a white spike and grain.—2. *Triticum hybernum*, winter or common wheat, has also four flowers in a calyx, three of which are mostly productive. The calyces stand on each side a smooth flat receptacle, as in the former species, but they are not quite so far asunder. The leaves of the calyx are bellying, and so smooth that they appear as if polished, but they have no arista. The glumes of the flowers too are smooth, and the outer ones near the top of the spike are often tipped with short aristæ. The grain is rather plumper than the former, and is the sort most generally sown in England; whence the name of *common wheat*. Its varieties are: *Triticum hybernum, spica et grana rubente*. Common wheat, with a red spike and grain. *Triticum hybernum rubrum, spica alba*. Common red wheat, with a white spike. *Triticum hybernum, spica et grana alba*. Common wheat, with a white spike and grain.—3. *Triticum turgidum*, thick spiked or cone-wheat, is easily distinguished from either of the former; for though it has four flowers in a calyx after the manner of them, yet the whole calyx and the edges of the glumes are covered with soft hairs. The calyces too stand thicker on the receptacle, which make the spike appear more turgid. Some of the outer glumes near the top of the spike are terminated by short aristæ, like those of the common wheat. The grain is shorter, plumper, and more convex on the back than either of the former species. Its varieties are numerous, and have various appellations in different counties, owing to the great affinity of several of them. Those most easily to be distinguished are: *Triticum turgidum conicum album*. White cone wheat. *Triticum turgidum conicum rubrum*. Red cone wheat. *Triticum turgidum aristiferum*. Bearded cone wheat. *Triticum turgidum, spica multiplici*. Cone wheat, with many ears. The third variety is what the farmers call *clog wheat*, *square wheat*, and *rivets*. The grain of this is remarkably convex on one side, and when ripe the awns generally break in pieces and fall off. This sort is very productive, but it yields an inferior flour to what the former two species do.—4. *Triticum Polonicum*, or Polish wheat, has some resemblance to the turgidum,

dum, but both grain and spike are longer. The calyx contains only two flowers, and the glumes are furnished with very long aristæ; the teeth of the midrib are bearded. As this sort is seldom sown in England, there is no telling what varieties it produces.—5. *Triticum Spelta*, spelt or German wheat. At first view this has a great resemblance to barley, but it has no involucrum. The calyx is truncated; that is, it appears as if the ends were snipped off, and it contains four flowers, two of which are hermaphrodite and the glumes bearded, but the intermediate ones are neuter. There are two rows of grain as in barley, but they are shaped like wheat. It is much cultivated in France, Germany, and Italy. 6. *Triticum monococcum*, St Peter's corn, or one-grained wheat, has three flowers in each calyx alternately bearded, and the middle one neuter. The spike is thinning, and has two rows of grain in the manner of barley. Where it grows naturally is not known, but it is cultivated in Germany; and in conjunction with spelt wheat is there made into bread, which is coarse, and not so nourishing as that made of common wheat. Malt made of any of our wheats is often put into beer, and a small quantity of it will give a large brewing a fine brown transparent tincture.

TRITON, a sea demigod, held by the ancients to be an officer or trumpeter of Neptune, attending on him, and carrying his orders from sea to sea.

TRITURATION, the act of reducing a solid body into a subtile powder; called also *pulverisation* and *levigation*.

TRIUMPH, in Roman antiquity, a public and solemn honour conferred by the Romans on a victorious general by allowing him a magnificent entry in the city.

The greater triumph, called also *curulis*, or simply the *triumph*, was decreed by the senate to a general, upon the conquering of a province or gaining a signal victory. The day appointed for the ceremony being arrived, scaffolds were erected in the forum and circus, and all the other parts of the city where they could best behold the pomp: the senate went to meet the conqueror without the gate called *Capena* or *Triumphalis*, and marched back in order to the Capitol: the ways being cleaned and cleared by a number of officers and tipstaffs, who drove away such as thronged the passage or straggled up and down. The general was clad in a rich purple robe, interwoven with figures of gold, setting forth his great exploits; his buskins were beset with pearl; and he wore a crown, which at first was only laurel, but afterwards gold; in one hand he bore a branch of laurel, and in the other a truncheon. He was carried in a magnificent chariot, adorned with ivory and plates of gold, drawn usually by two white horses; though sometimes by other animals, as that of Pompey, when he triumphed over Africa, by elephants; that of Marc Antony by lions; that of Heliogabalus by tygers; that of Aurelian by deer, &c. His children were at his feet, and sometimes on the chariot-horses. The procession was led up by the musicians, who played triumphal pieces in praise of the general: these were followed by young men, who led the victims to the sacrifice, with their horns gilded, and their heads adorned with ribbands and garlands; next came the carts and waggons, loaded with all the spoils taken from the enemy, with their horses, chariots, &c.; these were followed by the kings, princes, and generals, who had been taken captives, loaded with chains: after these appeared the triumphal chariot, before which, as it passed, they all along strewed flowers, and the people with loud acclamations called out, *Io triumphe!* The chariot was followed by the senate, clad in white robes; and the senate by such citizens as had been set at liberty or ransomed; and the procession was closed by the priests and their officers and utensils, with a white ox led along for the chief victim. In this order they proceeded through the triumphal gate, along the via sacra, to the Capitol, where the victims were slain. In the mean time all the temples were open, and all the altars loaded with offerings and incense; games and combats were celebrated in the public places, and [illegible] appeared every where.

TRIUMVIR, one of three persons who govern [illegible] ly, and with equal authority, in a state. It is chiefly applied to the Roman government: Cæsar, Pompey, and Crassus, were the first triumvirs who divided the government among them. There were also other officers so called; as the triumviri or tresviri capitales, who were tht keepers of the public gaol: they had the office of [illegible]; for which purpose they kept eight lictors under them.

TROAS, a country of Phrygia [illegible], of which Troy was the capital. When Troas is taken [illegible] kingdom of Priam, it may be said to contain Mysia and Phrygia Minor; but if only applied to that part of the country where Troy was situated, its extent is confined within very narrow limits. Troas was anciently called Dardania. See TROJA.

TROCHÆUS, in prosody, a foot consisting of a long and short syllable.

TROCHANTER, in anatomy. See there, n° 58.

TROCHE, in pharmacy, a sort of [illegible] tinous substances into little cakes, and afterwards [illegible]. See PHARMACY, n° 5[illegible].

TROCHILUS, HUMMING BIRD, a genus of birds belonging to the order of picæ. The [illegible] form, and longer than the head, the apex being tubular; the upper mandible sheaths the lower. The tongue is filiform and tubulous, [illegible]; the feet are slender and fit for walking; the tail has ten feathers. There are 65 species, none of which are natives of Britain. They are all remarkable for the beauty of their colours, and most of them for the smallness of their size, though some are eight or nine inches in length.—They are divided into two families, viz. those with crooked bills, and those with straight bills. Of these we shall describe the four following species:

1. The *exilis*, or little humming bird, has a crooked bill, [illegible] 50 grains. The bill is black, and half an inch in length: the body greenish-brown, with a red, shining, inimitable gloss: [illegible] is a native of Guiana; [illegible] great, that the eye can scarce keep pace with its motion.

2. [illegible], according to [illegible]. Its length is three inches four lines; the bill straight, eight lines long, and black; [illegible] of the neck are as bright as a ruby, and of the same colour: the upper parts of the body are brown, with a faint mixture of [illegible] colour of the most brilliant topaz: the belly, sides, and thighs are brown; but on the lower part of the belly, on each side, is a [illegible] olet at the ends; the two middle feathers are shortest: the legs and claws black. [illegible] the under parts are greyish white. This species is found in Brasil, [illegible].

3. The *minimus*, or least humming-bird, is exceeded, both in weight and dimensions, by several species of bees. The total length is one inch and a quarter; [illegible] weighs

Trochilus. weighs no more, according to Sir Hans Sloane, than 20 grains. The bill is straight and black, three lines and a half in length: the upper parts of the head and body are of a greenish gilded brown, in some lights appearing reddish: the under parts are greyish white; the wings are violet-brown; the tail of a bluish black, with a glofs of polifhed metal; but the outer feather except one on each fide, is grey from the middle to the tip, and the outer one wholly grey; legs and claws brown. The female is lefs than the male: the whole upper fide of a dirty brown, with a flight glofs of green; the under parts of a dirty white. Thefe birds are found in various parts of South America and the adjacent iflands.—Our author received it from Jamaica.

4. *Superciliofus*, white fhaft, or fupercilious humming-bird, has a bill twenty lines long; the feathers of the tail next the two long fhafts are alfo the longeft, and the lateral ones continually decreafe to the two outermoft which are the fhorteft, and this gives the tail a pyramidical fhape: its quills have a gold colour on a grey and blackifh ground, with a whitifh edge at the point, and the two fhafts are white through the whole projecting portions; all the upper fide of the back and head gold colour; the wing violet-brown; and the under fide of the body white-grey.

Thefe birds fubfift on the nectar or fweet juice of flowers: they frequent thofe moft which have a long tube; particularly the *impatiens noli me tangere*, the *monarda* with crimfon flowers, and thofe of the convolvulus tribe. They never fettle on the flower during the action of extracting the juice, but flutter continually like bees, moving their wings very quick, and making a humming noife; whence their name. They are not very fhy, fuffering people to come within a foot or two of the place where they are, but on approaching nearer fly off like an arrow out of a bow. They often meet and fight for the right to a flower, and this all on the wing: in this ftate they often come into rooms where the windows ftand open, fight a little, and go out again. When they come to a flower which is juicelefs, or on the point of withering, they pluck it off as it were in anger, by which means the ground is often quite covered with them. When they fly againft each other, they have, befides the humming, a fort of chirping noife like a fparrow or chicken. They do not feed on infects nor fruit; nor can they be kept long in cages, though they have been preferved alive for feveral weeks together by feeding them with water in which fugar had been diffolved.

This bird moft frequently builds in the middle of a branch of a tree, and the neft is fo fmall that it cannot be feen by a perfon who ftands on the ground; any one therefore defirous of feeing it, muft get up to the branch, that he may view it from above: it is for this reafon that the nefts are not more frequently found. The neft is of courfe very fmall, and quite round: the outfide, for the moft part, is compofed of green mofs, common on old pales and trees; the infide of foft down, moftly collected from the leaves of the great mullein, or the filk-grafs; but fometimes they vary the texture, making ufe of flax, hemp, hairs, and other foft materials: they lay two eggs of the fize of a pea, which are white, and not bigger at one end than the other.

The above account of the manners will in general fuit all the birds of this genus; for as their tongues are made for fuction, it is by this method alone that they can gain nourifhment: no wonder, therefore, they can fcarcely be kept alive by human artifice. Captain Davies, however, informed our author, that he kept thefe birds alive for four months by the following method:—He made an exact imitation of fome of the tubular flowers with paper, faftened round a tobacco-pipe, and painted them of a proper colour; thefe were placed in the order of nature, in the cage wherein thefe little creatures were confined; the bottoms of the tubes were filled with a mixture of brown fugar and water as often as emptied; and he had the pleafure of feeing them perform every action; for they foon grew familiar, and took the nourifhment in the fame manner as when ranging at large, though clofe under his eye.

TROGLODYTES, in the ancient geography, a people of Ethiopia, faid to have lived in caves under ground. Pomponius Mela gives a ftrange account of the Troglodytes: he fays, they did not fo properly fpeak as fhriek; and that they lived on ferpents.

TROGUS (Pompeius), Latin univerfal hiftorian to the time of Auguftus Cæfar, of whom we have only an abridgement by Juftin, flourifhed about 41 B. C.

TROJA, the capital city of Troas, or, according to others, a country of which Ilium was the capital. It was built on a fmall eminence near mount Ida, and the promontory of Sigæum, at the diftance of about four miles from the fea-fhore. Dardanus the firft king of the country built it, and called it *Dardania*, and from Tros one of his fucceffors it was called *Troja*, and from Ilus *Ilion*. This city has been celebrated by the poems of Homer and Virgil; and of all the wars which have been carried on among the ancients, that of Troy is the moft famous.

A defcription of the plan of Troy has been lately publifhed in French in the 3d volume of the Philofophical Tranfactions of the Royal Society of Edinburgh, written by M. Chevalier. The city of Troy, according to him, ftood on the prefent fite of the modern village of Bounarbachi, diftant four leagues from the fea, and which is the refidence of an Aga, ruling with abfolute fway the inhabitants of the Trojan plain and the inferior Agas, to whom they are immediately fubject. Bounarbachi is fituated on the fide of an eminence, expofed to every wind, at the termination of a fpacious plain, the foil of which is rich and of a blackifh colour. Clofe to the village is to be feen a marfh covered with tall reeds; and the fituation is impregnable on all fides except at Erin (Homer's ...), the *hill of wild fig trees*, which extended between the Scæan gate and the fources of the Scamander. Thefe circumftances, agreeing with Homer's defcriptions, ftrongly fupport M. Chevalier's opinion concerning the fituation of Troy. A very interefting part of this work is the account of conical mounds or barrows, feveral of them 100 feet in diameter at the bafe; and which the author maintains to be the identical tombs raifed over the afhes of the heroes of the Trojan war; fome of them he deems more ancient. He defcribes particularly the tombs of Efyetes, Ilus, Ajax, Hector, Achilles, Patroclus, and Antilochus.

This differtation, which runs to the length of 92 quarto pages, is replete with erudition and ingenious reafoning, and is illuftrated and embellifhed by maps of the plan of Troy and feveral tables of infcriptions. It has been tranflated with much accuracy and care by Mr Dalzel profeffor of Greek in the Univerfity of Edinburgh, and accompanied with large notes and illuftrations.

TROLLIUS, Globe-flower, or *Lucken Gowan*, in botany: A genus of plants belonging to the clafs of *polyandria* and order of *polygynia*; and in the natural fyftem ranging under the 26th order, *Multifiliquæ*. The calyx is wanting; there are about 14 petals; the capfules are very numerous, ovate, and monofpermons. There are two fpecies, the afiaticus and europæus; the latter of which is a Britifh plant.

Europæus, or European globe-flower, has its corollets connivent, and from 9 to 16 nectaria, of the length of the ftamina, linear, plane, incurvated, and perforated at the infide of the bafe. The leaves are divided firft into five fegments down

down to the base; the ſegments are again divided, each about half way, into two or three lobes, which are ſharply indented on the edges. The ſtalk is a foot high, and ſcarcely branched: the flower is yellow, globoſe, and ſpacious. It grows at the foot of mountains, and by the ſides of rivulets. The country people in Sweden ſtrew their floors and pavements on holidays with the flowers, which have a pleaſant ſmell, and are ornamented in gardens.

TROMP (Martin Happertz Van), a celebrated Dutch admiral, was born at the Baille, in Holland. He raiſed himſelf by his merit, after having diſtinguiſhed himſelf on many occaſions, eſpecially at the famous engagement near Gibraltar in 1607. He paſſed for one of the greateſt ſeamen that had till that time appeared in the world; and was declared admiral of Holland, even by the advice of the prince of Orange. He in that character defeated a large Spaniſh fleet in 1630, and gained 32 other victories at ſea; but was killed when under deck, in an engagement with the Engliſh in 1653. The ſtates-general cauſed medals to be ſtruck to his honour, and lamented him as one of the greateſt heroes of their republic. Van Tromp, in the midſt of the greateſt glory, conſtantly diſcovered a remarkable modeſty; for he never aſſumed a higher character than that of a burgher, and that of being the father of the ſailors.

TRONAGE, an ancient cuſtomary duty or toll, for weighing of wool. According to Fleta, *trona* is a beam to weigh with, mentioned in the ſtat. Weſtm. 2. cap. 25. And tronage was uſed for the weighing wool in a ſtaple or public mart, by a commou trona or beam; which, for the tronage of wool in London, was fixed at Leaden-Hall. The mayor and commonalty of London are ordained keepers of the beams and weights for weighing merchants commodities, with power to aſſign clerks and porters, &c. of the great beam and balance; which weighing of goods and wares is called *tronage;* and no ſtranger ſhall buy any goods in London before they are weighed at the king's beam, on pain of forfeiture.

TRONE-WEIGHT, the moſt ancient of the different weights uſed in Scotland; and, though now forbidden by ſeveral ſtatutes, is ſtill uſed by many for home-commodities, and that in a very irregular manner; for the pound varies in different places, and for different purpoſes, from 20 to 24 Dutch ounces. The common allowance is $21\frac{1}{2}$ oz. for wool, $20\frac{1}{2}$ for butter and cheeſe, 20 for tallow, lint, hemp, and hay. It is divided into 16 of its own ounces, and 16 pounds make a ſtone.

TROOP, a ſmall body of horſe or dragoons, about 50 or 60, ſometimes more, ſometimes leſs, commanded by a captain, lieutenant, cornet, quarter-maſter, and three corporals, who are the loweſt officers of a troop.

TROPE. See ORATORY, n° 52—66.

TROPHONIUS CAVE, or *Oracle* (anc. geog.), a cave near Lebadia in Bœotia, between Helicon and Chæronea (Strabo): ſo called from Trophonius, an enthuſiaſtic diviner; who, deſcending into this cave, pretended to give anſwers and pronounce oracles; and was hence called *Jupiter Trophonius*. Such as went down to this cave never after ſmiled; hence the proverbial ſaying of a man who has loſt his mirth, That he is come out of Trophonius's cave. Though Pauſanias, who writes from experience, contradicts this; affirming that perſons came out of the cave affected indeed with a ſtupor, but that they ſoon after recovered themſelves. See ORACLE.

TROPHY *(Tropæum)*, among the ancients, a monument of victory.

TROPIC-BIRD. See PHÆTON.

TROPICS. See GEOGRAPHY, n° 40.

TROUBADOURS, poets that flouriſhed in Provence during the 12th century.

They wrote poems on love and gallantry; on the illuſtrious characters and remarkable events of the times; ſatires which were chiefly directed againſt the clergy and monks; and a few didactic pieces. The troubadours were great favourites in different courts, diffuſed a taſte for their language and for poetry over Europe, which was about that time ſunk in ignorance and rudeneſs; they diſappeared in the 14th century. A hiſtory of the troubadours in 3 volumes 12mo, was begun by M. de Sainte Palaie, and finiſhed by the Abbé Millot. See MUSIC, n° 23.

TROVER, in law, an action that a man hath againſt one that, having found any of his goods, reſuſeth to deliver them upon demand.

TROUT. See SALMO.

TROY. See TROJA.

Troy-Weight, one of the moſt ancient of the different kinds uſed in Britain. The ounce of this weight was brought from Grand Cairo in Egypt, about the time of the cruſades, into Europe, and firſt adopted in *Troyes* a city of Champagne; whence the name.

The pound *Engliſh* Troy contains 12 ounces, or 5760 grains. It was formerly uſed for every purpoſe; and is ſtill retained for weighing gold, ſilver, and jewels; for compounding medicines; for experiments in natural philoſophy; and for comparing different weights with each other.

Scots Troy-Weight was eſtabliſhed by James VI. in the year 1618, who enacted, that only one weight ſhould be uſed in Scotland, viz. the French Troy ſtone of 16 pounds, and 16 ounces in the pound. The pound contains 7600 grains, and is equal to 17 oz. 6 dr. avoirdupois. The cwt. or 112 lb. avoirdupois, contains only 103 lb. $2\frac{1}{2}$ oz. of this weight, though generally reckoned equal to 104 lb. This weight is nearly, if not exactly, the ſame as that of Paris and Amſterdam; and is generally known by the name of *Dutch weight*. Though prohibited by the articles of union, it is ſtill uſed in weighing iron, hemp, flax, moſt Dutch and Baltic goods, meal, butcher-meat, unwrought pewter and lead, and ſome other articles.

TRUE-LOVE, in botany. See PARIS.

TRUFFLES. See LYCOPERDON.

TRUMPET, a muſical inſtrument, the moſt noble of all portable ones of the wind kind; uſed chiefly in war, among the cavalry to direct them in the ſervice. Each troop of cavalry has one. The cords of the trumpets are of crimſon, mixed with the colours of the facings of the regiments.

As to the invention of the trumpet, ſome Greek hiſtorians aſcribe it to the Tyrrhenians; but others, with greater probability, to the Egyptians; from whom it might have been tranſmitted to the Iſraelites. The trumpet was not in uſe among the Greeks at the time of the Trojan war; though it was in common uſe in the time of Homer. According to Potter (*Arch. Græc.* vol. ii. cap. 9), before the invention of trumpets, the firſt ſignals of battle in primitive wars were lighted torches; to theſe ſucceeded ſhells of fiſhes, which were ſounded like trumpets. And when the trumpet became common in military uſe, it may well be imagined to have ſerved at firſt only as a rough and noiſy ſignal of battle, like that at preſent in Abyſſinia and New Zealand, and perhaps with only one ſound. But, even when more notes were produced from it, ſo noiſy an inſtrument muſt have been an unfit accompaniment for the voice and poetry; ſo that it is probable the trumpet was the firſt ſolo inſtrument in uſe among the ancients.

Trumpet, articulate, comprehends both the *ſpeaking* and the *hearing* trumpet, is by much the moſt valuable inſtrument, and has, in one of its forms, been invented by people among whom we ſhould hardly have expected to find ſuch improvements.

That the *ſpeaking trumpet*, of which the object is to increaſe the

Trumpet. the force of articulate founds, fhould have been known to the ancient Greeks, can excite no wonder; and therefore we eafily admit the accounts which we read of the horn or trumpet, with which Alexander addreffed his army, as well as of the whifpering caverns of the Syracufan tyrant. But that the natives of Peru were acquainted with this inftrument, will probably furprife many of our readers. The fact however feems incontrovertible.

In the Hiftory of the Order of Jefuits, publifhed at Naples in 1[illegible] by Beritaria, it is faid, that in the year 1[illegible]95 a fmall convent of that order in Peru, fituated in a remote corner, was in danger of immediate deftruction by famine. One evening the fuperior Father Samaniac, implored the help of the cacique; next morning, on opening the gate of the monaftery, he found it furrounded by a number of women, each of whom carried a fmall bafket of provifions. He returned thanks to heaven for having miraculoufly interpofed, by infpiring the good people with pity for the diftrefs of his friars. But when he expreffed to them his wonder how they came all to be moved as if by mutual agreement with thefe benevolent fentiments, they told him it was no fuch thing; that they looked on him and his countrymen as a pack of infernal magicians, who by their forceries had enflaved the country, and had bewitched their good cacique, who hitherto had treated them with kindnefs and attention, as became a true worfhipper of the fun; but that the preceding evening at funfet he had ordered the inhabitants of fuch and fuch villages, about fix miles off, to come that morning with provifions to this neft of wizzards.

The fuperior afked them in what manner the governor had warned fo many of them in fo fhort a time, at fuch a diftance from his own refidence? They told him that it was by the trumpet; and that every perfon heard at their own door the diftinct terms of the order. The father had heard nothing; but they told him that none heard the trumpet but the inhabitants of villages to which it was directed. This is a piece of very curious information; but, after allowing a good deal to the exaggeration of the reverend Jefuits, it cannot, we think, be doubted, but that the Peruvians actually poffeffed this ftentorophonic art. For we may obferve that the effect defcribed in this narration refembles what we *now know* to be the effect of fpeaking trumpets, while it is unlike what the inventor of fuch a tale would naturally and ignorantly fay. Till fpeaking trumpets were really known, we fhould expect the found to be equally diffufed on all fides, which is not the cafe; for it is much ftronger in the line of the trumpet than in any direction very oblique to it.

About the middle of the laft century, Athanafius Kircher turned his attention to the philofophy of found, and in different works threw out many ufeful and fcientific hints on the conftruction of fpeaking trumpets (fee ACOUSTICS and KIRCHER); but his mathematical illuftrations were fo vague, and his own character of inattention and credulity fo notorious, that for fome time thefe works did not attract the notice to which they were well intitled.

About the 1670 Sir Samuel Morland, a gentleman of great ingenuity, fcience, and order, took up the fubject, and propofed as a queftion to the Royal Society of London, What is the beft form for a fpeaking trumpet? which he called a ftentorophonic horn. He accompanied his demand with an account of his own notions on the fubject (which he acknowledged to be very vague and conjectural), and an exhibition of fome inftruments conftructed according to his views. They were in general very large conical tubes, fuddenly fpreading at the very mouth to a greater width. Their effect was really wonderful. They were tried in St James's park; and his Majefty K. Charles II. fpeaking in his ordinary colloquial pitch of voice through a trumpet only $5\frac{1}{2}$ feet long, was clearly and moft diftinctly heard at the diftance of a thoufand yards. Another perfon, felected we fuppofe for the loudnefs and diftinctnefs of his voice, was perfectly underftood at the diftance of four miles and a half. The fame of this foon fpread; Sir Samuel Morland's principles were refined, confidering the novelty of the thing, and differ confiderably from father Kircher's. The aerial undulations (for he fpeaks very accurately concerning the nature of found) endeavour to diffufe themfelves in fpheres, but are ftopped by the tube, and therefore redundulate towards the axis like waves from a bank, and, meeting in the axis, they form a ftrong undulation a little farther advanced along the tube, which again fpreads, is again reflected, and fo on, till it arrives at the mouth of the tube greatly magnified, and then it is diffufed through the open air in the fame manner, as if all proceeded from a *very* fonorous point in the centre of the wide end of the trumpet. The author diftinguifhes with great judgment between the prodigious reinforcement of found in a fpeaking trumpet and that in the mufical trumpet, bugle-horn, conch-fhell, &c.; and fhows that the difference confifts only in the violence of the firft fonorous agitation, which can be produced by us only on a very fmall extent of furface. The mouth-piece diameter therefore of the mufical trumpet muft be very fmall, and the force of blaft very confiderable. Thus one ftrong but fimple undulation will be excited, which muft be fubjected to the modifications of harmony, and will be augmented by ufing a conical tube (A). But a fpeaking trumpet muft make no change on the nature of the firft undulations; and each point of the mouth-piece muft be equally confidered as the centre of fonorous undulations, all of which muft be reinforced in the fame degree, otherwife all diftinctnefs of articulation will be loft. The mouth-piece muft therefore take in the whole of of the mouth of the fpeaker.

When Sir Samuel Morland's trumpet came to be generally known on the continent, it was foon difcovered that the fpeaker could be heard at a great diftance only in the line of the trumpet; and this circumftance was by a Mr Caffegrain (*Journ. des Sçavans* 1672, p. 131) attributed to a defect in the principle of its conftruction, which he faid was not according to the laws of fonorous undulations. He propofed a conoid formed by the revolution of a hyperbola round its affymptote as the beft form. A Mr Hafe of Wirtemberg, on the other hand, propofed a parabolic conoid, having the mouth of the fpeaker placed in the focus. In this conftruction he plainly went on the principle of a reflection fimilar to that of the rays of light; but this is by no means the cafe. The effect of the parabola will be to give one reflection, and in this all the circular undulations will be converted into plane waves, which are at right angles to the axis of the trumpet. But nothing hinders their fubfequent diffufion; for it does not appear that the found will be enforced, becaufe the agitation of the particles on each wave is not augmented.

The fubject is exceedingly difficult. We do not fully comprehend on what circumftance the affection or agitation of our organ, or fimply of the membrana tympani, depends. A more violent agitation of the fame air, that is, a wider ofcillation of its particles, cannot fail to increafe the impulfe on this membrane. The point therefore is to find what concourfe

(A) Accordingly the found of the bugle-horn, of the mufical trumpet, or the French horn, is prodigioufly loud, when we confider the fmall paffage through which a moderate blaft is fent by the trumpeter.

concourfe of feeble undulations will produce or be equivalent to a great one. The reafonings of all thefe reftorers of the fpeaking trumpet are almoft equally fpecious, and each point out fome phenomenon which fhould characterife the principle of conftruction, and thus enable us to fay which is moft agreeable to the procedure of nature.—Yet there is hardly any difference in the performance of trumpets of equal dimenfions made after thefe different methods.

The propagation of light and of elaftic undulations feem to require very different methods of management. Yet the ordinary phenomena of echoes are perfectly explicable by the acknowledged laws either of optics or acouftics; ftill however there are fome phenomena of found which are very unlike the genuine refults of elaftic undulations. If founds are propagated fpherically, then what comes into a room by a fmall hole fhould diffufe itfelf from that hole as round a centre, and it fhould be heard equally well at twelve feet diftance from the hole in every direction. Yet it is very fenfibly louder when the hearer is in the ftraight line drawn from the fonorous body through the hole. A perfon can judge of the direction of the founding body with tolerable exactnefs. Cannon difcharged from the different fides of a fhip are very eafily diftinguifhed, which fhould not be the cafe by the Newtonian theory; for in this the two pulfes on the ear fhould have no fenfible difference.

The moft important fact for our purpofe is this: An echo from a fmall plane furface in the midft of an open field is not heard, unlefs we ftand in fuch a fituation that the angle of reflected found may be equal to that of incidence. But by the ufual theory of undulations, this fmall furface fhould become the centre of a new undulation, which fhould fpread in all directions. If we make an analogous experiment on watery undulations, by placing a fmall flat furface fo as to project a little above the water, and then drop in a fmall pebble at a diftance, fo as to raife one circular wave, we fhall obferve, that when this wave arrives at the projecting plane, it is difturbed by it, and this difturbance fpreads from it on all fides. It is indeed fenfibly ftronger in that line which is drawn from it at equal angles with the line drawn to the place where the pebble was dropped. But in the cafe of found, it is a fact, that if we go to a very fmall diftance on either fide of the line of reflection, we fhall hear nothing.

Here then is a fact, that whatever may be the nature of the elaftic undulations, founds are reflected from a fmall plane in the fame manner as light. We may avail ourfelves of this fact as a mean for enforcing found, though we cannot explain it in a fatisfactory manner. We fhould expect from it an effect fimilar to the hearing of the original found, along with another original found coming from the place from which this reflected found diverges. If therefore the reflected found or echo arrives at the ear in the fame inftant with the original found, the effect will be doubled; or at leaft it will be the fame with two fimultaneous original founds. Now we know that this is in fome fenfe equivalent to a ftronger found. For it is a fact, that a number of voices uttering the fame or equal founds are heard at a much greater diftance than a fingle voice. We cannot perhaps explain how this happens by mechanical laws, nor affign the exact proportion in which 10 voices exceed the effect of one voice; nor the proportion of the diftances at which they feem equally loud. We may therefore, for the prefent, fuppofe that two equal voices at the fame diftance are twice as loud, three voices three times as loud, &c. Therefore if, by means of a fpeaking trumpet, we can make 10 equal echoes arrive at the ear at the fame moment, we may fuppofe its effect to be to increafe the audibility 10 times; and we may exprefs this fhortly, by calling the found 10 times louder or more intenfe.

Trumpet

But we cannot do this precifely. We cannot by any contrivance make the found of a momentary fnap, and thofe of its echoes, arrive at the ear in the fame moment, becaufe they come from different diftances. But if the original noife be a continued found, a man's voice, for example, uttering a continued uniform tone, the firft echo may reach the ear at the fame moment with the fecond vibration of the larynx; the fecond echo along with the third vibration, and fo on. It is evident, that this will produce the fame effect. The only difference will be, that the articulations of the voice will be made indiftinct, if the echoes come from very different diftances. Thus if a man pronounce the fyllable *taw*, and the 10 fucceffive echoes are made from places which are 10 feet farther off, the 10th part of a fecond (nearly) will intervene between hearing the firft and the laft. This will give it the found of the fyllable *thaw*, or perhaps *raw*, becaufe *r* is the repetition of *t*. Something like this occurs when, ftanding at one end of a long line of foldiers, we hear the mufkets of the whole line difcharged in one inftant. It feems to us the found of a running fire.

The aim therefore in the conftruction of a fpeaking trumpet may be, to caufe as many echoes as poffible to reach a diftant ear without any perceptible interval of time. This will give diftinctnefs, and fomething equivalent to loudnefs. *Pure* loudnefs arifes from the violence of the fingle aerial undulation. To increafe this may be the aim in the conftruction of a trumpet; but we are not fufficiently acquainted with the mechanifm of thefe undulations to bring this about with certainty and precifion; whereas we can procure this accumulation of echoes without much trouble, fince we know that echoes are, *in fact*, reflected like light. We can form a trumpet fo that many of thefe lines of reflected found fhall pafs through the place of the hearer. We are indebted to Mr Lambert of Berlin for this fimple and popular view of the fubject; and fhall here give an abftract of his moft ingenious Differtation on Acouftic Inftruments, publifhed in the Berlin Memoirs for 1763.

Sound naturally fpreads in all directions; but we know that echoes or reflected founds proceed almoft ftrictly in certain limited directions. If therefore we contrive a trumpet in fuch a way that the lines of echo fhall be confined within a certain fpace, it is reafonable to fuppofe that the found will become more audible in proportion as this diffufion is prevented. Therefore if we can oblige a found which, in the open air, would have diffufed itfelf over a hemifphere, to keep within a cone of 120 degrees, we fhould expect it to be twice as audible within this cone. This will be accomplifhed, by making the reflections fuch that the lines of reflected found fhall be confined within this cone. *N. B.* We here fuppofe that nothing is loft in the reflection. Let us examine the effect of a cylindrical trumpet.

Let the trumpet be a cylinder ABED (fig. 1.), and let C be a founding point in the axis. It is evident that all the found in the cone BCE will go forward without any reflection. Let CM be any other line of found, which we may, for brevity's fake, call a *fonorous* or *phonic line*. Being reflected in the points M, N, O, P, it is evident that it will at laft efcape from the trumpet in a direction PQ, equally diverging from the axis with the line CM. The fame muft be true of every other fonorous line. Therefore the echoes will all diverge from the mouth of the trumpet in the fame manner as they would have proceeded from C without any trumpet. Even fuppofing, therefore, that the echoes are as ftrong as the original found, no advantage is gained by fuch a trumpet, but that of bringing the found forward

Plate DXII.

Trumpet.

from C to *c*. This is quite trifling when the hearer is at a distance. Yet we fee that founds may be heard at a very great distance, at the end of long, narrow, cylindrical, or prismatical galleries. It is known that a voice may be distinctly heard at the distance of feveral hundred feet in the Roman aqueducts, whofe fides are perfectly ftraight and fmooth, being plaftered with ftucco. The fmooth furface of the ftill water greatly contributes to this effect. Cylindrical or prifmatical trumpets muft therefore be rejected.

Let the trumpet be a cone BCA (fig. 2.), of which CN is the axis, DK a line perpendicular to the axis, and DFHI the path of a reflected found in the plane of the axis. The laft angle of reflection IHA is equal to the laft angle of incidence FHC. The angle DFH, or its equal CFD, is equal to the angles FHD and FCH; that is, the angle of incidence CFD exceeds the next angle of incidence FHC by the angle FCD; that is, by the angle of the cone. In like manner, FDH exceeds CFD by the fame angle FCD. Thus every fucceeding angle, either of incidence or reflection, exceeds the next by the angle of the cone. Call the angle of the cone a, and let b be the firft angle of incidence FDC. The fecond, or DFC, is $b - a$. The third, or FHC, is $b - 2a$, &c.: and the nth angle of incidence or reflection is $b - na$, after n reflections. Since the angle diminifhes by equal quantities at each fubfequent reflection, it is plain, that whatever be the firft angle of incidence, it may be exhaufted by this diminution; namely, when n times a exceeds or is equal to b. Therefore to know how many reflections of a found, whofe firft incidence has the inclination b, can be made in an infinitely extended cone, whofe angle is a, divide b by a; the quotient will give the number n of reflections, and the remainder, if any, will be the laft angle of incidence or reflection lefs than a. It is very plain, that when an angle of reflection IHA is equal to or lefs than the angle BCA of the cone, the reflected line HI will no more meet with the other fide CB of the cone.

We may here obferve, that the greateft angle of incidence is a right angle, or 90°. This found would be reflected back in the fame line, and would be incident on the oppofite fide in an angle $= 90° - a$, &c.

Thus we fee that a conical trumpet is well fuited for confining the found: for by prolonging it fufficiently, we can keep the lines of reflected found wholly within the cone. And when it is not carried to fuch a length as to do this, when it allows the founding line GH, for example, to efcape without farther reflection, the divergency from the axis is lefs than the laft angle of reflection BGH by half the angle BCA of the cone. Let us fee what is the connection between the length and the angle of ultimate reflection.

We have fin. $\overline{b-a}$: fin. b = CD : CF, and $CF = CD \times \frac{\text{fin. } b}{\text{fin. } \overline{b-a}}$, and fin. $\overline{b-2a}$: fin. $\overline{b-a}$ = CF : CH, and

$$CH = CF \times \frac{\text{fin. } b-a}{\text{fin. } b-2a} = CD \times \frac{\text{fin. } b}{\text{fin. } b-a} \times \frac{\text{fin. } \overline{b-a}}{\text{fin. } b-2a}, = CD \times \frac{\text{fin. } b}{\text{fin. } b-2a}, \text{ \&c.}$$

Therefore if we fuppofe X to be the length which will give us n reflections, we fhall have $X = CD \times \frac{\text{fin. } b}{\text{fin. } b-na}$. Hence we fee that the length increafes as the angle $\overline{b-na}$ diminifhes; but is not infinite, unlefs na is equal to b. In this cafe, the immediately preceding angle of reflection muft be a, becaufe thefe angles have the common difference a. Therefore the laft reflected found was moving parallel to the oppofite fide of the cone, and cannot again meet it. But though we cannot affign the length which will give the nth reflection, we can give the length which will give the one immediately preceding, whofe angle with the fide of the cone is a. Let Y be this length. We have $Y = CD \times \frac{\text{fin. } b}{\text{fin. } a}$. This length will allow every line of found to be reflected as often, faving once, as if the tube were infinitely long. For fuppofe a fonorous line to be traced backwards, as if a found entered the tube in the direction $i\,h$, and were reflected in the points h, f, d, δ, D, the angles will be continually augmented by the conftant angle a. But this augmentation can never go farther than $90° + \frac{1}{2}a$. For if it reaches that value at D, for inftance, the reflected line DK will be perpendicular to the axis CN; and the angle ADK will be equal to the angle DKB, and the found will come out again. This remark is of importance on another account.

Now fuppofe the cone to be cut off at D by a plane perpendicular to the axis, KD will be the diameter of its mouth-piece; and if we fuppofe a mouth completely occupying this circle, and every point of the circle to be fonorous, the reflected founds will proceed from it in the fame manner as light would from a flame which completely occupies its area, and is reflected by the infide of the cone. The angle FDA will have the greateft poffible fine when it is a right angle, and it never can be greater than ADK, which is $= 90 + \frac{1}{2}a$. And fince between $90° + \frac{1}{2}a$, and $90 - \frac{1}{2}a$, there muft fall fome multiple of a; call this multiple b. Then, in order that every found may be reflected as often as poffible, faving once, we muft make the length of it $X = CD \times \frac{S,\,b}{S,\,a}$.

Now fince the angle of the cone is never made very great, never exceeding 10 or 12 degrees, b can never differ from 90 above a degree or two, and its fine cannot differ much from unity. Therefore X will be very nearly equal to $\frac{CD}{S,\,a}$, which is alfo very nearly equal to $\frac{CD}{2\,S,\,\frac{1}{2}a}$; becaufe a is fmall, and the fines of fmall arches are nearly equal and proportional to the arches themfelves. There is even a fmall compenfation of errors in this formula. For as the fine of 90° is fomewhat too large, which would give X too great, $2\,S,\,\frac{1}{2}a$ is alfo larger than the fine of a. Thus let a be 12°: then the neareft multiple of a is 84 or 96°, both of which are as far removed as poffible from 90°, and the error is as great as poffible, and is nearly $\frac{1}{100}$th of the whole.

This approximation gives us a very fimple conftruction. Let CM be the required length of the trumpet, and draw ML perpendicular to the axis in O. It is evident that S, MCO : rad. = MO : CM, and CM; or $X = \frac{MO}{S,\,\frac{1}{2}a}, = \frac{LM}{2\,S,\,\frac{1}{2}a}$, but $X = \frac{CD}{2\,S,\,\frac{1}{2}a}$, and therefore LM is equal to CD.

If therefore the cone be of fuch a length, that its diameter at the mouth is equal to the length of the part cut off, every line of found will have at leaft as many reflections, fave one, as if the cone were infinitely long; and the laft reflected line will either be parallel to the oppofite fide of the cone, or lie nearer the axis than this parallel; confequently fuch a cone will confine all the reflected founds within a cone whofe angle is $2a$, and will augment the found in the proportion of the fpherical bafe of this cone to a complete hemifpherical furface. Defcribe the circle DKT round C, and making DT an arch of 90, draw the chord DT. Then fince the circles defcribed with the radii DK,

DK, DT, are equal to the ſpherical ſurfaces generated by the revolution of the arches DK and DKT round the axis CD, the ſound will be condenſed in the proportion of DK^2 to DT^2.

This appears to be the beſt general rule for conſtructing the inſtrument; for, to procure another reflection, the tube muſt be prodigiouſly lengthened, and we cannot ſuppoſe that one reflection more will add greatly to its power.

It appears, too, that the length depends chiefly on the angle of the cone; for the mouth-piece may be conſidered as nearly a fixed quantity. It muſt be of a ſize to admit the mouth when ſpeaking with force and without conſtraint. About an inch and a half may be fixed on for its diameter. When therefore we propoſe to confine the ſound to a cone of twice the angle of the trumpet, the whole is determined by that angle. For ſince in this caſe LM is equal to CD, we have $\mathrm{DK} : \mathrm{CD} = \mathrm{LM}$ (or CD) $: \mathrm{CM}$ and $\mathrm{CM} = \frac{\mathrm{CD}^2}{\mathrm{DK}}$.

But $\quad 2\,\mathrm{S},\tfrac{1}{2}a : 1 = \mathrm{DK} : \mathrm{CD}$,
and $\quad 2\,\mathrm{S},\tfrac{1}{2}a : 1 = \mathrm{CD} : \mathrm{CM}$;
therefore $\quad 4\,\mathrm{S},^2\tfrac{1}{2}a : 1 = \mathrm{DK} : \mathrm{CM}$,

And $\quad \mathrm{CM} = \frac{\mathrm{DK}}{4\,\mathrm{S},^2\frac{1}{2}a}, = \frac{\mathrm{DK}}{\mathrm{S},^2a}$ very nearly. And ſince DK is an inch and a half, we get the length in inches, counted from the apex of the cone $= \frac{1\frac{1}{2}}{\mathrm{S},^2a}$, or $\frac{3}{2\,\mathrm{S},^2a}$. From this we muſt cut off the part CD, which is $= \frac{\mathrm{DK}}{\mathrm{S},\frac{1}{2}a}$, or very nearly $\frac{\mathrm{DK}}{\mathrm{S},a}$, or $\frac{3}{2\,\mathrm{S},a}$, meaſured in inches, and we muſt make the mouth of the ſame width $\frac{3}{2\,\mathrm{S},a}$.

On the other hand, if the length of the trumpet is fixed on, we can determine the angle of the cone. For let the length (reckoned from C) be L; we have $2\,\mathrm{S},^2a = \frac{3}{\mathrm{L}}$, or $\mathrm{S},^2a = \frac{3}{2\mathrm{L}}$, and $\mathrm{S},a = \sqrt{\frac{3}{2\mathrm{L}}}$.

Thus let 6 feet or 72 inches be choſen for the length of the cone, we have $\mathrm{S},a = \sqrt{\frac{3}{144}} = \sqrt{\frac{1}{48}}, = 0{,}14434$, $=$ ſin 8° 17′ for the angle of the cone; and the width at the mouth is $\frac{3}{2,\mathrm{S},a} = 10{,}4$ inches. This being taken from 72, leaves 61,6 inches for the length of the trumpet.

And ſince this trumpet confines the reflected ſounds to a cone of 16° 34′, we have its magnifying power $= \frac{\mathrm{DT}^2}{\mathrm{DK}^2} = \frac{\frac{1}{2}\mathrm{DT}^2}{\frac{1}{2}\mathrm{DK}^2} = \frac{\mathrm{S},^2 45^\circ}{\mathrm{S},^2 4\ 8\frac{1}{2}} = 96$ nearly. It therefore condenſes the ſound about 96 times; and if the diſtribution were uniform, it would be heard $\sqrt{96}$, or nearly 10 times farther off. For the loudneſs of ſounds is ſuppoſed to be inverſely as the ſquare of the diſtance from the centre of undulation.

But before we can pronounce with preciſion on the performance of a ſpeaking trumpet, we muſt examine into the manner in which the reflected ſounds are diſtributed over the ſpace in which they are all confined.

Let BKDA (fig. 3.) be the ſection of a conical trumpet by a plane through the axis; let C be the vertex of the cone, and CW its axis; let TKV be the ſection of a ſphere, having its centre in the vertex of the cone; and let P be a ſonorous point on the ſurface of the ſphere, and P *a f e l* the path of a line of ſound lying in the plane of the ſection. Trumpet.

In the great circle of the ſphere take KQ = KP, DR = DQ, and KS = KR. Draw QB *b*; alſo draw Q *a n* parallel to DA; and draw PB, P *d*, PA.

1. Then it is evident that all the lines drawn from P, within the cone APB, proceed without reflection, and are diffuſed as if no trumpet had been uſed.

2. All the ſonorous lines which fall from P on KB are reflected from it as if they had come from Q.

3. All the ſonorous lines between BP and *d* P have ſuffered but one reflection; for *d n* will no more meet DAY ſo as to be reflected again.

4. All the lines which have been reflected from KB, and afterwards from DA, proceed as if they had come from R. For the lines reflected from KB proceed as if they had come from Q; and lines coming from Q and reflected by DA, proceed as if they had come from R. Therefore draw RA *o*, and alſo draw R *g m* parallel to KB, and draw Q *c* A *q*, Q *b g*, P *c*, and P *b*. Then,

5. All the lines between *b* P and *c* P have been twice reflected.

Again, draw SB *o*, B *r* R, *r u* Q, S *x* A, R *v x*, Q *z y*.

6. All the lines between *u* P and *z* P have ſuffered three reflections.

Draw the tangents TA *t*, VB *v*, croſſing the axis in W.

7. The whole ſounds will be propagated within the cone *v* W *t*. For to every ſonorous point in the line KD there correſponds a point ſimilar to Q, regulating the firſt reflection from KB; and a point ſimilar to R, regulating the ſecond reflection from DA; and a point S regulating the third reflection from KB, &c. And ſimilar points will be found regulating the firſt reflection from DA, the ſecond from KB, and the third from DA, &c.; and lines drawn from all theſe through A and B muſt lie within the tangents TA and VB.

8. Thus the centres of reflection of all the ſonorous lines which lie in planes paſſing through the axis, will be found in the ſurface of this ſphere; and it may be conſidered as a ſonorous ſphere, whoſe ſounds firſt concentrate in W, and are then diffuſed in the cone *v* W *t*.

It may be demonſtrated nearly in the ſame manner, that the ſonorous lines which proceed from P, but not in the plane paſſing through the axis, alſo proceed, after various reflections, as if they had come from points in the ſurface of the ſame ſphere. The only difference in the demonſtration is, that the centres Q, R, S of the ſucceſſive reflections are not in one plane, but in a ſpiral line winding round the ſurface of the ſphere according to fixed laws. The foregoing concluſions are therefore general for all the ſounds which come in all directions from every point in the area of the mouth-piece.

Thus it appears, that a conical trumpet is well fitted for increaſing the force of ſounds by diminiſhing their final divergence. For had the ſpeaker's mouth been in the open air, the ſounds which are now confined within the cone *v* W *t* would have been diffuſed over a hemiſphere: and we ſee that prolonging the trumpet muſt confine the ſounds ſtill more, becauſe this will make the angle BWA ſtill ſmaller; a longer tube muſt alſo occaſion more reflections, and conſequently ſend more ſonorous undulations to the ear at a diſtance placed within the cone *v* W *t*.

We have now obtained a very connected view of the whole effect of a conical trumpet. It is the ſame as if the whole ſegment TKDV were ſounding, every part of it with an intenſity proportional to the denſity of the points Q, R, S, &c. correſponding to the different points P of the mouth-piece. It is eaſy to ſee that this cannot be uniform: but

Trumpet. must be much rarer towards the margin of the segment. It would require a good deal of discussion to show the density of these fictitious sounding points; and we shall content ourselves with giving a very palpable view of the distribution of the sonorous rays, or the density (so to speak) of the echoes, in the different situations in which a hearer may be placed[1].

We may observe, in the mean time, that this substitution of a sounding sphere for the sounding mouth piece has an exact parallel in OPTICS, by which it will be greatly illustrated. Suppose the cone BKDA to be a tube polished in the inside, and in a wall BA, perforated in BA, and that the mouth piece DK is occupied completely by a flat

Fig. 3 flame. The effect of this on a spectator will be the same if he is properly placed in the axis, as if he were looking at a flame as big as the whole sphere. This is very evident.

It is easy to see that the line $b\,S$ is equal to the line $b\,r\,a\,P$; therefore the reflected sounds also come to the ear in the same moments as if they had come from their respective points in the surface of the substituted sphere. Unless, therefore, this sphere be enormously large, the distinctness of articulation will not be sensibly affected, because the interval between the arrival of the different echoes of the same snap will be insensible.

Our limits oblige us to content ourselves with exhibiting this evident similarity of the progress of echo from the surface of this phonic sphere, to the progress of light from the same luminous sphere shining through a hole of which the diameter is AB. The direct investigation of the intensity of the sound in different directions and distances would take up much room, and give no clearer conception of the thing. The intensity of the sound in any point is precisely similar to the intensity of the illumination of the same point; and this is proportional to the portion of the luminous surface seen from this point through the hole directly, and to the square of the distance inversely. The intelligent reader will acquire a distinct conception of this matter from fig. 4. which represents the distribution of the sonorous lines, and by consequence the degree of loudness which may be expected in the different situations of the hearer.

As we have already observed, the effect of the cone of the trumpet is perfectly analogous to the reflection of light from a polished concave, conical mirror. Such an instrument would be equally fitted for illuminating a distant object. We imagine that these would be much more powerful than the spherical or even parabolic mirrors commonly used for this purpose. These last, having the candle in the focus, also send forward a cylinder of light of equal width with the mirror. But it is well known, that oblique reflections are prodigiously more vivid than those made at greater angles. Where the inclination of the reflected light to the plane of the mirror does not exceed eight or ten degrees, it reflects about three-fourths of the light which falls on it. But when the inclination is 8°, it does not reflect one fourth part.

We may also observe, that the density of the reflected sounds by the conical trumpet ABC (fig. 4.) is precisely similar to that of the illumination produced by a luminous sphere TDV, shining through a hole AB. There will be a space circumscribed by the cone formed by the lines TBt and VAv, which is uniformly illuminated by the whole sphere (or rather by the segment TDV), and on each side there is a space illuminated by a part of it only, and the illumination gradually decreases towards the borders. A spectator placed much out of the axis, and looking through the hole AB, may not see the whole sphere. In like manner, he will not hear the whole sounding sphere: He may be so far from the axis as neither to see nor hear any part of it.

Assisting our imagination by this comparison, we perceive that beyond the point w' there is no place where *all* the reflected sounds are heard. Therefore, in order to preserve the magnifying power of the trumpet at any distance, it is necessary to make the mouth as wide as the sonorous sphere. Nay, even this would be an imperfect instrument, because its power would be confined to a very narrow space; and if it be not accurately pointed to the person listening, its power will be greatly diminished. And we may observe, by the way, that we derive from this circumstance a strong confirmation of the justness of Mr Lambert's principles; for the effects of speaking trumpets are really observed to be limited in the way here described.—Parabolic trumpets have been made, and they fortify the sound not only in the cylindrical space in the direction of the axis, but also on each side of it, which should not have been the case had their effect depended only on the undulations formed by the parabola in planes perpendicular to the axis. But to proceed.

Let BCA (fig. 5.) be the cone, ED the mouth-piece, TEDV the equivalent sonorous sphere, and TBAV the circumscribed cylinder. Then CA or CB is the length of cone that is necessary for maintaining the magnifying power at all distances. We have two conditions to be fulfilled. The diameter ED of the mouth piece must be of a certain fixed magnitude, and the diameter AB of the outer end must be equal to that of the equivalent sonorous sphere. These conditions determine all the dimensions of the trumpet and its magnifying power. And, first, with respect to the dimensions of the trumpet.

The similarity of the triangles ECG and BCF gives $CG : ED = CF : AB$; but $CG = EC, = \frac{1}{2} AB$, and $CF = CG + GF, = GF + \frac{1}{2} AB$; therefore $\frac{1}{2} AB : ED = GF + \frac{1}{2} AB : AB$, and $AB : ED = 2GF + AB : AB$; therefore $2GF \times ED + AB \times ED = AB^2$, and $2GF \times ED = AB^2, - AB \times ED, = AB \times \overline{AB - ED}$, and $GF = \frac{AB \times \overline{AB - ED}}{2\,ED}$. And, on the other hand, because $AB^2 - \times EBAD = 2GF \times ED$, we have $AB^2 - AB \times ED + \frac{1}{4} ED^2 = 2GF \times ED + \frac{1}{4} ED$, or $\overline{AB - \frac{1}{2} ED}^2 = 2\,GF \times ED + \frac{1}{4} ED^2$, and $AB = \sqrt{\overline{2GF \times ED + \frac{1}{4} ED^2}} + \frac{1}{2} ED$.

Let x represent the length of the trumpet, y the diameter at the great end, and m the diameter of the mouth-piece. Then $x = \frac{y \times \overline{y - m}}{2m}$, and $y = \sqrt{\overline{2xm + \frac{1}{4} m^2}} + \frac{1}{2} m$. Thus the length and the great diameter may be had reciprocally. The useful case in practice is to find the diameter for a proposed length, which is gotten by the last equation.

Now if we take all the dimensions in inches, and fix m at an inch and a half, we have $2xm = 3x$, and $\frac{1}{4} m^2 = 0{,}5625$, and $\frac{1}{2} m = 0{,}75$; so that our equation becomes $y = \sqrt{3x + 0{,}5625} + 0{,}75$. The following table gives the dimensions of a sufficient variety of trumpets. The first column is the length of the trumpet in feet; the second column is the diameter of the mouth in inches; the third column is the number of times that it magnifies the sound; and the fourth column is the number of times that it increases the distance at which a man may be distinctly heard by its means; the fifth contains the angle of the cone.

GF

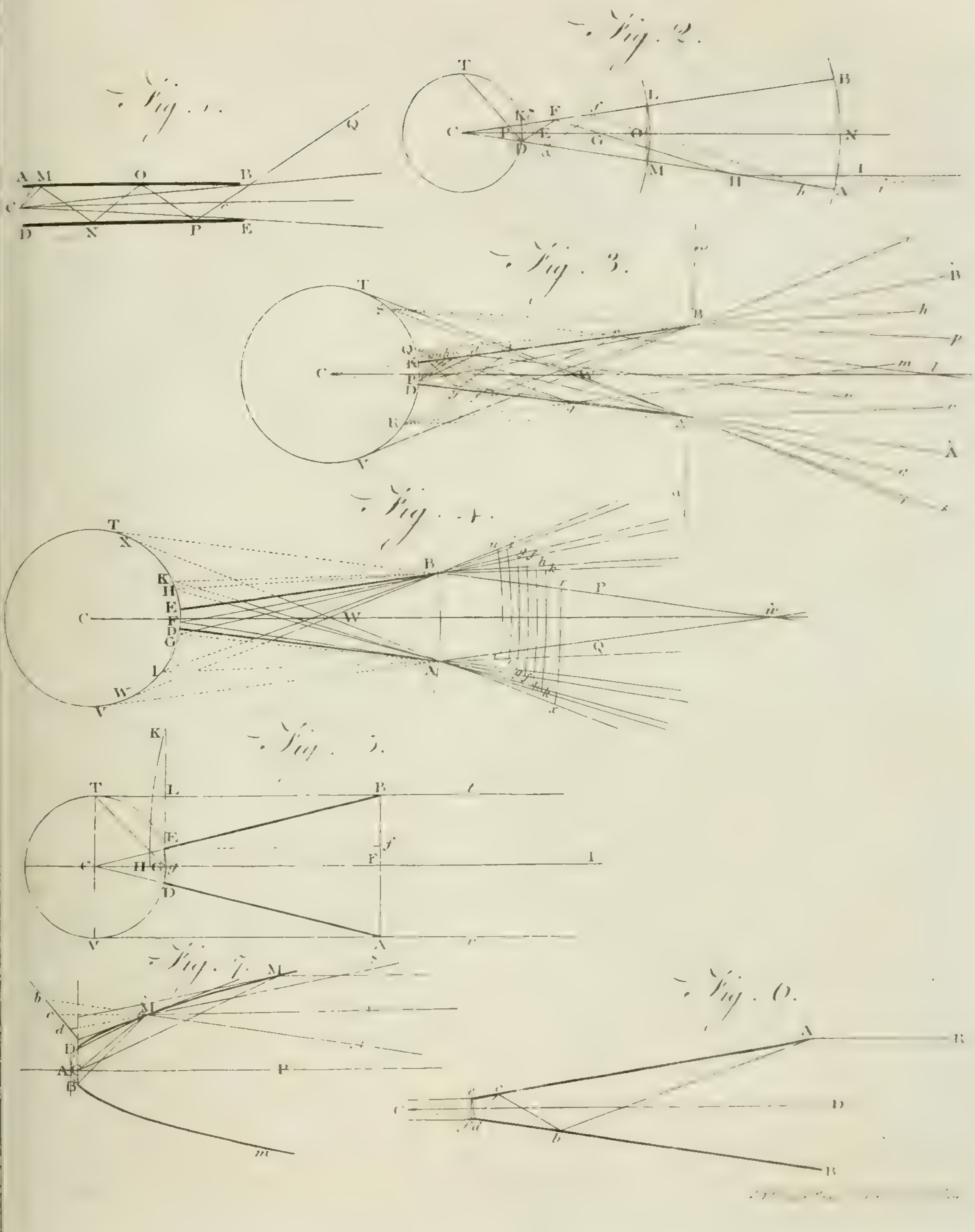


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 7.
Fig. 6.

GF feet.	AB inches.	Magnifying.	Extending	ACB.
				° ′
1	6,8	42,6	6,5	24.53
2	9,3	77,8	8,3	18.23
3	11,2	112,4	10,6	15.18
4	12,8	146,6	12,1	13.24
5	14,2	180,4	13,4	12.04
6	15,5	214,2	14,6	11.05
7	16,6	247,7	15,7	10.18
8	17,7	281,3	16,8	9.40
9	18,8	314,6	17,7	[illegible]
10	19,8	347,7	18,6	8.42
11	20,7	[illegible]	19,5	8.1[illegible]
12	21,5	414,6	2[illegible],4	7.5[illegible]
15	24,	513,6	22,7	7.[illegible]
18	26,2	612,3	24,7	6.33
21	28,3	711,2	26,6	6.[illegible]5
24	30,2	81[illegible],1	28,5	5.12
ED in all is = 1,5.				

The two last columns are constructed on the following considerations: We conceive the hearer placed within the cylindrical space whose diameter is BA. In this situation he receives an echo coming apparently from the whole surface TGV; and we account the effect of the trumpet as equivalent to the united voices of as many mouths as would cover this surface. Therefore the quotient obtained by dividing the surface of the hemisphere by that of the mouth-piece will express the magnifying power of the trumpet. If the chords gE, gT, be drawn, we know that the spherical surfaces TgV, EgD, are respectively equal to the circles described with the radii Tg, Eg, and are therefore as Tg^2 and Eg^2. Therefore the audibility of the trumpet, when compared with a single voice, may be expressed by $\frac{Tg^2}{Eg^2}$. Now the ratio of Tg^2 to Eg^2 is easily obtained. For if Ef be drawn parallel to the axis, it is plain that $Bf = \frac{BA - ED}{2}$, and that Ef is to fB as radius to the tangent of ECF; which angle we may call a. Therefore $\tan. a = \frac{y-m}{2x}$, and thus we obtain the angle a. But if the radius CE be accounted 1, Tg is $= \sqrt{2}$. and Eg is $= 2 \text{ fin. } \frac{a}{2}$. Therefore $\frac{Tg}{Eg} = \frac{\sqrt{2}}{2 \text{ fin. } \frac{a}{2}}$, and the magnifying power of the trumpet is $= \frac{2}{4 \text{ fin.}^2 \frac{a}{2}}, = \frac{1}{2 \text{ fin.}^2 \frac{a}{2}}$. The numbers, therefore, in the third column of the table are each $= \frac{1}{2 \text{ fin.}^2 \frac{a}{2}}$.

But the more usual way of conceiving the power of the trumpet is, by considering how much farther it will enable us to hear a voice equally well. Now we suppose that the audibility of sounds varies in the inverse duplicate ratio of the distance. Therefore if the distance d, at which a man may be distinctly heard, be increased to z, in the proportion of EG to Tg, the sound will be less audible, in the proportion of Tg^2 to EG^2. Therefore the trumpet will be as well heard at the distance z as the simple voice is heard at the distance d. Therefore $\frac{z}{d}$ will express the *extending power* of the trumpet, which is therefore $= \frac{\sqrt{2}}{2 \text{ fin. } \frac{a}{2}}$.

In this manner were the numbers computed for the fourth column of the table.

When the angle BCA is small, which is always the case in speaking trumpets, we may, without any sensible error, consider EG as $= \frac{ED}{2}, = \frac{m}{2}$. And $TG = TC \times \sqrt{2}, = \frac{AB}{2} \sqrt{2} = \frac{AB}{\sqrt{2}} = \frac{y}{\sqrt{2}}$. This gives a very easy computation of the extending and magnifying powers of the trumpet.

The extending power is $= \sqrt{2} \frac{y}{m}$

The magnifying power is $= 2 \frac{y^2}{m^2}$.

We may also easily deduce from the premises, that if the mouth-piece be an inch and a half in diameter, and the length x be measured in inches, the extending power is very nearly $= \sqrt{[illegible] x}$ and the magnifying power $= [illegible] x$.

An inconvenience still attends the trumpet of this construction. Its complete audibility is confined to the cylindrical space in the direction of the axis, and it is more faintly heard on each side of it. This obliges us to direct the trumpet very exactly to the spot where we wish it to be heard. This is confirmed by all the accounts we have of the performance of great speaking trumpets. It is evident, that by [illegible] the trumpet, and therefore enlarging its mouth, we make the lines TB and VA to extend (fig. 4.); and therefore it will not be so difficult to direct the trumpet.

But even this is confined within the limits of a few degrees. Even if the trumpet were continued without end, the sounds cannot be reinforced in a wider space than the cone of the trumpet. But it is always advantageous to increase its length; for this makes the extreme tangents embrace a greater portion of the sonorous sphere, and thus increases the sound in the space where it is [illegible] reflected. And the limiting tangents TB, VA, extend still more, and thus the space of full effect is increased. But either of these augmentations is very small in comparison of the augmentation of [illegible]. If the trumpet of fig. 5 were made an hundred times longer, its power would not be increased one half.

We need not therefore aim at much more than to produce a cylindrical space of full effect: and this will always be done by the preceding rules, or [illegible] constructions. We may give the trumpet a third or a fourth part more length, in order to spread a little the space of its full effect, and thereby make it more easily directed to the intended object. But in doing this we must be careful to increase the diameter of the mouth as much as we increase the length; otherwise we produce the very opposite effect, and make the trumpet greatly inferior to a shorter one, at all distances beyond a certain point. For by increasing the length while the part CG remains the same, we cause the tangents TB and VA to meet on some distant point, beyond which the sound diminishes prodigiously. The construction of a speaking trumpet is therefore a problem of some nicety; and as the trials are always made at some considerable distance, it may frequently happen that a trumpet, which is not heard at a mile's distance, may be made very audible two miles off by cutting off a piece at its wide end.

After this minute consideration of the conical trumpet, we might proceed to consider the other forms. In particular, the hyperbolic, proposed by Cassegrain; and the parabolic,

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parabolic, propoſed by Haaſe, ſeem to merit conſideration. But if we examine them merely as reflectors of echoes, we ſhall find them inferior to the conical.

With reſpect to the hyperbolic trumpet, its inaptitude is evident at firſt ſight. For it muſt diſſipate the echoes more than a conical trumpet. Indeed Mr Caſſegrain proceeds on quite different principles, depending on the mechaniſm of the aerial undulations: his aim was to increaſe the agitation in each pulſe, ſo that it may make a more forcible impulſe on the ear. But we are too imperfectly acquainted with this ſubject to decide *a priori*; and experience ſhows that the hyperbola is not a good form.

With reſpect to the parabolic trumpet, it is certain that if the mouth piece were but a point, it would produce the moſt favourable reflection of all the ſounds; for they would all proceed parallel to the axis. But every point of an open mouth muſt be conſidered as a centre of ſound, and none of it muſt be kept out of the trumpet. If this be all admitted, it will be found that a conical trumpet, made by the preceding rules, will diſſipate the reflected ſounds much leſs than the parabolic.

Thus far have we proceeded on the fair conſequences of the well known fact, that echoes are reflected in the ſame manner as light, without engaging in the intricate inveſtigation of aerial undulations. Whoever conſiders the Newtonian theory of the propagation of ſound with intelligence and attention, will ſee that it is demonſtrated ſolely in the caſe of a ſingle row of particles; and that all the general corollaries reſpecting the lateral diffuſion of the elaſtic undulations are little more than ſagacious gueſſes, every way worthy of the illuſtrious author, and beautifully confirmed by what we can moſt diſtinctly and accurately obſerve in the circular waves on the ſurface of ſtill water. But they are by no means fit for becoming the foundation of any doctrine which lays the ſmalleſt claim to the title of accurate ſcience. We really know exceedingly little of the theory of aerial undulations; and the conformity of the phenomena of ſound to theſe gueſſes of Sir Iſaac Newton has always been a matter of wonder to every eminent and candid mathematician: and no other ſhould pretend to judge of the matter. This wonder has always been acknowledged by Daniel Bernoulli; and he is the only perſon who has made any addition to the ſcience of ſounds that is worth mentioning. For ſuch we muſt always eſteem his doctrine of the ſecondary undulations of muſical cords, and the ſecondary pulſes of air in pipes. Nothing therefore is more unwarrantable, or more plainly ſhows the precipitant preſumption of modern ſciolists, than the familiar uſe of the general theory of aerial undulations in their attempts to explain the abſtruſe phenomena of nature (ſuch as the communication of ſenſation from the organ to the ſenſorium by the vibrations of a nervous fluid, the reciprocal communication of the volitions from the ſenſorium to the muſcle, nay, the whole phenomena of mind), by vibrations and vibratiunculæ.

Such attempts equally betray ignorance, preſumption, and meanneſs of ſoul. Ignorance of the extent to which the Newtonian theory may be logically carried, is the neceſſary conſequence of ignorance of the theory itſelf. It is preſumption to apply it to the phenomena of the intellectual world; and ſurely he has an abject ſoul who hugs and cheriſhes the humble thought, that his mind is an undulating fluid, and that its all-graſping comprehenſion, and all its delightful emotions, are nothing more than an etherial tune. "Pol me occidiſtis amentes." This whim is older than Hartley: It may be found in Robinet's *Syſteme de la Nature*. This by the by made its firſt appearance as a diſcourſe delivered by Brother Orateur in the lodge of the grand Orient at Lyons; from which ſource have proceeded all the coſmopolitical ſocieties in Europe, and that illumination by which reaſon is to triumph over revelation, and liberty and equality over civil government. We crave pardon of our readers for this ebullition of ſpleen; and we hope for it from all thoſe who can read Newton, and who eſteem his modeſty.

Thoſe who have endeavoured to improve the ſpeaking trumpet on mechanical principles, have generally aimed at increaſing the violence of the elaſtic undulations, that they may make a more forcible impulſe on the ear. This is the object in view in the parabolic trumpet. All the undulations are converted into others which are in planes perpendicular to the axis of the inſtrument; ſo that the ſame little maſs of air is agitated again and again in the ſame direction. From this it is obvious to conclude, that the total agitation will be more violent. But, in the firſt place, theſe violent agitations muſt diffuſe themſelves laterally as ſoon as they get out of the trumpet, and thus be weakened, in a proportion that is perhaps impoſſible for the moſt expert analyſt to determine. But, moreover, we are not ſufficiently acquainted with the mechaniſm of the very firſt agitations, to be able to perceive what conformation of the trumpet will cauſe the reflected undulations to increaſe the firſt undulations, or to check them. For it muſt happen, during the production of a continued ſound in a trumpet, that a parcel of air, which is in a ſtate of progreſſive agitation, as it makes a pulſe of one ſound, may be in a ſtate of retrograde agitation, as it is part of a pulſe of air producing another ſound. We cannot (at leaſt no mathematician has yet done it) diſcriminate, and then combine theſe agitations, with the intelligence and preciſion that are neceſſary for enabling us to ſay what is the ultimate accumulated effect. Mr Lambert therefore did wiſely in abſtaining from this intricate inveſtigation; and we are highly obliged to him for deducing ſuch a body of demonſtrable doctrine from the acknowledged, but ill underſtood, fact of the reflection of echoes.

We know that two ſounds actually croſs each other without any mutual diſturbance; for we can hear either of them diſtinctly, provided the other is not ſo loud as to ſtun our ears, in the ſame manner as the glare of the ſun dazzles our eyes. We may therefore depend on all the conſequences which are legitimately deduced from this fact, in the ſame manner as we depend on the ſcience of catoptrics, which is all deduced from a fact perfectly ſimilar and as little underſtood.

But the preceding propoſitions by no means explain or comprehend all the reinforcement of ſound which is really obtained by means of a ſpeaking trumpet. In the firſt place, although we cannot tell in what degree the aerial undulations are increaſed, we cannot doubt that the reflections which are made in directions which do not greatly deviate from the axis, do really increaſe the agitation of the particles of air. We ſee a thing perfectly ſimilar to this in the waves on water. Take a long ſlip of lead, about two inches broad, and having bent it into the form of a parabola, ſet it into a large flat trough, in which the water is about an inch deep. Let a quick ſucceſſion of ſmall drops of water fall preciſely on the focus of the parabola. We ſhall ſee the circular waves proceeding from the focus all converted into waves perpendicular to the axis; and we ſhall frequently ſee theſe ſtraight waves conſiderably augmented in their height and force. We ſay generally, for we have ſometimes obſerved that theſe reflected waves were not ſenſibly ſtronger than the circular or original waves. We do not exactly know to what this difference muſt be aſcribed: we are diſpoſed to attribute it to the frequency of the drops. This may be ſuch, that the interval of time between each drop is preciſely equal, or at leaſt commenſurable, to the time

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time in which the waves run over their own breadth. This is a pretty experiment; and the ingenious mechanician may make others of the same kind which will greatly illustrate several difficult points in the science of sounds. We may conclude, in general, that the reflection of sounds, in a trumpet of the usual shapes, is accompanied by a real increase of the aerial agitations; and in some particular cases we find the sounds prodigiously increased. Thus, when we blow through a musical trumpet, and allow the air to take that uniform undulation which can be best maintained in it, namely, that which produces its musical tone, where the whole tube contains but one or two undulations, the agitation of a particle must then be very great; and it must describe a very considerable line in its oscillations. When we suit our blast in such a manner as to continue this note, that is, this undulation, we are certain that the subsequent agitations conspire with the preceding agitation, and augment it. And accordingly we find that the sound is increased to a prodigious degree. A cor de chasse, or a bugle horn, when properly winded, will almost deafen the ear; and yet the exertion is a mere nothing in comparison with what we make when bellowing with all our force, but with not the tenth part of the noise. We also know, that if we speak through a speaking trumpet in the key which corresponds with its dimensions, it is much more audible than when we speak in a different pitch. These observations show, that the loudness of a speaking trumpet arises from something more than the sole reflection of echoes considered by Mr Lambert—the very echoes are rendered louder.

In the next place, the sounds are increased by the vibrations of the trumpet itself. The elastic matter of the trumpet is thrown into tremors by the undulations which proceed from the mouth-piece. These tremors produce pulses in the contiguous air, both in the inside of the trumpet and on that which surrounds it. These undulations within the trumpet produce original sounds, which are added to the reflected sounds: for the tremor continues for some little time, perhaps the time of three or four or more pulses. This must increase the loudness of the subsequent pulses. We cannot say to what degree, because we do not know the force of the tremor which the part of the trumpet acquires: but we know that these sounds will not be magnified by the trumpet to the same degree as if they had come from the mouth-piece; for they are reflected as if they had come from the surface of a sphere which passes through the agitated point of the trumpet. In short, they are magnified only by that part of the trumpet which lies without them. The whole sounds of this kind, therefore, proceed as if they came from a number of concentric spherical surfaces, or from a solid sphere, whose diameter is twice the length of the trumpet cone.

All these agitations arising from the tremors of the trumpet tend greatly to hurt the distinctness of articulation; because, coming from different points of a large sphere, they arrive at the ear in a sensible succession; and thus change a momentary articulation to a lengthened sound, and give the appearance of a number of voices uttering the same words in succession. It is in this way that, when we clap our hands together near a long rail, we get an echo from each post, which produces a chirping sound of some continuance. For these reasons it is found advantageous to check all tremors of the trumpet by wrapping it up in woollen lists. This is also necessary in the musical trumpet.

With respect to the undulations produced by the tremors of the trumpet in the air contiguous to its outside, they also hurt the articulation. At any rate, this is so much of the sonorous momentum uselessly employed; because they are diffused like common sounds, and receive no augmentation from the trumpet.

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Hearing trumpet.

It is evident, that this instrument may be used (and accordingly was so) for assisting the hearing; for the same conspiring lines are reflected in either direction. We know that all tapering cavities greatly increase external noises; and we observe the brutes prick up their ears when they want to hear uncertain or faint sounds. They turn them in such directions as are best suited for the reflection of the sound from the quarter whence the animal imagines that it comes.

Let us apply Mr Lambert's principle to this very interesting case, and examine whether it be possible to assist dull hearing in like manner as the optician has assisted imperfect sight.

The subject is greatly simplified by the circumstances of the case; for the sounds to which we listen generally come in nearly one direction, and all that we have to do is to produce a constipation of them. And we may conclude, that the audibility will be proportional to this constipation.

Therefore let ACB, fig 6. be the cone, and CD its axis. The sound may be conceived as coming in the direction RA, parallel to the axis, and to be reflected in the points A, *b*, *c*, *d*, *e*, till the angle of incidence increases to 90°; after which the subsequent reflections send the sound out again. We must therefore cut off a part of the cone; and, because the lines increase their angle of incidence at each reflection, it will be proper to make the angle of the cone an aliquot part of 90°, that the least incidence may amount precisely to that quantity. What part of the cone should be cut off may be determined by the former principles. Call the angle ACD, *a*. We have $Ce = \frac{CA \cdot \text{sin.}\, a}{\text{sin.}\,(2n+1)\,a}$, when the sound gets the last useful reflection. Then we have the diameter of the mouth $AB = 2\,CA \cdot \text{sin.}\, a$, and that of the other end $ef = Ce \cdot 2\,\text{sin.}\, a$. Therefore the sounds will be constipated in the ratio of CA^2 to Ce^2, and the trumpet will bring the speaker nearer in the ratio of CA to C*e*.

When the lines of reflected sound are thus brought together, they may be received into a small pipe perfectly cylindrical, which may be inserted into the external ear. This will not change their angles of inclination to the axis nor their density. It may be convenient to make the internal diameter of this pipe $\frac{1}{3}$ of an inch. Therefore $Ce \cdot \text{sin.}\, a$ is $= \frac{1}{6}$ of an inch. This circumstance, in conjunction with the magnifying power proposed, determines the other dimensions of the hearing trumpet. For $Ce = \frac{1}{6\,\text{sin.}\, a} = \frac{CA \cdot \text{sin.}\, a}{\text{sin.}\,(2n+1)\,a}$, and $CA = \frac{\text{sin.}\,(2n+1)\,a}{6\,\text{sin.}^2\, a}$.

Thus the relation of the angle of the cone and the length of the instrument is ascertained, and the sound is brought nearer in the ratio of CA to C*e*, or of sin. $(2n+1)\,a$ to sin. *a*. And seeing that we found it proper to make $(2n+1)\,a = 90°$, we obtain this very simple analogy, $1 : \text{sin.}\, a = CA : Ce$. And the sine of $\frac{1}{2}$ the angle of the cone is to radius as 1 to the approximating power of the instrument.

Thus let it be required that the sound may be as audible as if the voice were 12 times nearer. This gives $\frac{CA}{Ce} = 12$. This gives $\text{sin.}\, a = \frac{1}{12}$, and $a = 4°\ 47'$, and the angle of the cone $= 9.34$. Then $CA = \frac{1}{6\,\text{sin.}^2 a} = \frac{1}{6 \cdot \frac{1}{144}} = \frac{144}{6} = 24$. Therefore the length of the cone is 24 inches. From this

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this take $Ce = \frac{CA}{12} = 2$, and the length of the trumpet is 22 inches. The diameter at the mouth is $2\,Ce, = 4$ inches. With this instrument one voice should be as loud as 144.

If it were required to approximate the sound only four times, making it 16 times stronger than the natural voice at the same distance, the angle ACB must be 29°; Ae must be 2 inches, AB must be $1\frac{1}{3}$d inches, and ef must be $\frac{2}{3}$d of an inch.

It is easy to see, that when the size of the ear-end is the same in all, the diameters at the outer end are proportional to the approximating powers, and the length of the cones are proportional to the magnifying powers.

We shall find the parabolic conoid the preferable shape for an acoustic trumpet; because the sounds come into the instrument in a direction parallel to the axis, they are reflected so as to pass through the focus. The parabolic conoid must therefore be cut off through the focus, that the sounds may not go out again by the subsequent reflections; and they must be received into a cylindrical pipe of $\frac{1}{3}$d of an inch in diameter. Therefore the parameter of this parabola is $\frac{1}{6}$th of an inch, and the focus is $\frac{1}{12}$th of an inch from the vertex. This determines the whole instrument; for they are all portions of one parabolic conoid. Suppose that the instrument is required to approximate the sound 12 times, as in the example of the conical instrument. The ordinate at the mouth must be 12 times the 6th of an inch, or 2 inches: and the mouth diameter is 4 inches, as in the conical instrument. Then, for the length, observe, that DC in fig. 7. is $\frac{1}{6}$th of an inch, and MP is 2 inches, and AC is $\frac{1}{12}$th of an inch, and $DC^2 : MP^2 = AC : AP$. This will give $AP = 12$ inches, and $CP = 11\frac{11}{12}$ths; whereas in the conical tube it was 22. In like manner an instrument which approximates the sounds 4 times is only $1\frac{1}{3}$d inches long, and $1\frac{1}{3}$d inches diameter at the big end. Such small instruments may be very exactly made in the parabolic form, and are certainly preferable to the conical. But since even these are of a very moderate size when intended to approximate the sound only a few times, and as they can be accurately made by any tin-man, they may be of more general use. One of 12 inches long, and 3 inches wide at the big end, should approximate the sound at least 9 times.

A general rule for making them.—Let m express the approximating power intended for the instrument. The length of the instrument in inches is $\frac{m \times \overline{m-1}}{6}$, and the diameter at the mouth is $\frac{m}{3}$. The diameter at the small end is always $\frac{1}{3}$d of an inch.

In trumpets for assisting the hearing all reverberation of the trumpet must be avoided. It must be made thick, of the least elastic materials, and covered with cloth externally. For all reverberation lasts for a short time, and produces new sounds which mix with those that are coming in.

We must also observe, that no acoustic trumpet can separate those sounds to which we listen from others that are made in the same direction. All are received by it, and magnified in the same proportion. This is frequently a very great inconvenience.

There is also another imperfection, which we imagine cannot be removed, namely, an odd confusion, which cannot be called indistinctness, but a feeling as if we were in the midst of an echoing room. The cause seems to be this: Hearing gives us some perception of the direction of the sounding object, not indeed very precise, but sufficiently so for most purposes. In all instruments which we have described for constipating sounds, the last reflections are made in directions very much inclined to the axis, and inclined in many different degrees. Therefore they have the appearance of coming from different quarters; and instead of the perception of a single speaker, we have that of a sounding surface of great extent. We do not know any method of preventing this, and at the same time increasing the sound.

There is an observation which it is of importance to make on this theory of acoustic instruments. Their performance does not seem to correspond to the computations founded on the theory. When they are tried, we cannot think that they magnify so much: Indeed it is not easy to find a measure by which we can estimate the degrees of audibility. When a man speaks to us at the distance of a yard, and then at the distance of two yards, we can hardly think that there is any difference in the loudness; though theory says, that it is four times less in the last of the two experiments; and we cannot but adhere to the theory in this very simple case, and must attribute the difference to the impossibility of measuring the loudness of sounds with precision. And because we are familiarly acquainted with the sound, we can no more think it four times less at twice the distance, than we can think the visible appearance of a man four times less when he is at a quadruple distance. Yet we can completely convince ourselves of this, by observing that he covers the appearance of four men at that distance. We cannot easily make the same experiment with voices.

But, besides this, we have compared two hearing trumpets, one of which should have made a sound as audible at the distance of 40 feet as the other did at 10 feet distance; but we thought them equal at the distance of 40 and 18. The result was the same in many trials made by different persons, and in different circumstances. This leads us to suspect some mistake in Mr Lambert's principle of calculation; and we think him mistaken in the manner of estimating the intensity of the reflected sounds. He conceives the proportion of intensity of the simple voice and of the trumpet to be the same with that of the surface of the mouth-piece to the surface of the sonorous hemisphere, which he has so ingeniously substituted for the trumpet. But this seems to suppose, that the whole surface, generated by the revolution of the quadrantal arch TEG round the axis CG (fig. 4.), is equally sonorous. We are assured that it is not: For even if we should suppose that each of the points Q, R, and S (fig. 3.), are equally sonorous with the point P, these points of reflection do not stand so dense on the surface of the sphere as on the surface of the mouth-piece. Suppose them arranged at equal distances all over the mouth-piece, they will be at equal distances also on the sphere, only in the direction of the arches of great circles which pass through the centre of the mouth-piece. But in the direction perpendicular to this, in the circumference of small circles, having the centre of the mouth-piece for their pole, they must be rarer in the proportion of the sine of their distance from this pole. This is certainly the case with respect to all such sounds as have been reflected in the planes which pass through the axis of the trumpet; and we do not see (for we have not examined this point) that any compensation is made by the reflection which is not in planes passing through the axis. We therefore imagine, that the trumpet does not increase the sound in the proportion of gE^2 to gT^2 (fig. 5.), but in that of $\frac{gE^2}{GE}$ to $\frac{gT^2}{CT}$.

Mr Lambert seems aware of some error in his calculation, and proposes another, which leads nearly to this conclusion, but

but founded on a principle which we do not think in the least applicable to the case of sounds.

Trumpet, Marine, is a musical instrument consisting of three tables, which form its triangular body. It has a very long neck with one single string, very thick, mounted on a bridge, which is firm on one side, but tremulous on the other. It is struck by a bow with one hand, and with the other the string is pressed or stopped on the neck by the thumb.

It is the trembling of the bridge, when struck, that makes it imitate the sound of a trumpet, which it does to that perfection, that it is scarce possible to distinguish the one from the other. And this is what has given it the denomination of trumpet-marine, though, in propriety, it be a kind of monochord. Of the six divisions marked on the neck of the instrument, the first makes a fifth with the open chord, the second an octave, and so on for the rest, corresponding with the intervals of the military trumpet.

Trumpet-Flower. See Bignonia.

TRUMPETER. See Psophia.

TRUNCATED, in general, is an appellation given to such things as have, or seem to have, their points cut off: thus, we say, a truncated cone, pyramid, leaf, &c.

TRUNCHEON, a short staff or baton used by kings, generals, and great officers, as a mark of their command.

TRUNDLE, a sort of carriage with low wheels, whereon heavy and cumbersome burdens are drawn.

TRUNK, among botanists, that part of the herb which arises immediately from the root, and is terminated by fructification; the leaves, buds, and auxiliary parts of the herb not entering in its description.

TRUNNIONS, or Trunions, of a piece of ordnance, are those knobs or bunches of metal which bear her up on the cheeks of the carriage.

TRUSS, a bundle, or certain quantity of hay, straw, &c. A truss of hay contains 56 pounds, or half an hundred weight: 36 trusses make a load.

Truss is also used for a sort of bandage or ligature made of steel, or the like matter, wherewith to keep up the parts in those who have hernias or ruptures.

Truss, in a ship, a machine employed to pull a yard home to its respective mast, and retain it firmly in that position.

TRUSTEE, one who has an estate, or money, put or trusted in his hands for the use of another.

TRUTH, a term used in opposition to falsehood, and applied to propositions which answer or accord to the nature and reality of the thing whereof something is affirmed or denied.

TRYPHIODORUS, an ancient Greek poet, who lived some time between the reigns of Severus and Anastasius. His writings were very numerous; yet none of them have come down to us, except an epic poem, on which Mr Addison has made some entertaining remarks in the Spectator, N° 63.

The first edition of this extraordinary work was published by Aldus at Venice, with Quintus Calaber's Paralipomena, and Coluthus's poem on the rape of Helen. It has been since reprinted at several places, particularly at Francfort in 1580 by Frischlinus; who not only corrected many corrupt passages, but added two Latin versions, one in verse and the other in prose. That in verse was reprinted in 1742, with the Greek, at Oxford, in 8vo, with an English translation in verse, and Notes, by Mr Merrick.

TUAM, a town of Ireland, in the province of Connaught, and county of Galway, with an archbishop's see. It was once a famous city, though now it is reduced to a village; yet it still retains the title of a city, as being an archiepiscopal see. It is seven miles from the borders of Mayo. W. Long. 8. 46. N. Lat. 53. 33.

TUB, in commerce, denotes an indetermined quantity or measure: thus, a tub of tea contains about 60 pounds; and a tub of camphor from 56 to 86 pounds.

TUBE, in general, a pipe, conduit, or canal; a cylinder, hollow within-side, either of lead, iron, glass, wood, or other matter, for the air or some other matter to have a free conveyance through it.

Auricular Tube, or instrument to facilitate hearing. See *Articulate Trumpet*.

TUBERCLES, among physicians, denote little tumors which suppurate and discharge pus; and are often found in the lungs, especially of consumptive persons.

TUCUMAN, a province of South America, in Paraguay; bounded on the north by the provinces of Los-Chicas and Chaco; on the east by Chaco and Rio de-la-Plata, on the south by the country of Chicuitos and Pampes, and on the west by the bishopric of St Jago. The air is hot, and the earth sandy: however, some places are fruitful enough, and the original natives have a good character. The Spaniards possess a great part of this country.

TUFA, a stone consisting of volcanic ashes concreted together with various other species of stone. It is of various colours, blackish grey, bluish grey, and yellow; every colour having a different mixture and solidity: but all of them have the bad quality of mouldering down on long exposure to the weather; notwithstanding which, they have been used in buildings both ancient and modern. The yellow kind resists the air less than any other.

TULIPA, Tulip, in botany: A genus of plants belonging to the class of *hexandria*, and order of *monogynia*; and in the natural system ranging under the 10th order *Coronariæ*. The corolla is hexapetalous and campanulated, and there is no style. The species of this genus are four; the *sylvestris*, or Italian yellow tulip, a native of the south of Europe; the *gesneriana*, or common tulip, a native of the Levant; the *breyniana*, or cape tulip, a native of the Cape of Good Hope; and the *biflora*.

1. The *sylvestris*, or wild European tulip, hath an oblong bulbous root, sending up long narrow spear-shaped leaves; and a slender stalk, supporting at top a small yellow flower, nodding on one side, having acute petals.

2. The *gesneriana*, Gesner's Turky tulip of Cappadocia, or common garden-tulip, hath a large, oblong, tunicated, solid, bulbous root, covered with a brown skin, sending up long oval spear-shaped leaves; an upright round stalk, from half a foot to a yard high, garnished with a few leaves, and its top crowned with a large bell-shaped erect hexapetalous flower, of almost all colours and variegations in the different varieties.

This tulip, and its vast train of varieties, is the sort so generally cultivated for the ornament of our gardens, and so much admired by all for its great variety and beautiful appearance: It grows freely in the open ground in any common soil of a garden, and proves a very great decoration to the beds and borders of the pleasure ground for six weeks or two months in spring, by different plantings of early and late sorts; planting the principal part in autumn, and the rest towards Christmas, and in January or February. The autumn plantings will come earliest into bloom, and flower the strongest: and the others will succeed them in flowering. In summer, when the flowering is past, and the leaves and stalks are in a state of decay, the bulbs of the choicest varieties are generally taken up, the offsets separated, and the whole cleaned from filth; then put up to dry till October or November, and then planted again for the future year's bloom.

Tulipa. Of this ſpecies, which is the floriſts delight, the varieties may be divided into two principal claſſes, *viz.* 1. Early or dwarf ſpring tulips *(præcocea)*. 2. Late-flowering tall tulips *(ſerotina)*. 1. *Early tulips.* The early tulips are among floriſts diſtinguiſhed by the appellation of *præcoces* (early), becauſe they flower early in the ſpring, a month or more before the others; are much ſhorter ſtalked, and the flowers ſmaller; but are in greater reputation for their early bloom and their gay lively colours, both of ſelf-colours, and broken into flaked variegations; ſuch as reds, crimſon, ſcarlet, carnation, violets, purples, yellow, &c. with flowers of each, edged and flaked with red, yellow, and white, in many diverſities. 2. *Late-flowering common tulips.*—This claſs is denominated *late-flowering*, and by the floriſts called *ſerotines*, becauſe they blow later in the ſpring, a month or more, than the præcoces, *i. e.* not coming into flower before the end of April, May, and June. They are all of tall growth, ſupporting large flowers, and furniſh an almoſt endleſs variety in the vaſt diverſity of colours, after they break from whole blowers into variegations and ſtripes, exceeding all others of the tulip kind in beauty and elegance of flower.

Both theſe ſpecies of tulipa are hardy perennials, durable in root, or at leaſt, although the old bulb decays annually, it perpetuates its ſpecies by off-ſets, and is annual in leaf and ſtalk; which riſing from the bulb early in the ſpring, arrives to a flowering ſtate in April and May. All the varieties are ſucceeded by plenty of ripe ſeed in July and Auguſt, contained in an oblong capſule of three cells, having the ſeeds placed on each other in double rows. By the ſeeds many new varieties may be raiſed, which however will not attain a flowering ſtate till they are ſeven or eight years old; and after that will require two or three years or more to break into variegations, when the approved varieties may be marked, and increaſed by off-ſets of the root, as directed in their propagation.

The colours in greateſt eſtimation in variegated tulips, are the blacks, golden yellows, purple-violets, roſe, and vermilion, each of which being variegated various ways; and ſuch as are ſtriped with three different colours diſtinct and unmixed, with ſtrong regular ſtreaks, but with little or no tinge of the breeder, may be called the moſt perfect tulips. It is rare to meet with a tulip poſſeſſing all theſe properties.

As to the manner of obtaining this wonderful variety of colours in tulips, it is often accompliſhed by nature alone, but is ſometimes aſſiſted and forwarded by ſome ſimple operations of art; ſuch as that, in the firſt place, when the ſeedling bulbs of the whole blower or breeder are arrived to full ſize, and have flowered once, to tranſplant them into beds of any poor dry barren ſoil, in order that by a defect of nutriment in the earth the natural luxuriance of the plant may be checked, and cauſe a weakneſs in their general growth, whereby they generally in this weakened or infirm ſtate gradually change and break out into variegations, ſome the firſt year, others not till the ſecond or third; and according as they are thus broke, they ſhould be planted in beds of good earth.

Another method to aſſiſt nature in effecting the marvellous work of breaking the breeding tulips into diverſified colours, is to make as great a change as poſſible in the ſoil; if they were this year in a light poor ſoil, plant them the next in a rich garden mould, and another year in a compoſt of different earths and dung; or tranſplant them from one part of the garden to another, or into different gardens, &c. or from one country to another; all of which contributes in aſſiſting nature in producing this deſirable diverſity of colours and variegations.

The double tulip is alſo a variety of the common tulip, and is very beautiful, though not in ſuch eſtimation among the floriſts as the common ſingle variegated ſorts, not poſſeſſing ſuch a profuſion of variegations in the colours and regularity of ſtripes: they however exhibit an elegantly ornamental appearance, as they riſe with an upright, talliſh, firm ſtem, crowned with a very large double flower compoſed of numerous petals, multiplied in ſeveral ſeries one within another like a double peony, but far more beautiful in their diverſity of colours, variegations, and ſtripes of white and red, yellow and red, &c. ſo that they highly deſerve culture, both in beds alone near the other ſorts to increaſe their variety, alſo to plant in patches about the borders, in aſſemblage with the late variegated tulips, as they blow nearly about the ſame time, *i. e.* April and May.

Tulip roots are ſold in full collection, conſiſting of numerous varieties, at moſt of the nurſeries and ſeeds-mens, who both propagate them themſelves by off-ſets and ſeed, and import vaſt quantities annually from Holland; the Dutch being famous for raiſing the grandeſt collections of the fineſt tulips, and other bulbous flowers, in the greateſt perfection, for the ſupply of almoſt all the other European gardens; diſtinguiſhing every variety in their vaſt collections by ſome pompous name or other, arranged in regular catalogues, charging prices in proportion to their eſtimation; which formerly was ſo great, among the Hollanders themſelves in particular, that there are accounts of a ſingle root being ſold for from 2000 to 5500 guilders; but ſome time ago they were more plentiful, and were ſold at from 5s. or 10s. to ſo many pounds *per* hundred, and even *per* root for very ſcarce capital ſorts.

Tulip-Tree. See Liriodendron.

TULL (Jethro), an Oxfordſhire gentleman who farmed his own land, and introduced a new method of culture, to raiſe repeated crops of wheat from the ſame land without the neceſſity of manure: the principles of which he publiſhed about 30 years ſince, in A Treatiſe on Horſe-hoeing Huſbandry.

TUMBRELL, Tumbrellum, or *Turbichetum*, is an engine of puniſhment, which ought to be in every liberty that hath the view of frank-pledge, for the correction of ſcolds and unquiet women.

TUMEFACTION, the act of ſwelling or riſing into a tumor.

TUMOR, in medicine and ſurgery, a preternatural riſing or eminence in any part of the body.

Tumors, in farriery. See there, § 26.

TUN, a large veſſel or caſk, of an oblong form, biggeſt in the middle, and diminiſhing towards its two ends, girt about with hoops, and uſed for ſtowing ſeveral kinds of merchandiſe for convenience of carriage; as brandy, oil, ſugar, ſkins, hats, &c.

Tun is alſo the name of a meaſure. A tun of wine is four hogſheads; of timber, a ſquare of 40 ſolid feet; and of coals, 20 cwt.

Tun is alſo a certain weight whereby the burden of ſhips, &c. are eſtimated.

TUNBRIDGE, a town of Kent in England, ſituated on a branch of the river Medway, over which there is a bridge. It is a large well built place, noted for the mineral waters four or five miles ſouth of the town. E. Long. 0. 20. N. Lat. 51. 14.

TUNE. See Music and Tone.

TUNGSTEN, or lapis ponderosus; a genus of calcareous earth. It contains about one half its weight of calcareous earth, and the remainder iron, and a peculiar acid of an earthy appearance, now known by the name of the *tungſten acid.* When pure, it is of a grey colour and lamellated texture; its ſpecific gravity being from 4,99 to 5,8.

TUNICA,

TUNICA, a kind of waistcoat or under garment, in use among the Romans. They wore it within doors by itself, and abroad under the gown. The common people could not afford the toga, and so went in their tunics; whence Horace calls them *populus tunicatus*.

Tunica, in anatomy, is applied to the membranes which invest the vessels, and divers others of the less solid parts of the body; thus the intestines are formed of five tunics or coats.

TUNIS, a large and celebrated town of Africa, in Barbary, and capital of a kingdom of the same name. It is seated on the point of the Gulph of Goletta, about eight miles from the place where the city of Carthage stood. It is in the form of a long square, and is about four miles in circumference, with 10 large streets, 5 gates, and 35 mosques. The houses are all built with stone, though but one story high; but the walls are very lofty, and flanked with several strong towers. It has neither ditches nor bastions, but a good citadel, built on an eminence on the west side of the city. It is said to contain 300,000 inhabitants, of whom 30,000 are Jews. The divan, or council of state, assembles in an old palace; and the dey is the chief of the republic, who resides there. The harbour of Tunis has a very narrow entrance, through a small canal. In the city they have no water but what is kept in cisterns, except one well kept for the bashaw's use. It is a place of great trade, and is 10 miles from the sea. E. Long. 10. 16. N. Lat. 36. 42.

Tunis, a country of Africa, bounded on the north and east by the Mediterranean Sea and the kingdom of Tripoli, on the south by several tribes of the Arabs, and on the west by the kingdom of Algiers and the country of Esab; being 300 miles in length from east to west, and 250 in breadth from north to south. This country was formerly a monarchy; but a difference arising between a king and his son, one of whom was for the protection of the Christians, and the other for that of the Turks, in 1574 the inhabitants shook off the yoke of both. From this time it became a republic under the protection of the Turks, and pays a certain tribute to the bashaw who resides at Tunis. The air in general is healthy; but the soil in the eastern parts is indifferent for want of water. Towards the middle the mountains and valleys abound in fruits; but the western part is the most fertile, because it is watered with rivers. The environs of Tunis are very dry, upon which account corn is generally dear. The inroads of the Arabs oblige the inhabitants to sow their barley and rye in the suburbs, and to inclose their gardens with walls. However, there are plenty of citrons, lemons, oranges, dates, grapes, and other fruits. There are also olive-trees, roses, and odoriferous plants. In the woods and mountains there are lions, wild beeves, ostriches, monkeys, cameleons, roebucks, hares, pheasants, partridges, and other sorts of birds and beasts. The most remarkable rivers are the Guadilcarbar, Magrida, Magerada, and Caps. The form of government is aristocratic; that is, by a council, whose president is the dey, not unlike the doge of Venice. The members of the divan or council are chosen by the dey, and he in his turn is elected by the divan; which is composed of soldiers, who have more than once taken off the dey's head. The bashaw is a Turk, residing at Tunis; whose business is to receive the tribute, and protect the republic: the common revenues are only 400,000 crowns a-year, because the people are very poor; nor can they send above 40,000 men into the field; nor more than 12 men of war of the line to sea, even upon the most extraordinary occasions. There are generally about 12,000 Christian slaves in this country; and the inhabitants carry on a great trade in linen and woollen cloth. In the city of Tunis alone there are above [illegible] clothiers and weavers. They also have a trade in [illegible], olives, oil, soap, ostriches eggs and feathers. The Mahometans of this city have nine colleges for students, and [illegible] petty schools. The principal religion is Mahometanism; but the inhabitants consist of Moors, Turks, Arabs, Jews, and Christian slaves. However, the Turks, though fewest in number, domineer over the Moors, and treat them little better than slaves.

TUNKERS, a religious sect of baptists in Pennsylvania, so called from the word *tunker*, to put a morsel in sauce. They are also called *tumblers*, because in performing baptism they plunge the person into the water with the head first. As the Germans sound the letters *t* and *b* like *d* and *p*, the words *tunkers* and *tumblers*, have been sometimes written *dunkers* and *dumplers*. Their church government and discipline are the same with those of the English baptists, except that every brother is allowed to speak in the congregation, and the best speaker is usually ordained to be their minister. They are a harmless, well meaning people.

TUNNAGE. See Tonnage.

TUNNY, in ichthyology. See Scomber.

TUNNY-Fishing. See Fishery.

TURBAN, the head-dress of most of the eastern nations. It consists of two parts, a cap and sash of fine linen or taffety, artfully wound in divers plaits about the cap. The cap has no brim, is pretty flat, though roundish at top, and quilted with cotton; but does not cover the ears. There is a good deal of art in giving the turban a fine air; and the making of them is a particular trade. The sash of the Turks turban is white linen; that of the Persians red woollen. These are the distinguishing marks of their different religions. Sophi king of Persia, being of the sect of Ali, was the first who assumed the red colour, to distinguish himself from the Turks, who are of the sect of Omar, and whom the Persians esteem heretics.

TURBINATED, is a term applied by naturalists to shells which are spiral or wreathed conically, from a larger basis to a kind of apex.

TURBITH-mineral. See Chemistry, n° 705, and Pharmacy, n° 323.

TURBO, the wreath, in zoology, a genus of insects belonging to the order of *vermes testacea*. The animal is of the snail kind; the shell consists of one spiral solid valve, and the aperture is orbicular. There are 116 species; of which the most remarkable are, 1. The *littoreus*, or periwinkle. This is abundant on most rocks far above low-water mark. The Swedish peasants believe, that when these shells creep high up the rocks, they indicate a storm from the south. They are eaten by the poor people in most parts of this kingdom. Young lobsters are said to take up their lodging in the empty shells of these animals, which has given occasion to a notion that periwinkles are changed into lobsters. 2. The *clathrus*, or barbed wreath, has a taper shell of eight spires, distinguished by elevated divisions running from the aperture to the apex. There is a variety pellucid, with very thin edges. It is analogous to that curious and expensive shell, the *wentle-trap*.

TURBOT, in ichthyology. See Pleuronectes.

TURCÆ, or Turci, (Mela); supposed to be the *[illegible]* of Ptolemy; whom he places between Caucasus and the Montes Ceraunii. The name is said to denote, "to desolate, or lay waste." Herodotus places them among the wild or barbarous nations of the north. There is a very rapid river called *Turk*, running into the Caspian Sea, from which some suppose the Turks to take their name. They made no figure in the world till towards the 7th century; about the beginning of which they sallied forth from the

Portæ Caspiæ, laid waste Persia, and joined the Romans against Chosroes king of Persia. In 1042 they subdued the Persians, in whose pay they served, and from whom they derived the Mahometan religion: and afterwards pouring forth, over-ran Syria, Cappadocia, and the other countries of the Hither Asia, under distinct heads or princes, whom Ottoman subduing, united the whole power in himself, which to this day continues in his family, and who fixed his seat of empire at Prusa in Bithynia. His successors subdued all Greece, and at length took Constantinople in 1453; which put a period to the Roman empire in the East, under Constantine the last emperor. It is a standing tradition or prophecy among the Turks, that their empire will at length be overturned by the Franks or Christians; which seems now to be drawing on apace towards accomplishment.

TURCOISE. See TURQUOISE.

TURCOMANIA, a province of Asiatic Turkey, answering to the ancient kingdom of Armenia.

TURDUS, the thrush; a genus of birds belonging to the order of *passeres*. The bill is straightish, bending towards the point, and slightly notched near the end of the upper mandible. The nostrils are oval, naked or half covered with a membrane; the corners of the month are furnished with a few slender hairs, and the tongue is slightly jagged at the end. There are 136 species; of which 7 are British, the viscivorus, pilaris, iliacus, musicus, roseus, merula, and torquatus.

1. The *viscivorus*, or missel, is the largest of the genus. Its length is 11 inches; its breadth 16½. The bill is shorter and thicker than that of other thrushes; dusky, except the base of the lower mandible, which is yellow. The irides are hazel. Head, back, and lesser coverts of the wings, are of a deep olive brown. The lower part of the back is tinged with yellow. The lowest order of lesser coverts, and the great coverts, are brown; the first tipped with white, the last both tipped and edged with the same colour. The inner coverts of the wings white. The tail is brown; the three outermost feathers tipped with white. The cheeks and throat are mottled with brown and white; the breast and belly are whitish yellow, marked with large spots of black; the legs are yellow.

These birds build their nests in bushes, or on the side of some tree, generally an ash, and lay four or five eggs: their note of anger or fear is very harsh, between a chatter and shriek; from whence some of its English names. Its song, however, is very fine; which it begins sitting on the summit of a high tree, very early in the spring, often with the new-year, in blowing showery weather, which makes the inhabitants of Hampshire to call it the *storm-cock*. It feeds on insects, holly and misseltoe berries, which are the food of all the thrush kind: in severe snowy weather, when there is a failure of their usual diet, they are observed to scratch out of the banks of hedges the root of arum, or the cuckoo pint; this is remarkably warm and pungent, and a provision suitable to the season.

2. The *pilaris*, or fieldfare, is in length 10 inches, in breadth 17. The head is ash-coloured inclining to olive, and spotted with black; the back and greater coverts of the wings of a fine deep chesnut; the tail is black; the lower parts of the two middlemost feathers, and the interior upper sides of the outmost feathers excepted; the first being ash coloured, the latter white. The legs are black; the talons very strong.

This bird passes the summer in the northern parts of Europe; also in Lower Austria. It breeds in the largest trees; feeds on berries of all kinds, and is very fond of those of the juniper. Fieldfares visit our islands in great flocks about Michaelmas, and leave us the latter end of February or the beginning of March.

These birds and the redwings were the *turdi* of the Romans, which they fattened with crumbs of figs and bread mixed together. Varro informs us that they were birds of passage, coming in autumn, and departing in the spring. They must have been taken in great numbers; for, according to Varro (lib. 3. c. 5.) they were kept by thousands together in their fattening aviaries. They do not arrive in France till the beginning of December.

3. The *musicus*, or throstle, is in length 9 inches, in breadth 13½. In colour, it so nearly resembles the missel-thrush, that no other remark need to be added, but that it is less, and that the inner coverts of the wings are yellow.

The throstle is the finest of our singing birds, not only for the sweetness and variety of its notes, but for the long continuance of its harmony; for it obliges us with its song for near three parts of the year. Like the missel-bird, it delivers its music from the top of some high tree; but to form its nest descends to some low bush or thicket: the nest is made of earth, moss, and straw, and the inside is curiously plastered with clay. It lays five or six eggs, of a pale bluish green, marked with dusky spots.

4. The *iliacus*, or redwing, has a very near resemblance to the throstle; but is less: their colours are much the same; only the sides under the wings and the inner coverts in this are of a reddish orange, in the throstle yellow; above each eye is a line of yellowish white, beginning at the bill and passing towards the hind part of the head.

These birds appear in Great Britain a few days before the fieldfare; they come in vast flocks, and from the same countries as the latter. With us they have only a disagreeable piping note; but in Sweden, during the spring, they sing very finely, perching on the top of some tree among the forests of maples. They build their nests in hedges, and lay six bluish-green eggs spotted with black.

5. The *merula*, or black-bird, when it has attained its full age, is of a fine deep black, and the bill of a bright yellow; the edges of the eyelids yellow. When young, the bill is dusky, and the plumage of a rusty black, so that they are not to be distinguished from the females; but at the age of one year they attain their proper colour.

This bird is of a very retired and solitary nature; frequents hedges and thickets, in which it builds earlier than any other bird: the nest is formed of moss, dead grass, fibres, &c. lined and plastered with clay, and that again covered with hay or small straw. It lays four or five eggs of a bluish-green colour, marked with irregular dusky spots. The note of the male is extremely fine, but too loud for any place except the woods: it begins to sing early in the spring, continues its music part of the summer, desists in the moulting season, but resumes it for some time in September and the first winter-months.

6. The *torquatus*, or ring-ouzel, is superior in size to the black-bird; the length is 11 inches, breadth 17. The bill in some is wholly black, in others the upper half is yellow; on each side the mouth are a few bristles; the head and whole upper part of the body are dusky, edged with pale brown; the quill-feathers and the tail are black. The coverts of the wings, the upper part of the breast, and the belly, are dusky, slightly edged with ash-colour. The middle of the breast is adorned with a white crescent, the horns of which point to the hind part of the neck. In some birds this is of a pure white, in others of a dirty hue. In the females and in young birds this mark is wanting, which gave occasion to some naturalists to form two species of them.

The ring-ouzel inhabits the Highland hills, the north of England, and the mountains of Wales. They are also found to breed in Dartmoor, in Devonshire, and in banks

on the sides of streams. The places of their retreat are not known. In Scotland and Wales they breed in the hills, but descend to the lower parts to feed on the berries of the mountain ash. They migrate in France at the latter season; and appear in small flocks about Montbard in Burgundy, in the beginning of October, but seldom stay above two or three weeks.

To these we shall add the description of the *polyglottus*, or mocking thrush, which is a native of America. It is about the size of a thrush, of a white and grey colour, and a reddish bill. It is possessed not only of its own natural notes, which are musical and solemn, but it can assume the tone of every other animal in the wood, from the wolf to the raven. It seems even to sport itself in leading them astray. It will at one time allure the lesser birds with the call of their males, and then terrify them when they have come near with the screams of the eagle. There is no bird in the forest but it can mimick; and there is none that it has not at times deceived by its call. But, unlike such as we usually see famed for mimicking with us, and who have no particular merit of their own, the mock bird is ever surest to please when it is most itself. At those times it usually frequents the houses of the American planters; and sitting all night on the chimney top, pours forth the sweetest and the most various notes of any bird whatever. It would seem, if accounts be true, that the deficiency of most other song-birds in that country is made up by this bird alone. They often build their nests in the fruit-trees about houses, feed upon berries and other fruits, and are easily rendered domestic.

TURENNE (Viscount). See Tour.

TURF, *peat*, a blackish earth used in several parts of England, Holland, and Flanders, as fuel. Turf, as distinguished from peat, consists of mould interwoven with the roots of vegetables; when those roots are of the bulbous kind, or in a large proportion, they form the looser and worse kind of turf; but when mixed with a considerable proportion of peat, they form what is called *stone-turf*: it at first hardens, but at last crumbles by long exposure to the air.

TURGESCENCE, among physicians, denotes a swelling or growing bloated.

TURGOT (Anne Robert James), the famous financier, was born at Paris May 10. 1727, of a very ancient Norman family. His father was for a long time provost of the corporation of merchants. During this period he was the object of general admiration; and the regularity and economy of his administration procured him the particular respect of the citizens. M. Turgot was the youngest of three brothers. The eldest was intended for the rank of magistracy, which had been the station of his family for several generations; the second was destined for the army; and Robert for the church. He had scarcely attained the age at which reflection commences, when he resolved to sacrifice all temporal advantages to liberty and conscience, and to pursue his ecclesiastical studies without declaring his repugnance to their proposed object. At the age of 23 years he took his degree, and was elected prior of the Sorbonne.

The time when it was necessary for him to declare that he would not be an ecclesiastic was now arrived. He announced this resolution to his father by letter, stating the motives which induced him to decline the clerical order. His father consented, and he was appointed master of requests. M. Turgot prepared himself for this office by particular application to those parts of science which are most connected with its functions and duties, viz. the study of natural philosophy, as far as it relates to agriculture and manufactures, to the subjects of merchandise, and the execution of public works, together with such parts of mathematical knowledge as lead to a practical application of natural philosophy, and facilitate the calculations that are frequently necessary in matters of commerce, and law.

About this period he wrote some articles for the *Encyclopédie*, of which the most capital were, *Etymology*, *Existence*, *Expansibility*, *Fair*, and *Foundation*. He had prepared several others, but these five only were inserted; the persecution set on foot against the *Encyclopedie* hindered him from continuing to write in it, being unwilling that his opinions should be published in a work which was received with disapprobation by some of the most distinguished people of that time.

In 1761 M. Turgot was appointed intendant of Limoges. In this office he did much good. He gave activity to the society of agriculture established at Limoges, by directing their efforts to important objects: he opened a course of public instruction for female practisers of midwifery: he procured for the people the attendance of able physicians during the raging of epidemic disorders: he established houses of industry, supported by charity (the only species of alms-giving which does not encourage idleness): he introduced the cultivation of potatoes into his province, &c. &c. While M. Turgot proceeded with unremitting activity and zeal, in promoting the good of the people over whom he was placed, he meditated projects of a more extensive nature, such as an equal distribution of the taxes, the construction of the roads, the regulation of the militia, the prevention of a scarcity of provision, and the protection of commerce.

At the death of Louis XV. the public voice called M. Turgot to the first offices of government, as a man who united the experience resulting from habits of business to all the improvement which study can procure. After being at the head of the marine department only a short time, he was, August 24. 1774, appointed comptroller general of the finances. During his discharge of this important office, the operations he carried on are astonishing. He suppressed 23 kinds of duties on necessary consumptions, useful contracts, or merited compensations. He abolished the corvée (A) for the highways, saving the nation thirty millions of livres annually.—He set aside another kind of corvée, which respected the carriage of military stores and baggage.—He abated the rigour in the administration of indirect impositions, to the great profit of the contributors, the king, and the financiers.—He softened the mode of collecting the territorial imposts.—He stopped the progress of a plague among cattle.—He suppressed a sedition conducted with art.—He provided for the equal distribution of subsistence.—He gave the utmost encouragement to the cultivation of the three chief productions of France, viz. wheat, cattle, and wine, and to the commerce thence resulting.—He reformed a number of abuses, some of which yielded a profit to

(A) The word *corvee* seems to be derived from *cura viæ*, i. e. "the care of the roads." It signifies the call made on individuals to furnish labour and materials in kind for the construction and repair of roads. The same exists to this day in England, under the name of *statute days*. It is indeed with us under proper restrictions; but in France, where there are no turnpikes, all the roads, which are very good, were made and repaired by the *corvee* alone; whence it became an intolerable burden to the labourers

Turgot, Turin.

to the place he filled.—He abolished as much as he could the sale of offices.—He formed many useful establishments.—He paid the pensions of the poorer servants of the state, who were four years in arrear.—He supplied the expences of a coronation, the marriage of a princess, and the birth of a prince.—He facilitated payments as far as India.—He settled a part of the colony debts, and put the rest in order.—He found the public borrowing at five and a half *per cent.* and reduced the rate to four.—He lessened the public engagements 84 millions.—He found the revenue 19 millions deficient, and left a surplus of three millions and a half.—All these he accomplished within the space of 20 months, during seven of which severe fits of the gout totally incapacitated him for business.

At length, however, by the artifices of the courtiers, his office was taken from him; but when removed to a private station, M. Turgot did not experience that frightful void which is the just but dreadful punishment of ambitious men when deserted by fortune. The sciences and the belles lettres, which he had cultivated in his youth, afforded him consolation, while an active sphere of life was denied him. Natural philosophy and chemistry were his favourite pursuits; yet he frequently entertained himself with poetry, especially with translating Virgil into French verse. "We know (says the Marquis de Condorcet) but of one Latin verse composed by M. Turgot, and which was intended for a picture of Dr Franklin.

Eripuit cælo fulmen, mox sceptra tyrannis."

The attacks of the gout, under which he had long laboured, becoming more frequent and excessive, forewarned him of the approaching moment, when, in conformity to the laws of nature, he was going to fill, in a higher order of beings, the rank which these laws destined for him. He died March 20. 1781.

For a more ample account of this illustrious statesman, we refer the reader to the History of his Life, written by the Marquis de Condorcet.

TURIN, an ancient, populous, strong, handsome, flourishing city of Italy, and capital of Piedmont, where the sovereign resides, with an archbishop's see, a strong citadel, and an university. It is seated on a vast plain, at the confluence of the rivers Doria and Po. It is one of the handsomest places in Italy; but the air is unhealthy in the autumn and winter on account of the thick fogs. One half of this place is lately built; and the streets are straight and clean, being washed by an aqueduct. The two largest streets are the New-street and that of the Po, which are lighted in the winter-time. The houses are handsome, and all built of the same height. The ducal palace consists of two magnificent structures, joined together by a gallery, in which are several statues, all sorts of arms, the genealogy of the dukes of Savoy, a representation of the celestial signs, a royal library, and many other curiosities. Besides these two structures, there is the palace of the prince of Carignan, the hospital of St John, the seminary of the Jesuits, the royal hospital, and the metropolitan church of St John, wherein they pretend to keep the cloth in which is the print of the face of Jesus Christ. These are all superb structures. When the plague reigned at Marseilles in 1720, a great number of artificers withdrew to Turin; insomuch that there are now above 87,000 inhabitants, and 48 churches and convents. Turin is very well fortified, and extremely strong; as the French found by experience in 1706, who then besieged it a long while to no purpose. The citadel, which is flanked with five bastions, is without doubt a masterpiece of architecture. There are very fine walks on the ramparts, which require two hours to pass round them. There are also very fine gardens on the side of the river Po; and the house commonly called *La Charité* is remarkable, as there is room for 3000 poor people. The college of the academy is very large and well built, and has a great number of ancient inscriptions. In the royal library are 19,000 manuscripts, besides 50,000 printed books. It is charmingly seated at the foot of a mountain, 62 miles north east of Genoa, 72 south-west of Milan, and 280 north-west of Rome. E. Long. 7. 45. N. Lat. 44. 50.

TURKEY, in ornithology. See MELEAGRIS.

TURKEY, a very extensive empire, comprehending some of the richest countries in Europe, Asia, and Africa. See TURCÆ.

1 Constantinople conquered; the capital of the Turkish dominions.

Under the article CONSTANTINOPLE, n° 111, *et seq*, we have given an account of the origin and progress of the Turks, as far as seemed necessary for understanding the subsequent and more important part of their history. In 1453 they made themselves masters of the city of Constantinople, which from that time became the capital of their empire. Mohammed II. at that time the sultan, after having treated the inhabitants with the greatest cruelty, began to think of adding Servia to his dominions. Accordingly, in 1454, he entered that country at the head of 20,000 men, and obliged the inhabitants to pay him an annual tribute of 40,000 ducats. On his return to Adrianople, Mohammed repeopled the towns and villages about Constantinople with 4000 men and women who fell to his share; and going to that city, built a palace eight stadia in compass, which he lined with lead taken from the monasteries. Next year a 2
fleet was sent against the islands of Rhodes and Chios; but the attempt on both proved unsuccessful: however, the island Cos was reduced, and some other places; after which the sultan, turning his arms towards Hungary, laid siege to Belgrade. At first he met with success; beat down part of the wall, and stopped the navigation of the river with 60 vessels: but the celebrated John Hunniades, happening to arrive at that critical juncture, made a furious sally, entirely routed the Turkish army, wounded Mohammed himself in the thigh, and burnt all his ships. Hunniades himself did not long survive this engagement, dying soon after of a wound he had received therein according to some, or of the plague according to others.

Unsuccessful attempt on Rhodes and Chios.

3 Mohammed repulsed at Belgrade.

4 Expedition against the Morea.

Mohammed being thus repulsed from Belgrade, set about the entire conquest of the Morea, the ancient Peloponnesus. The Grecian princes, among whom were two of the emperor's brothers, Thomas and Demetrius, were so terrified by the taking of Constantinople, and the great progress of the Turks, that they prepared to retire into Italy; upon which the Albanians seized on the country, choosing one Manuel Cantacuzenus, a Greek, for their prince. Then falling on the Greeks who remained, they made an offer to the sultan of the cities and fortresses, provided he would allow them to keep the open country; for the Albanians were shepherds, who had no fixed habitation. At this time, however, the sultan chose rather to support the Greeks than to let the country fall into the hands of such barbarians; and having defeated the Albanians, was content to accept of a tribute from the Greeks. But the danger was no sooner over, than the Grecian princes revolted anew; upon which Mohammed entering the country with a powerful army, prince Thomas, with his family, fled to Italy; while Demetrius 5
thought it most eligible to submit to the sultan, by whom he was carried away, with many of the most considerable persons of Lacedæmon, Achaia, &c. where Turkish governors were appointed. Two thousand families were also carried away from the Morea, in order to be settled at Constantinople, and 2000 young men to be enrolled among the sultan's troops. Many cities at this time fell into the hands

5 One of the Greek princes submits.

of the Turks, among which the principal were Corinth and Athens. The Greeks, however, still made some faint struggles; but all in vain: for by the year 1460 the whole country was subdued, excepting some maritime places held by the Venetians; and prince Thomas was obliged finally to take up his abode at Rome, where he was lodged in the pope's palace, and had a pension of 3000 livres a-year allowed him for his expences.

Mohammed now pursued his good fortune; and having made war on the emperor of Trebizond, he subdued his dominions, and put him to death. His career, however, was for some time stopped by Scanderbeg the Epirote. This prince had already defeated an army of 12,000 Turkish horse, of whom only 5000 escaped the slaughter; and dispersed another, with the loss of their general, and 4120 of his men killed on the spot. Encouraged by this success, he laid siege to Belgrade, which it seems was now in the hands of the Turks: but, through the treachery of his scouts, his army was defeated, and 5000 of his men killed; upon which, one of his generals, by name *Moses*, went over to the Turks.

Scanderbeg, not at all dispirited by this misfortune, prosecuted the war with the utmost vigour. His first enterprise was against his perfidious general Moses, who had been immediately put at the head of an army by the sultan. This army was by Scanderbeg totally destroyed, excepting about 4000 men; upon which Moses fell into such disgrace with the Turks, that he returned to his old master, who forgave his treachery, and restored him to all his former posts.

The bad success of Moses did not prevent Amesa, the nephew of Scanderbeg, from following his example. Mohammed received him kindly, and sent him with Ishak bashaw of Constantinople; whom he intrusted with an army of 50,000 men against his uncle. Scanderbeg, with only 6000 men, retired towards Lyssa, a maritime city of the Venetians. The Turks pursued, contrary to the advice of Amesa; and being surprised by Scanderbeg, were utterly defeated, with the loss of their camp, 20,000, or, according to others, 30,000 men killed on the spot, and the treacherous Amesa taken prisoner. With the like good fortune Scanderbeg defeated three other Turkish armies, one of 20,000, another of 30,000, and the third of 18,000 men. On this Mohammed sent against him an old experienced commander, at the head of 40,000 chosen troops; but as he likewise was able to atchieve nothing, the sultan thought proper to conclude a peace with Scanderbeg in 1461.

Mohammed being thus freed from such a troublesome enemy, completed the conquest of the Greek islands; subdued Wallachia, Bosnia, and Illyria, extending his empire nearly to the confines of Italy. But as it was easy to see that no conquests would satisfy the Turkish ambition, the Venetians, who found themselves ill-treated by their warlike neighbours, entered into an alliance with the Hungarians, to repress the overgrown power of the Turks, and prevent the western parts of the world from being totally over-run by them; and into this alliance Scanderbeg was soon drawn, notwithstanding his treaty with Mohammed already mentioned. The Hungarians invaded the Turkish dominions on the west side, defeated some troops, and carried off 20,000 slaves: the Venetians invaded the Morea, where they made some conquests, but were soon obliged to abandon them: however, they recovered the island of Lemnos; but being defeated in two engagements at land, they were obliged to solicit assistance from France, Germany, and Spain. Having obtained considerable supplies from those parts, they again entered the Morea; but meeting with still worse success than before, they applied for assistance to Matthias the son of John Hunniades king of Hungary. Matthias willingly made another incursion into the Turkish dominions, ravaged Servia, and carried off a vast number of prisoners with a great booty.

In the mean time, Mohammed, fearing lest Scanderbeg should be declared generalissimo of the Christian forces, sent to him, desiring a renewal of the league between them. But this being refused, the war was renewed with the utmost vigour. Many Turkish armies were sent against this hero; but they were utterly defeated and dispersed, till the year 1466, when by his death the sultan was freed from the most formidable enemy he had ever encountered.

The death of Scanderbeg was followed by the entire reduction of Epirus and Albania. The Venetians in 1469 defeated the Turks in a pitched battle; but were driven out of Negropont, at that time the strongest city in Europe: after which they entered into an alliance with Ferdinand king of Naples, Lewis king of Cyprus, and the grand master of Rhodes, at the same time that they sent ambassadors to Uzun Hassan king of Persia, in order to persuade him to attack the Turkish dominions on the east side. Mohammed did not lose his courage at the number of his enemies; but having defeated the Persians, reduced the Venetians to such distress, that they were obliged to conclude a treaty in 1479.

In 1481 the war was renewed, and the city of Rhodes besieged, but without success; however, the city of Cephalonia was taken from the Venetians, Italy invaded, and the city of Otranto taken. This was the last of the exploits of Mohammed II. who died this year of the gout, and was succeeded by his son Bayezid, or Bajazet II. Under this prince a war commenced with the Mamalukes of Egypt, which, under his successor Selim I. ended in the total subjection of that country. Bajazet, however, greatly facilitated Selim's conquest by the reduction of Circassia, whence the Mamalukes drew their principal recruits. Caramania and Croatia were totally reduced; the cities of Lepanto, Modon, and Durazz, taken by the Turks, though the Venetians recovered Cephalonia; Syria on the east, and Moldavia on the west, were invaded and ravaged by the victorious armies of the sultan; till at last a peace was concluded with the European powers in 1503.

The year 1509 is remarkable for a dreadful earthquake at Constantinople, which overturned a great number of houses, and destroyed 13,000 people; being also followed by an epidemic distemper, which carried off great numbers. About this time also the sultan, finding the infirmities of old age drawing on, and being desirous of passing the remainder of his days in quiet, resolved to resign the throne to his eldest son Achmed. But having engaged in this affair with too great precipitation, and before he had gained over the grandees, his second son Selim, whom he had made governor of Trebezond, hastily crossing the Euxine sea, dethroned and put to death his father, in the year 1512.

The new emperor, who had not scrupled to sacrifice his father to his ambition, did not hesitate at establishing himself on the throne by the death of his brother also. Accordingly, as Achmed, knowing he could be nowhere safe, resolved to stand on his defence, Selim with a powerful army marched against him; and having defeated the troops of his brother, took him prisoner, and put him to death. Having thus secured himself, he marched against the Persians, whom he overthrew in a great battle; after which he took the city of Taurus; made some other conquests; and having secured tranquility on the eastern side of his dominions, turned his arms against Sultan Gauri of Egypt. That he reduced in the manner related under the article EGYPT, n° 101. His farther designs of conquest were frustrated by his death, which happened in the year 1519.

Selim was succeeded by his son Solyman I. surnamed *Kanuni*, or *The Lawgiver*, who proved no less ambitious and warlike than his father. Having defeated and killed the governor of Damascus, who had rebelled against him, he attacked the European princes with a design to extend his dominions as far to the westward as he possessed to the eastward of his capital. In 1520 he set out with a great army to conquer Hungary. The city of Belgrade was immediately invested, and in a short time taken.

25 The city of Rhodes reduced.

Rhodes also being attacked by a great force by sea and land, was obliged to submit, after a most desperate resistance, as is related under that article, n° 33. *et seq.*; and Solyman entered the city in triumph on Christmas day 1522. His conquests for some time were stopped by a rebellion in Egypt; but this being soon quashed, the war with Hungary was renewed in 1525.

26 The king of Hungary defeated and killed.

King Lewis having rashly engaged the Turkish army of 200,000 men with only 25,000, was utterly defeated, himself drowned in a ditch, and his whole army, excepting a few horse, cut in pieces.—This defeat was followed by the surrender of Buda, which, however, the Hungarians retook in 1528; but next year it was again taken by the Turks, and soon after both the Moldavias submitted to their jurisdiction.

27 Vienna besieged unsuccessfully.

The city of Vienna was then invested: but after being reduced to the greatest straits, the sultan was obliged to abandon the siege by the coming on of the autumnal rains; which, however, he did not without barbarously massacring all his prisoners.

The raising the siege of Vienna was followed by an entire repulse of the Turks from the German territories: on

28 Georgia, Bagdad, &c. reduced.

which Solyman, resolving to extend his dominions on the east, subdued the country of Georgia, and made himself master of the city of Bagdad; at the same time that his admiral, the celebrated Barbarossa, ravaged the coasts of Italy, and took the cities of Biserta and Tunis in Africa. But, in

29 Tunis reduced by Charles V.

1536, he was obliged to retire before Charles V. of Spain, who retook the city of Tunis. Solyman, to revenge this disgrace, suspended for a time the war in Persia, in order to turn all his forces against Italy: but while this country was in danger of being totally overwhelmed, a Venetian captain having rashly taken and sunk some Turkish vessels, Solyman changed his design of attacking Italy into that of chastising the Venetians. However, after some trifling encounters, a peace was concluded in 1545.

30 Hungary reduced to a Turkish province.

This year the war was renewed in Hungary: the transactions were very unfortunate for the Christians, and ended in the entire reduction of the kingdom to a Turkish province. The kingdom of France, being oppressed by its enemies, entered into an alliance with Solyman, who was now grown so powerful, that the whole European powers seemed scarce able to resist him. However, in 1565, he

31 Malta besieged unsuccessfully

was baffled by the knights of MALTA, as is related under that article; and in 1566 an end was put to his ambition and his conquests by death.

Solyman was succeeded by his son Selim II. surnamed *Mest*, or "The Drunken." Under him the empire at first

32 Account of the battle of Lepanto.

lost nothing of its lustre; but in 1571 the maritime power of the Turks was almost entirely destroyed at Lepanto, where one of the most remarkable sea-engagements mentioned in history took place. The Christian fleet was commanded by Doria the Venetian admiral; and consisted of 78 Spanish and 3 Maltese galleys, under Don John of Austria, natural son to the emperor Charles V. Besides these, under Veniero, a Venetian officer, were 108 galleys, 6 galleasses, 2 [illegible], and a great many small galliots. Colonna, a kinsman of the pope, had also 12 of his galleys under his command. On board this fleet were 20,000 good soldiers, many of them persons of great quality, who went volunteers in the expedition. Though the Turkish fleet consisted of 335 sail, the most experienced officers were against fighting at that time, considering the great strength of the confederates, and that there was no necessity for an engagement. But the opinion of Ali Pasha, the chief admiral, who was for a battle, prevailing, Parteu Pasha, the next in command, took on board 12,000 janissaries and spahis, drawn out of the neighbouring garrisons; besides 4000 other soldiers. Then putting out of the gulf, the fleet steered their course for the isle of Curzalates, of old Echinates, half-way between Lepanto and Patras; and the Christians moving towards them, both fleets came in sight, October 7. afternoon. Hereupon Don John, having ordered the great ensigns of the confederates, which was the signal for engaging, to be hoisted, clad in armour, went in his long boat to encourage the several squadrons of the centre under his command; while Doria did the like in the right wing, and Barbadico, the Venetian proveditor-general, in the left.

The signal was no sooner given, than the Turks, with a hideous cry, fell on six galleasses which lay at anchor near a mile a-head of the confederate fleet; but those ships fired so briskly on them, first from their forecastles and then as they passed by, so galled their galleys with whole broadsides, that several of them were sunk, which made the rest bear farther off. The wind likewise chopped about to the west, and incommoded the Turks with the smoke. However, they soon rallied their disordered squadrons, and came on with surprising resolution. The action was continued for several hours with equal bravery on both sides; but victory at last declared for the confederates.

The number of Turks slain in this famous naval fight could not with certainty be known. An author who wrote an account of this war, makes their number 32,000 besides prisoners, who were about 3500. The galleys taken from them amounted to 161. Forty more were sunk or burnt; and of galliots, with other small vessels, about 60 were taken.

Notwithstanding the prodigious loss sustained by the Turks on this occasion, the confederates reaped but little advantage from this victory; and next year Kilij Ali Pasha, who had succeeded to the post of high admiral, fitted out a fleet of 250 galleys, with which he ravaged the coasts of Christendom wherever he came, and maintained his ground so well, that the confederates could never gain the least advantage over him.

The Turkish power from this time, however, began to decline. The progress of civilization being much more quick among the western nations, and their improvements in the art of war very considerable, the Turks found it not only impossible to extend their dominion over Germany, but even a matter of some difficulty to withstand the power of the western princes. During the remainder of the reign of Selim, the war was carried on in Hungary with little advantage on either side; but under his successor, sultan Morad III. the Turks met with several severe checks from the Germans.

In 1594, Mohammed III. having succeeded his father Morad, destroyed his 19 brethren, in order to secure himself on the throne; and for the same reason caused 10 of his father's wives and concubines to be thrown into the sea, lest any of them should prove with child. The emperor Rodolph II. having entered into a confederacy against him with the princes of Transylvania, Walachia, and Moldavia, defeated the Turks and their Tartar auxiliaries in several engagements, and took many cities; while so grievous a famine and plague raged in Hungary, that of 85,000 Tartars who had entered the country the year before, scarce 8000 remained alive. This was followed by new misfortunes; so that

that in the year following the Turks were entirely driven out of Transylvania, Moldavia, and Walachia.

In 1621, under Othman or Ozman II. we find the Turks first engaged in a war with Poland; but a peace was concluded the same year; the chief article of which was, that the Poles should have a free trade in the Turkish dominions, and that for this their merchants should pay 10,000 sequins. The Turkish affairs continued pretty much in the same way till the year 1673, when a dreadful war broke out with Germany, Russia, and Poland, whose army was at that time commanded by the celebrated John Sobieski. The year before, hostilities had commenced on account of the Poles having endeavoured to detach the Cossacks from their allegiance to the sultan. At this time the Turks were successful, through the dissensions which reigned among the Poles; and the latter were obliged to pay an annual tribute of 20,000 rixdollars, and to deliver up 48 towns and villages in the territory of Kaminieck. However, the articles of this treaty were never executed; for, in 1673, the states of Poland sent a letter to Kyoprili Ahmed Pasha, the vizir at that time, informing him that they considered as null the conditions of the treaty, being concluded without their consent, and that they would rather suffer death than submit to the infamy of paying one single farthing by way of tribute. On this the sultan, Mohammed IV. determined to take a severe revenge on their perfidy, set out with a great army; but was entirely defeated, with the loss of 20,000 men killed on the spot, all the baggage, 25,000 waggon loads of provision and ammunition, and 2000 purses of money for paying the army. Soon after this victory, John was proclaimed king of Poland: but his subjects, jealous of his glory, refused to support him properly in prosecuting his advantage; so that, four years after, a treaty was concluded, by which the Poles for ever resigned their pretensions to Kaminieck and to the dominion of the Cossacks in Podolia.

But though peace was thus made with Poland, the war was carried on very unsuccessfully with Russia. In 1678, an army of the Tartars was entirely cut in pieces or taken near the city of Cherin; which so intimidated another army of 40,000 Turks, who had waited for the arrival of these auxiliaries, that they threw away their arms, and fled without stopping till they had crossed the river Bog. This defeat inclined the sultan to peace; but the negotiations proving ineffectual, he, in 1679, again sent a powerful army of 80,000 Turks, 30,000 Tartars, and 4000 Cossacks, under the command of the vizir, to retrieve his lost honour. This army, however, succeeded little better than the former: for the vizir was defeated in several engagements; and at last, according to custom, put to death on account of the bad success of the war. In 1684 the Venetians again declared war, while the Poles and Germans continued their hostilities with the utmost violence. The Turks were forced to yield to the superior fortune and valour of their adversaries; they were defeated in a great number of engagements, and lost many places of importance. In short, their affairs seemed to be totally going to wreck, when, in 1688, they were retrieved by the new vizir Ahmed Kyoprili, a man of great skill and experience in war, as well as of the most upright and blameless character. Having prevailed in the divan to have the war carried on, he applied his whole care to the raising of an army, and providing warlike stores. But finding the people everywhere intimidated and unwilling to oppose the enemy, the treasury exhausted, and an universal langour prevailing, he made a new kind of proclamation, in which he told the people, that "as he found it necessary to trust the command of the army against the haughty Germans to none but himself, so he would not employ in this expedition any soldier forced into the service; knowing that the will was of more value with God than the deed: that he would only put the Mussulmans in mind, that, by the precepts of God and his prophet, every one is commanded neither to avoid martyrdom, nor to despair of success against infidels, &c. Having thus once roused the enthusiasm of the common people, they flocked in great numbers to his standard; after which, having reformed many abuses both in the civil and military departments, he led them against the enemy. The good effects of his reformations were evident. Great numbers of the enemy were cut off, and almost all the important places taken which had been lost before, when, in 1691, he was defeated and killed by the Germans at Salankement. After his death the Turkish affairs again fell into disorder; and, though the utmost efforts were used by succeeding vizirs, no progress could be made; and, in 1697, a terrible overthrow was given them by Prince Eugene at Zenta. At last, in 1698, all parties being weary of such an expensive and ruinous war, a pacification took place at Carlowitz, but on different terms with the different nations who had been at war with the Turks. The emperor made a truce for 25 years, upon condition that all Transylvania should be resigned to him: the city of Temeswaer was to be restored to the Turks, and the navigation of the Teisse and Maros rivers be free to both nations; that the country between the Danube and the Teisse, called *Bachbak*, remain in the emperor's hands; that the boundary of the eastern part of Hungary, belonging to the emperor, should be a right line drawn from the mouth of the Maros towards the banks of the river Teisse to the mouth of the Bossut, where it falls into the Saave; that towards the south the Saave should part the Turkish from the Imperial limits, till it receives the Unna; and that no new castles besides Belgrade and Peterwaradin should be erected, or old ones fortified, anywhere within these boundaries.

Turkey.
49
50 Peace concluded.
51 Terms made with the emperor.

The Russian ambassador made a truce only for two years, upon the foot of each party possessing what he had taken. The Poles made a truce on the like terms with the sultan; namely, that they should have Kaminieck, Podolia, and Ukrania, restored to them, in the same extent as possessed by them before sultan Mohammed's first expedition into Poland; and, on the other hand, resign Soczava, Nemoz, and Soraka, in Moldavia, to the Turks. The Venetians obtained these conditions: that all the Morea, as far as Hexamilos, should belong to them; and that the firm land, with Naupaktum (or Lepanto), Prevesa, and the castle of Romania, which had been demolished, should be restored to the Turks; that the bay of Corinth should be common to both, and the Venetians possess Leucade with the adjacent islands. The yearly tribute paid by the islands in the Archipelago to the Venetians was to be abolished; and Zakinth to be declared free from the like burden by the Turks. In Dalmatia, Knin, Cing, Kiklut, Verlika, Duare, and Vergoraz, were to be left to the republic, and fixed as the boundaries of their dominions on that side. The Ragusans were to continue free, and the Venetians to retain the castles of Castlenuovo and Risano, with what they possessed in the neighbourhood. Both parties were allowed to fortify their borders with new fortresses; or to repair those which were decayed, excepting Naupaktum, Prevesa, and the castle of Romania before mentioned.

52 With the Russians.
53 With the Venetians.

From the conclusion of the peace of Carlowitz to the year 1769, nothing very remarkable occurs in the Turkish history, excepting their recovery of the Morea from the Venetians by the treaty of Passarowitz. (See the article VENICE). Their war with the Russians under Peter the Great has been taken notice of under the article RUSSIA; their wars with PERSIA, under that article. [illegible]

54 Turkish affairs to the year 1769.

Turkey.

indeed, were of any great conſequence; but, in 1769, a war commenced with Ruſſia, which threatened the Ottoman empire with deſtruction, and which has given it ſuch a ſevere

55
War with Ruſſia.

check as it can ſcarcely recover. The origin of this war is given under the article POLAND, n° 101; and during the courſe of it, an almoſt uninterrupted train of ſucceſs attended the Ruſſian arms.—About the end of March 1769, a

56
Aſoph taken by the Ruſſians.

body of Ruſſian troops made themſelves maſters of the important fortreſs of Aſoph, at the mouth of the river Don. In the end of April, prince Gallitzin, commander in chief of the Ruſſian army on the frontiers of Poland, paſſed the river Nieſter, hoping to take the fortreſs of Choczim by ſurpriſe; but being diſappointed, he was obliged to return. Near the beginning of July, however, he again paſſed that river, and on the 13th attacked and defeated the van of the

57
The Turks defeated.

grand vizir's army, conſiſting of about 50,000 or 60,000 men. Thirteen thouſand of the fugitives entered Choczim; which was next day inveſted by the Ruſſians: but they were at laſt obliged to raiſe the ſiege and repaſs the Nieſter; which they could not effect without conſiderable loſs.

In the mean time, both the Ottoman and Ruſſian courts

58
The Turkiſh vizir beheaded.

were diſpleaſed with the conduct of their generals. The Turkiſh grand vizir was deprived of his command, and afterwards beheaded; and was ſucceeded by Moldovani Aga Pacha, a man of a bold and enterpriſing ſpirit. On his firſt taking the command of the army, finding it impoſſible to ſubſiſt where he was, he attempted to force a paſſage

59
Choczim taken by the Ruſſians.

over the Nieſter; but being three times repulſed with great loſs, he made a precipitate retreat towards Bender, at the ſame time drawing the troops out of Choczim, which the Ruſſians immediately took poſſeſſion of.

Prince Gallitzin was now ſuperſeded by general Roman-

60
They reduce the province of Yaſſy

zow, who took the command of the army on the 29th of September. Soon after his arrival, he received news of the ſucceſs of general Elmpt, who, with a body of 10,000 men, had reduced the province of Yaſſy. He inveſted Bender; but finding the ſeaſon of the year too far advanced, he ſoon withdrew his troops, and put them into winter quarters.

61
Unſucceſsful negotiations for peace.

This firſt campaign had proved ſo unpropitious to the Turkiſh affairs, that the court would gladly have concluded a peace, if they could have obtained it upon honourable terms; but the Ruſſians inſiſting upon the entire ceſſion of Moldavia and Walachia as a preliminary article, the negotiations came to nothing. A new campaign was therefore reſolved on; and this proved ſtill more unſucceſsful than before. The grand Ruſſian army under general Romanzow paſſed the Nieſter in the month of May 1770; and, having aſſembled at Choczim on the 3d of June, marched towards Pruth: at the ſame time, their ſecond army, commanded by

62
Bender inveſted.

general Panin, arrived before Bender. The plan of operation was, that the latter ſhould form the ſiege of Bender, and Romanzow ſhould cover it.

63
The Turks and Tartars defeated by General Romanzow.

On the 18th of July, general Romanzow attacked an army of 80,000 Turks and Tartars, commanded by the Khan of Crimea, and ſtrongly intrenched on an almoſt inacceſſible mountain, forced their intrenchments, and obliged them to flee in the utmoſt confuſion, leaving an immenſe quantity of ammunition and proviſions, &c. in their camp; which they totally abandoned to the victors.—After this

64
The grand vizir defeated with prodigious ſlaughter.

victory, the Ruſſian general puſhed on towards the Danube; and on the 2d of Auguſt attacked another Turkiſh army, commanded by the grand vizir in perſon, and totally defeated it, making himſelf maſter of their camp, ammunition, 143 pieces of cannon, and above 7000 carriages loaded with proviſions. The loſs of the Turks on this occaſion was not reckoned leſs than 40,000 men, and ſome accounts raiſed it to 60,000.—During the courſe of this ſummer alſo, the fortreſs of Kilia Nova, at the moſt northerly mouth of the Danube, ſurrendered by capitulation; and likewiſe that of Ackerman, or Bialogorod, near the mouth of the Nieſter. Bender was taken by ſtorm on the 27th of November; and the Ruſſians, enraged at the obſtinate reſiſtance they had met with, made a terrible ſlaughter of their enemies. It was computed that 30,000 Turks periſhed on this occaſion. The

65
Bender taken, and the inhabitants maſſacred.

fortreſs of Brailow, ſituated on the northern ſide of the Danube, was inveſted on the 26th of September; and the garriſon were ſo much intimidated by the taking of Bender, that they abandoned the place, and moſt of them were drowned in croſſing the river.—During this campaign, it was reckoned that the Ruſſians took 1000 pieces of cannon from their enemies.

66
Vaſt nu[mber] of c[annon] taken by the R[uſ]ſians.

This year alſo a Ruſſian fleet of 16 or 18 ſhips entered the Mediterranean, and landed a body of troops on the Morea. These being joined by the Greeks, committed great cruelties on the Turks, and made themſelves maſters of almoſt the whole country. At laſt, however, the Porte, notwithſtanding their bad ſucceſs in other parts, found means to ſend a force into the Morea ſufficient to overpower the Ruſſians. The Greeks now ſuffered in their turn; and the Ruſſians, hearing that a Turkiſh fleet had paſſed the Dardanelles, abandoned the Morea, and ſailed to meet their antagoniſts. A battle enſued, in which the Turks were defeated; and having imprudently retired into a neighbouring harbour, they were next day entirely deſtroyed by the Ruſſian fire ſhips, except one ſhip of 64 guns, which was taken. This fleet conſiſted of 15 ſhips of the line, from 96 to 60 guns, three large frigates, and ſeven large armed veſſels, beſides galleys. After this victory, the Ruſſian fleet blocked up the mouth of the Dardanelles, interrupted the Turkiſh trade, prevented the carrying of proviſions to Conſtantinople by ſea, and raiſed contributions from moſt of the iſlands in the Archipelago.

67
A Ruſſ[ian] fleet lan[ds] ſome tr[oops] on the M[o]rea.

68
They d[e]ſtroy th[e] Turkiſh fleet.

In 1771, matters did not at firſt go on ſo ſucceſsfully on the part of the Ruſſians. On the ſide of the Danube they were obliged to keep on the defenſive. Another army, under prince Dolgorucki, had better ſucceſs; they reduced the whole peninſula of Crim Tartary in leſs than a month, though defended by an army of 50,000 men.—During theſe tranſactions the Turks made themſelves maſters of the fortreſs of Giurgewo; which enabled them to become ſo formidable on the ſide of Walachia, that prince Repnin durſt not attack them. Upon his refuſal to do ſo, he was deprived of his command; which was given to General Eſſen. On the 17th of Auguſt, he attacked the Turkiſh intrenchments; but, after a deſperate engagement of four hours, was defeated, with the loſs of upwards of 3000 men.

69
The Tu[rks] gain ſo[me] advanta[ge].

70
They ta[ke] Giurgev[o] and def[eat] General Eſſen.

This was the only engagement of any conſequence in which the Turks had proved victorious ſince the beginning of the war; and, after it, their uſual bad fortune attended them. In conſequence of their victory, they determined to winter on the northern ſide of the Danube, which would have been of the utmoſt ſervice to them; and with which view they conſiderably reinforced their army in Walachia. But general Romanzow, by a train of maſterly diſpoſitions, not only thwarted all their ſchemes, but ſurpriſed them on their own ſide of the river. They had divided their army into two great bodies, which were ſtationed in the neareſt and moſt important poſts on the Turkiſh ſide of the Danube. On the 20th of October, one of theſe bodies was ſurpriſed at Tulcza by general Weiſman, and another at Maczin by general Milarodowits. The event was the ſame in both places. The intrenchments were forced, the Turks totally routed, and their artillery, ſtores, and magazines taken, together with the two towns and their caſtles. Next day general Weiſman attacked the grand vizir himſelf, with the like

71
Are out[wi]tted b[y] General Romanzow.

72
Two T[ur]kiſh armi[es] totally [de]feated.

like succefs. The intrenchments were forced, a vaft quantity of artillery taken, and likewife the town and caftle of Babadagh; while the vizir, with the remains of his army, fled 30 miles to feek refuge at Mount Hemus. A few days afterwards general Effen defeated another body of Turks, and retook the fortrefs of Giurgewo, driving the enemy totally out of Walachia. The Ruffian fleet this year fpread ruin and defolation through the defencelefs iflands of the Archipelago and the coafts of Afia, ftriking terror into the city of Conftantinople itfelf. A dreadful peftilence raged this year in the Turkifh army; and in the autumn broke out at Mofcow, where it deftroyed vaft numbers.

75 The affairs of the Turks were now in fuch a defperate condition, that they very eagerly fued for peace. The only conditions on which this could be obtained, however, were, that the Crimea, Budziac Tartary, and all that vaft tract of country on the coaft of the Black Sea, as far as the north fhore of the Danube, fhould continue for ever under the dominion of Ruffia; that the Ruffians fhould enjoy an unlimited freedom of navigation on the Black Sea, together with the poffeffion of the city of Afoph, on the mouth of the Don; and that a fum of money fhould be paid them by way of indemnification for the expences of the war. Thefe terms, however, were rejected; and the negotiations, which continued through the whole year 1772, at laft came to nothing. The commiffioners on both fides retired from Buchareft, the place where the congrefs was held, on the 22d of March 1773. For fome time a defultory kind of war was carried on between detachments from the two armies. But as this was very prejudicial to the Ruffians, who could not be fo eafily recruited as the Turks, about the middle of June, Romanzow made preparations for paffing the Danube with the grand Ruffian army, confifting of 87,000 men: which, however, he did not accomplifh till the 24th; and then marched with his army, in large divifions, towards the city of Siliftria. He was terribly haraffed on his march by large bodies of the Turkifh cavalry, of whom the grand vizir had detached 27,000 for this purpofe. At laft, however, they arrived before the city, which was ftrongly fortified, and defended by a body of troops confifting of about 24,000 men. On the 29th of June, this body was defeated by general Weifman, who commanded the van of the Ruffian army, and forced to retire into Siliftria. The grand vizir then detached 50,000 men to the relief of the place: upon this the Ruffians found it neceffary to retreat; which was not accomplifhed without very great difficulty and lofs. In this retreat general Weifman was killed, and the army left all their magazines behind them.

Many other fevere conflicts happened this campaign, which proved lefs glorious to the Ruffians than any of the former ones. In 1774, however, their arms were attended with better fuccefs. Romanzow's army was reinforced by 10,000 men; and, on the night between the 16th and 17th of June, paffed the Danube in fpite of all oppofition. A continued feries of engagements then happened between the Ruffian generals and different bodies of the Turks. In thefe the latter were always defeated; and at laft became fo much difpirited, that a body of 40,000, or, according to fome accounts, of 70,000 Turks, fled at the firft fight of a body of their enemies greatly inferior in number, leaving behind them all their tents and baggage, with a fine train of brafs artillery. From this time, diforder, mutiny, and difmay, feized all the Turkifh armies, and they abfolutely refufed to face their enemies. They plundered the baggage, robbed and murdered their officers, deferted by thoufands, taking the road to Conftantinople, and committing every kind of outrage by the way. The minifters of ftate, after having tried all methods to induce this lawlefs crew to return to their duty, were obliged to furnifh them with veffels for their tranfportation into Afia. According to fome accounts, no fewer than 30,000 of the Turkifh troops deferted in this manner. Even in the grand vizir's camp at Schumla, matters went on in the fame diforderly manner. He was abandoned by his whole cavalry; his European and Afiatic troops quarrelled, and cut one another to pieces before his face; and, in fhort, the vaft army he commanded was reduced almoft to nothing. The Ruffian general did not fail to take advantage of thefe circumftances. He placed the different divifions of his army in fuch advantageous fituations, that he totally cut off all communication between the Turkifh camp and every means of fubfiftence. The unfortunate vizir, therefore, was obliged at laft to fubmit to the terms which Romanzow dictated to him. The principal articles were, the independency of the Crimea; the abfolute ceffion of Kilburn, Kerche, and Jenikala, and all the country between the Bog and the Nieper; a free navigation in all the Turkifh feas, in which was included the paffage through the Dardanelles, with all the privileges and immunities which were granted to the moft favoured nations. Ruffia gave up all her conquefts, except Afoph and Taganrok. There were, befides, feveral ftipulations in favour of the inhabitants of Moldavia and Walachia, and the Greek iflands which were reftored by Ruffia.

Soon after this period an extraordinary alarm was excited at the Porte by the fudden appearance of a new prophet in Upper Afia. This man, whofe name was Sheik Manfour, pretended that he was predoomed by the eternal and immutable decrees of Heaven to fill up the meafure of Divine revelation to mankind; and that as he was to be the laft, fo he was the greateft of the prophets. The fcene of his miniftry was in the wide and defolate regions on the borders of the Cafpian Sea; and though the firft rumour of his proceedings reprefented him as at the head of a multitude of armed enthufiafts ready to overturn the eftablifhed government and the religion of Mahomet, it was foon difcovered that all the military fury of his zeal was directed againft the Chriftians. He had even influence enough to form a combination of all the nations of Caucafean Tartars againft the Ruffians, which was certainly of fome fervice to the Turks in that war, which the emprefs Catherine was now meditating againft them.

In the mean time, while this war was impending, the moft formidable rebellion broke out in Egypt, the granary of the Turkifh empire (fee EGYPT, n° 125); but it was, after a long, bloody, and dangerous war, almoft fuppreffed by the wife conduct and intrepid bravery of Haffan Bey, the Captain Pacha or Grand Admiral, who, at the age of 70, fought with all the ardour of youth, and all the fkill of the moft confummate general. That veteran, however, was recalled before he was able to carry all his patriotic defigns into execution, that he might aid the divan with his counfel, in the critical fituation into which the empire was brought by the arrogant claims of the court of Ruffia. The refult of the deliberations was a precipitate declaration of war againft that court, contrary to the better judgment of the old Pacha. The war commenced in autumn 1787, and the hordes of Tartars which were firft brought into the field, headed by the new prophet, were every where defeated by the fuperior difcipline of the Ruffian troops commanded by prince Potemkin. Some enterprizes which were undertaken by the Turks againft the ifland of Tamen and the Crimea were attended with as little fuccefs as the attempts of the Tartars; while the Emperor Jofeph declared to the Porte that he would affift his ally the emprefs of Ruffia with an army of 80,000 men. Four Auftrian armies were accordingly affembled; one at Carlftadt in Croatia, under the command of general de Vins; another at Peterwaradin in Hungary, commanded by general Langlois; a third on the borders of Lithuania,

76 Negotiations broken off.

77 Romanzow passes the Danube.

78 Turkish army defeated by general Weisman, who is killed.

79

80 The Turks every where defeated.

81 Almost the whole army deserts.

82 Peace dictated by Romanzow.

83 Appearance of a new prophet in Upper Asia.

84 A rebellion in Egypt.

85 A new war with Russia.

86 And Austria.

thuania, under general Febris; and the fourth in the Buccowine, under the orders of the prince of Saxe Cobourg. Two other generals, ten lieutenant-generals, and thirty major-generals, were all ordered to prepare for active ſervice in the frontier armies. If any thing had been yet wanting to ſhow the fixed determination of the court of Vienna, the meaſure of ſending general Alvinzi to act in and obſerve the conduct of the Ruſſian armies during the war, and the receiving a Ruſſian officer of equal rank to act the ſame part in the Auſtrian, would have been alone a ſufficient explanation.

87
The Turks at firſt ſucceſsful.

The war between the Turks and Auſtrians was carried on with various ſucceſs. At firſt the advantage was evidently on the ſide of the Ottomans, and the imperial Joſeph acquired no warlike renown. His declared purpoſe was to get poſſeſſion of Belgrade; from which however his enemies repulſed him with diſgrace. The prince of Saxe-Cobourg in his department of the war diſplayed indeed prodigies of valour; but being oppoſed to a ſuperior force, he was long obliged to act only on the defenſive. At length, being joined by a body of Ruſſian forces under general Soltikow, preparations were made for commencing in form the ſiege of Choczim, which was ſurrendered to the allied armies on Michaelmas day 1788, after a defence which would have done honour to the ableſt general in Europe. Still, however, ſucceſs ſeemed to lean to the Turks. The grand vizir made a ſudden incurſion into the Bannat, and ſpread conſternation and diſmay to the very gates of Vienna. The Auſtrian affairs ſeemed approaching to a very alarming criſis; not only the ſplendid views of conqueſt which were beheld in the imagined partition of a tottering empire had totally diſappeared, but had left in their place the ſad and gloomy reverſe of a diſcontented and impoveriſhed people, an exhauſted treaſury, and an army thinned by peſtilence and deſertion. The firſt campaign of an invaſive war had already produced an impreſſion on the territory of the invader.

88
General Laudohn takes the command of the Auſtrian army.

In this ſituation of affairs Marſhal Laudohn was with ſome difficulty drawn from his retirement to take the command of the army in Croatia; and under his auſpices fortune began to ſmile on the Auſtrian arms. He quickly reduced Dubicza and Nevi, though they were both defended with the moſt obſtinate bravery. He then ſat down before Turkiſh Gradiſca; but the autumnal rains coming on with ſuch violence that the Saave overflowed its banks, he was compelled to raiſe the ſiege. During this period the war in the Bannat raged with the utmoſt violence; torrents of blood were ſhed on both ſides; much deſperate valour diſplayed on the one ſide, and many brave actions performed on the other; while a very great part of that fine but unfortunate country ſuffered all the deſolation and ruin that fire and ſword, under the dominion of vengeance and animoſity, could inflict. The inhabitants were objects of commiſeration; but the injuſtice with which the emperor had commenced the war made his perſonal loſſes be conſidered as nothing more than the due reward of his conduct.

Hitherto the Ruſſians had hardly entered into the war; but at laſt they began to act with vigour both by ſea and land. They experienced however a very general coldneſs with reſpect to their claims, pretenſions, and deſigns, in almoſt all the courts of Europe. The court of London prohibited Britiſh ſeamen from entering into foreign ſervice, and declared its reſolution to obſerve the ſtricteſt neutrality. The united provinces of Holland purſued the ſame line of conduct; and ſome of the ambitious views of Ruſſia were thus blaſted. In the mean time a vaſt Ruſſian army, eſtimated at 150,000 men, appeared on the banks of the river Bog, adjoining to the confines of Poland, Turkey, and Tartary, and on the way to the Black Sea, under the orders of prince Potemkin and general Romanzow; theſe being aſſiſted by prince Repnin, general Soltikow, and other commanders of note. This great force was ſupported by a field train of 137 pieces of artillery, beſides a vaſt park of heavy battering cannon and mortars, deſtined for the ſiege of Oczakow; and furniſhed with that exuberance of powder, ball, ſhells, and all manner of military machines, which are the uſual concomitants of a Ruſſian army. After the moſt obſtinate defence, Oczakow was taken on the 17th of December 1788, and the governor baſha graced the triumphant return of prince Potemkin to Peterſburgh. In the mean time Ruſſia found herſelf attacked by a new and formidable enemy in the Swediſh monarch, of whoſe exploits we have given an account elſewhere (ſee SWEDEN, n° 246.); and by his interference her conqueſts were certainly retarded.

89
Ruſſians take Oczakow.

90
Gradiſca and Belgrade taken by Laudohn.

Marſhal Laudohn renewed his attemps upon Gradiſca as ſoon as the ſeaſon would permit, and after a brave defence it fell into his hands. This with ſome other ſucceſſes rouſed the emperor from his inactivity, and made him ſeriouſly determine upon the attack which he had long meditated upon Belgrade. The enterprize was entruſted to Laudohn, who, with that good fortune which ſeemed conſtantly to attend him, made himſelf maſter of the place in leſs than a month. The reſt of the campaign was little elſe than a ſucceſſion of the moſt important ſucceſſes; and a circumſtance that did not a little contribute to this, was the ſyſtem adopted by the Auſtrians and Ruſſians, of ſuffering the Turkiſh troops to march out of the ſeveral places they garriſoned without moleſtation. Accordingly, while one detachment of general Laudohn's forces took poſſeſſion of Czernitz in Walachia, another made itſelf maſter of Cladova in Servia. Buchareſt, the capital of the former of theſe provinces, fell without oppoſition into the hands of prince Cobourg; while Akerman on the Black Sea was reduced by the Ruſſians; and Bender ſurrendered to prince Potemkin, not without ſuſpicion of ſiniſter practices, on the 15th of November.

91
The emperor dies, and his ſucceſſor concludes a peace.

Soon after this, the emperor Joſeph died, and his ſucceſſor Leopold ſhowed a deſire for peace. After the reduction of Orſova, therefore, which happened on the 16th of April 1790, the war was carried on with languor on the part of Auſtria; and in the month of June a conference was agreed upon at Reichenbach, at which the miniſters of Pruſſia, Auſtria, England, and the United Provinces, aſſiſted, and at which alſo an envoy from Poland was occaſionally preſent. After a negotiation, which continued till the 17th of Auguſt, it was agreed that a peace ſhould be concluded between the king of Hungary and the Ottoman Porte; that the baſis of this treaty ſhould be a general ſurrender of all the conqueſts made by the former, retaining only Choczim as a ſecurity till the Porte ſhould accede to the terms of the agreement, when it was alſo to be reſtored. Catherine was thus deprived of an ally, but ſtill ſhe continued the war. On the 22d of December 1790, the fortreſs of Iſmail was taken by ſtorm by general Suwarrow; and it is ſaid that the ſiege and the capture did not coſt the Ruſſians leſs than 10,000 men. The moſt ſhocking part of the tranſaction is, that the garriſon (whoſe bravery merited, and would have received from a generous foe, the higheſt honours) were maſſacred in cold blood by the merciless Ruſſians, to the amount of, by their own account, upwards of 30,000 men; and the place was given up to the unreſtrained fury of the brutal ſoldiery. After this bloody ſcene, the Ruſſians went into winter quarters; the vizir retired towards Conſtantinople, and on his return fell a ſacrifice to the ſanguinary policy which has long diſgraced the Ottoman councils.

92
Succeſs of the Ruſſians.

The campaign of 1791 opened on the part of Ruſſia with the taking of Maczin, on the 4th of April, by prince Gallitzin; and in a ſubſequent victory on the 12th by the ſame general, in the neighbourhood of Brailow, the Turks loſt not leſs

less than 4000 men and upwards of 100 officers, besides many pieces of cannon. On the 14th the Russian arms experienced a check, by which they lost about 700 men, and were obliged to relinquish the intention of besieging Brailow. After reinforcing this place, the vizir proceeded to the banks of the Danube near Silistria; and, by means of a bridge which he threw across the river, his advanced posts were enabled to make incursions on the opposite side. The ability of the vizir and the valour of the Turks were however exerted in vain against the discipline and experience of European armies. In the month of June, 15,000 Turks were defeated by a party of cavalry under general Kutusow. On the 3d of July the fortress of Anape was taken by general Gudowitsch, and the garrison, to the amount of 6000 men, made prisoners. This event was followed, on the 9th of the same month, by a signal victory which prince Repnin obtained near Maczin over a body of 70,000, the flower of the Turkish army. The Ottomans left upwards of 4000 dead upon the field of battle, and lost their entire camp equipage, colours, and 30 pieces of cannon. The Russians are said to have lost only 150 men killed, and between 200 and 300 wounded. At last peace was restored between the Porte and Russia, principally through the mediation of Great Britain and the northern powers. Catherine, who talked high at first, confined her views at length to the possession of Oczakow, with the district extending from the Bog to the Niester, and even then providing for the free navigation of the latter river. These terms, considering the ill success of the war, cannot be accounted very disadvantageous to the Porte, who has lost a fortress more useful for the purpose of annoying Russia than for defending their own territories; but certainly of considerable importance to Russia, which, by this cession, has secured the peaceable enjoyment of the Crimea.

The Turkish empire comprehends several countries in Europe, Asia, and Africa. In Europe it is bounded on the south by the Mediterranean; on the north by Croatia, Sclavonia, and Transylvania; on the east by Poland, Russia, and Asia; and on the west by the Adriatic and Dalmatia. The principal countries of Turkey in Europe are Romania, Bulgaria, Servia, Walachia, Moldavia, Bessarabia, Greece, Macedonia, Albania, Thessaly, Levadia, Morea, and the Archipelago islands. Turkey in Asia is divided into Eastern and Western. The Eastern comprehends Georgia, Turcomania, and Dearbekr; and the Western, Anatolia, or Asia Minor, Syria, and Palestine.—In Africa the Turkish dominions are Egypt, and some districts of Barbary. But for an account of these different countries, see the articles as they occur in the order of the alphabet.

The grand signior, or emperor of the Turks, is restrained by no laws or compacts, the government being purely monarchical: but if he indulges not the humours of the people, and especially of the mutinous janisaries, he is in danger not only of being deposed, but also of being put to death. Those who have offices under the government he squeezes, disgraces, and puts to death, upon the least suggestion of their disaffection or misconduct, without giving them an opportunity of answering for themselves, they being looked upon as more immediately his slaves: but others seem to enjoy almost as great a degree of security, both in their persons and properties, as the subjects of other absolute monarchies. Indeed, in all such there is a gradation of governors and officers, of which the higher fleece and oppress those below them, and the lowest make reprisals upon the common people. In the succession to the empire, no regard is paid to age or birthright, the Turks thinking it sufficient if, in their elections, they keep to the family. Women are excluded from the throne. The emperor's council is either ordinary or extraordinary. The first, meeting every Sunday and Thursday, consists of the great officers of state, and is called the *galibe divani*. To the other, which is called *ajak divani*, are summoned all the great persons and officers of the empire, and even the oldest and most experienced soldiers. The sultan hears what passes from an adjoining chamber. At the head of the ministry is the grand vizir, who is as it were his lieutenant-general, with whom he divides, or rather to whom he leaves, the care of the whole empire; he being entrusted not only with the finances, with foreign affairs, and the administration of justice in civil and criminal matters, but also with the conduct of the war, and the command of the army. Great and dangerous as this charge is, there have been men who have executed it with safety and success both in peace and war, and have died quietly in their beds; but that is not the case with the most of them, it being the usual policy of the emperors to shelter themselves from the clamours of the people by throwing the whole blame of any mal-administration upon him, and giving him up to the public resentment. His income, without any breach of probity, may amount to 600,000 dollars, exclusive of presents and other perquisites. Notwithstanding his high dignity, his palace is open to every one, and he gives audience to the meanest of the poor. When the sultan names a grand vizir, he puts into his hand the seal of the empire; and when he honours him with the command of an army, he takes out one of the plumes of his own turban at the head of the troops, and delivers it to him to place it in his own. The other great officers of state are the kaimakan, or vizir's deputy, not to be confounded with the governor of Constantinople, who is also called *kaimakan*; the vizirs of the bench, or bashas of three horse-tails, because three horse-tails are carried before them when they march, and who sit in the divan or courts of justice with him; the kadinlasquiers, or chief justices of provinces; the beiglerbegs or viceroys, of which the chief are those of Romelia, Natolia, and Damascus; the ordinary bashas or governors of towns and districts under the beiglerbegs; the reis effendi, or lord chancellor and secretary of state; the testerder or high treasurer; the aga of the janisaries; the aga of the spahis; the aga of the silade, &c. The chief officers of the seraglio are the kislaraga, who is superintendant of the women and has the command of all the black eunuchs; the capi aga, who has the command of all the white eunuchs, and to whom all petitions to be presented to the prince are delivered. Both these are also eunuchs, and of the same complexion as those of whom they have the command. Besides the women and eunuchs, there are in the seraglio the ichoglans and azamoglans, mutes, dwarfs, and buffoons. The ichoglans are young men bred up in the seraglio, not only to serve about the prince, but to fill in time the first posts of the empire. The azamoglans are trained up there for inferior employments.

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No children are admitted into the seraglios of Constantinople, Pera, or Adrianople, till they are first reviewed and approved of by the grand signior. They are generally the most beautiful, well-made, and sprightly, that can be met with. They are first taught, after being circumcised, silence and a modest humble behaviour. Then they are instructed in the Mohammedan religion, to speak and write the Turkish language, and afterwards the Persian and Arabic. As they grow up, they are taught manly exercises, and whatever is thought requisite to qualify them for state-employments: but they are seldom preferred out of the seraglio until the age of 40.

The ladies of the haram are a collection of young beautiful virgins, either the presents of governors, purchased, or captives taken in war; most of them being the children of Christian parents. They are taught music, dancing, and other accomplishments, and furnished with the richest clothes and

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and ornaments. Some of them frequently play and dance before the grand signior, while others divert him with their conversation. They have a great many female slaves to wait on them; but are scarce ever suffered to go abroad, except when the grand signior changes his place of residence; when a troop of black eunuchs convey them to the boats, which are enclosed with lattices: and when they go by land, they are put into close chariots, and signals made at certain distances, to give notice that none may approach the road through which they are to pass.

96
Dress, manners, &c. of the Turks.

The Turks are generally robust and well-shaped, of a good mien, and patient of hardships, which render them fit for war. They shave their heads; but wear their beards long, except the military and those in the seraglio, who wear only whiskers. They cover their heads with a white linen turban of an enormous size, and never pull it off but when they sleep. None but Turks must presume to wear a white turban. Their breeches or drawers are of a piece with their stockings; and they have slippers instead of shoes, which they pull off when they enter a temple or house. They wear shirts, with wide sleeves, not gathered at the wrists, and over them a vest tied with a sash; their upper garment being a loose gown, something shorter than the vest.

The women's dress pretty much resembles that of the men; only they have a stiffened cap with horns, something like a mitre, on their heads instead of a turban, and wear their hair flowing down. When they go abroad, they are so wrapped up, that their faces cannot be seen.

The Turks sit, eat, and sleep, according to the custom of the east, on sophas or cushions, mattresses, and carpets. Rice is their most general food, and coffee their common drink. Their most usual salutation is to bow the head a little, laying the right-hand on their breasts; but to persons of rank they stoop so low as to touch the border of their vest. The women are kept under a rigorous confinement. They have generally delicate skins, regular features, black hair and eyes, with an admirable chest. Many of them are complete beauties. Their cleanliness is extraordinary; for they bathe twice a-week, and suffer not the smallest hair or the least soil to be upon their bodies. As to the qualities of their minds, they are said to want neither wit, vivacity, nor tenderness; and to be exceedingly amorous. It is no doubt for this reason that the men never suffer their wives faces to be seen, not even by the dearest friend they have in the world.

There is no need of much wit to behave one's self well here; for a good mien and gravity supply the place of merit in the east, and much gaiety would spoil all. Not that the Turks want wit; but they speak little, and pride themselves in sincerity and modesty more than eloquence. The Turks use no unnecessary words, whereas the Greeks talk incessantly. Though these two nations are born under one climate, their tempers are more different than if they lived in the most distant countries. The Turks make profession of candour and faithfulness, and are a charitable good-natured people, jealousy excepted, and very sober. On the other hand, they are extremely proud, insolent, indolent, superstitious, and covetous. They are also much addicted to unnatural lusts; and despise all other nations in general, especially those which are not of their religion. The common appellation that they give the Christians is that of dogs. An uniformity runs through all the actions of the Turks, and they never change their manner of living. They seem to have no kind of genius for the improvement of the arts and sciences, though they live under the influence of the same heaven, and possess the same countries, as the ancient Grecians did. They generally loiter away their time, either among the women in the haram, or in smoking or taking opium; and though they herd together, you will observe as little conversation among them as among st so many horses in a stable. They seldom travel, or use any exercise or rural sports; and discover little or no curiosity to be informed of the state of their own or any other country: but Turkey, after all, is not without men of parts, probity, and honour; nor without benevolent, liberal, conversible, and ingenious people. They behave very commendably to their slaves and servants, and frequently better than the Christians do to theirs. There are no hereditary governments or titles of nobility in Turkey; and indeed the commonalty there enjoys the greatest liberty.

97
Language and learning.

The languages spoken in Turkey in Europe are the Turkish and Tartarian, which have a great affinity to one another; the modern Greek, which differs widely from the ancient; the Sclavonian, and Walachian. The Arabic is the language of the learned. Learning is at a very low ebb among the Turks: however, they have some schools, colleges, and academies; but they are on a very different footing from those among us. Not many years since a printing-house was set up at Constantinople, where books of all kinds were allowed to be printed, except on matters of religion. The most ingenious Musselmen employ themselves in reading the Alcoran and the commentators upon it, to which almost all their learning is confined. Some of them amuse themselves with poetry, in which they are said to succeed very well. Other Turks delight in music, and spend the whole day in playing upon an instrument, without being tired, though they only repeat the same tune. It is said there are a great many manuscripts in the Turkish, Arabian, and Persian languages, among the Turks; but it is not to be supposed that they contain any very deep, solid, ingenious, or useful learning.

98
Forces.

The Turkish regular troops are the spahis and timar-spahis, who are light-horse. The latter, who have estates in land assigned them instead of pay, are obliged to bring a certain number of slaves into the field with them. The tributary princes of Moldavia and Walachia, and the Crim Tartars, are also obliged to send auxiliaries. But the flower of the Turkish army consists of the janisaries, who amount to about 40,000, and are all infantry. They have particular privileges, being subject to no jurisdiction but that of their aga or commander. Their pay is three aspers a-day, besides victuals, and a suit of clothes every year. They are all lodged at Constantinople together in a sort of barracks, having been educated in the seraglio, and trained up to the exercise of arms from their infancy. Besides the janisaries, there is another body of foot called *capis*. The whole Turkish army, regulars and irregulars, amounts to above 300,000 men. Besides the true janisaries, or janisaries of the porte, and in actual pay, there are great numbers all over the empire, who procure themselves to be registered in this body, in order to be entitled to their privileges. The bachelors only are capable of bearing offices in the barracks or chambers at Constantinople. When any of the janisaries are disabled in the service, they have an allowance for life. To distinguish them, they wear a cap of a particular make. The emperor's guards are composed of them, and they are feared and respected everywhere, though they carry only a cane in their hand; for arms are not delivered to them but when they take the field. The chief commanders of the army are distinguished by two or three horse tails carried before them. The Turkish navy is not so considerable as might be expected in such extensive dominions, situated on several seas, and abounding in commodious harbours. By their neglecting navigation and foreign commerce, they can never find sailors to man a great fleet; and those they have are unskilful, as well as their pilots and officers. If they would

would apply themselves to navigation, and make the most of their situation and advantages, they could not fail to become a very formidable maritime power. Their navy generally consists of about 40 large ships, exclusive of galleys. In time of war they hire or buy merchant-ships, and others are sent them from Algiers, Tunis, and Tripoli. The captain-basha, or admiral, is the second officer in the empire, the grand vizir being the only officer above him. His power is absolute when he is out of the Dardanelles; and not only the sea-officers, but all the governors of the maritime provinces, receive orders from him. The pilots are mostly Greeks, and the captains renegadoes. The captain-basha sails round the Archipelago, in summer, to collect the capitation tax, and learn the state of affairs in those parts.

The revenues of the empire are paid either into the public treasury, or into the sultan's private treasury. The former, called by the Turks *ditalmaii musl mim*, i. e. *the public money of the Mussulmen*, is not to be touched but on the most pressing exigency of the state. The other the sultan may dispose of at pleasure. Prince Cantimir says, in his time, 27,000 purses, amounting to 13,000,000 and a half of crowns, were annually returned to both treasuries; arising from the produce of the customs, demesne lands, the capitation or tax paid by every subject of the empire who is not of the Mahometan religion; the annual tributes paid by the cham of the Crim Tartars, the princes of Moldavia, Walachia, the little republic of Ragusa, and part of Mingrelia; together with half a million of money out of a million and a half levied annually in Egypt. These are the fixed revenues: but vast sums are also raised by the confiscations of the estates and effects of the bashas and other officers, and from the estates of Turks dying without male issue.

The manufactures and commodities of Turkey are, silks, carpets, goat's hair, wool, camel's hair, cotton-yarn, dimity, burdets, waxed linen, shagreen skins, blue, red, and yellow Morocco leather; coffee, rhubarb, turpentine, storax, gums, opium, galls, mastic, emery, lemnian bole, pomegranate-shells, sponges, dates, almonds, wine, oil, figs, raisins, mother-of pearl, boxwood, saffron, &c. These are exported in large quantities by the several European trading nations, who import their own goods and purchase those of the country. The inland trade is carried on chiefly by the Jews and Armenians; and even the Turks send merchandise, both by land and water, from one part of the empire to another, but not to foreign Christian countries. No nation is more advantageously situated for traffic than the Turkish; having the navigation of the Black Sea, the Levant, and the Red Sea; and consequently greater opportunities of importing the rich merchandises of the East, and distributing them all over Europe, than any maritime power: but they never attempt distant voyages, and have but few merchant-ships, both their imports and exports being chiefly made in foreign bottoms. Tyre, Sidon, and Alexandria, which once commanded the navigation and trade of the world, are in their possession, but make no figure in commerce at this day: and well it is for the Christians that the Turks are such an indolent generation; for their situation and vast extent of empire would enable them to monopolize the trade of the world, if they attended to it. Several European Christian nations have envoys and residents at Constantinople, and consuls in other ports. In this empire there is a great traffic in the human species: not only male slaves, but beautiful young girls, being publicly bought and sold.

The empire is styled the Ottoman kingdom or empire, the Ottoman Porte, the Sublime Porte, the Sublime Sultanian Porte, &c. The appellation of *Porte* is said to be derived from the large gate built by Mohammed II. at the entrance of the seraglio at Constantinople; though the Orientals in general call a royal palace the *king's porte* or *gate*.

Turmeric | Turning.

TURMERIC, in botany. See CURCUMA.

TURNEBUS (Adrian), an eminent French critic, was born in 1512. His true name was Turnbull. He was the son of a Scotchman, an officer in the Scotch troop of guards, who married a Norman lady. The son, who is the subject of this article, changed his name into Tourneboeuf; but this name giving occasion for puns, he varied it to Tournebe, in Latin Turnebus. He acquired so extensive a reputation by his learning, that he had great offers made him from Italy, Germany, and England; but we are told he preferred poverty in his own country to riches in any other. He taught polite literature first at Toulouse; but in 1547 went to be Greek professor at Paris, whither his name drew scholars to him from all parts of Europe: in 1552, he took upon him the care of the royal Greek press for three years, when he quitted it on being admitted into the number of royal professors. He died in 1565; and his works, which are all in Latin, were printed at Strasburg, in one vol. folio, 1600. His *Adversaria*, 3 vols folio, had been printed at Paris before.

TURNEP, in botany, a species of BRASSICA. For the culture of them, see AGRICULTURE, n° 151.

Turnep-Bread. See BREAD.

Turnep-Fly. See CHRYSOMALA.

TURNING, the art of forming hard bodies, as wood, ivory, iron, into a round or oval shape by means of a machine called a *lathe*.

This art was well known to the ancients, and seems to have been carried by them to a very great degree of perfection; at least, if we believe the testimony of Pliny and several other authors, who tell us, that those precious vases enriched with figures in *half-relief*, which still adorn our cabinets, were turned on the lathe.

The art of turning is of considerable importance, as it contributes essentially to the perfection of many other arts. The architect uses it for many ornaments, both within and without highly finished houses. The mathematician, the astronomer, and the natural philosopher, have recourse to it, not only to embellish their instruments, but also to give them the necessary dimension and precision. In short, it is an art absolutely necessary to the goldsmith, the watchmaker, the joiner, the smith.

Turning is performed by the lathe, of which there are various kinds, and several instruments, as gouges, chissels, drills, formers, screw tales, used for cutting what is to be turned into its proper form as the lathe turns round. One of the most simple kinds of lathe is represented in Plate DXL. fig. 1. in which *a* is the footstool, *b* the cord, *c* the frame of the lathe, *d d* the puppets, *e e* the points, *f* the spanging-tree.

The lathe should be fixed in a place very well lighted; it should be immoveable, and neither too high nor too low. The puppets should neither be so low as to oblige the workman to stoop in order to see his work properly, nor so high that the little chips, which he is continually driving off, should come into his eyes.

The piece to be turned should be rounded (if it be wood) before it be put on the lathe, either with a small hatchet made for the purpose, or with a plane, or with a file, fixing it in a vice, and shaving it down till it is everywhere almost of an equal thickness, and leaving it a little bigger than it is intended to be when finished off. Before putting it on the lathe, it is also necessary to find the centres of its two end surfaces, and that they should be exactly opposite to each other, that when the *points* of the puppets are applied to

to them, and the piece is turned round, no side may belly out more than another. To find these two centres, lay the piece of wood to be turned upon a plank; open a pair of compasses to almost half the thickness of the piece; fix one of the legs in the plank, and let the point of the other touch one of the ends of the piece, brought into the same plane with the plank on which the compasses is fixed and very near the fixed leg. Describe four arches on that end at equal distances from each other at the circumference of the end, but intersecting one another within; the point of intersection is the centre of the end. In the same manner must the centre of the other end be found. After finding the two centres, make a small hole at each of them, into which insert the points of the puppets, and fix the piece so firmly as not to be shaken out, and yet loose enough to turn round without difficulty.

The piece being thus fixed, it is necessary in the next place to adjust the cord, by making it pass twice round the piece, and in such a manner that the two ends of the cord, both that which is fixed to the *spang* and to the *foot-board*, come off on the side on which the turner stands, that the piece many move against the edge of the cutting-tool and be turned. If the lathe be moved by a wheel, the manmer of adjusting the cord needs no directions.

If the workman does not choose to be at the trouble to find the two centres of the piece in the manner described above, let him lay, as nearly as he can, the centre of one end upon the *point* of the left hand *puppet*, and then let him push forward the right hand puppet, striking it with a mallet till its point is as near as he can in the centre of the other end of the piece; and then fixing the right hand puppet by a gentle blow of the mallet on the key, let him turn round the piece to see by the eye if the centres have been properly found. If any part of it bellies out, let him strike that part gently with the mallet till it goes properly; then let him strike one of the puppets pretty smartly to drive the points into the piece, and afterwards fix the puppet by striking the key. If the workman cannot judge by the eye whether the piece be turning properly round its centres or not, he should apply gently the point of an instrument called a *triangular graver*, leaning it on the *rest*, and it will mark by a line the place where the piece is out of its centre; and by striking upon this line with a mallet, the piece can easily be placed properly. The *rest*, of which we have just spoken, ought to be placed upon the two arms of the lathe, and fixed with screws as near the piece as the workman pleases.

The piece being fixed between the two points of the puppets (or, as we call them in Scotland, the *heads*), the cord adjusted, and the *rest* fixed as near the work as possible without touching it; the workman is now to take a *gouge* (fig. 2. in which *a* is the mouth and *b* the handle) of a proper size in his left hand, and hold it by the handle a little inclined, keeping the back of the hand lowermost. With his right hand, the back of which is to be turned upwards, he is to grasp it as near the end as possible on this side of the *rest*; then leaning the gouge on the *rest*, he is to present the edge of it a little higher than the horizontal diameter of the piece, so as to form a kind of tangent to its circumference; then putting the right foot on the foot-board, and turning round the wheel, and holding the gouge firmly on the *rest*, the piece will be cut neatly. In the same manner are the chisels, formers, and other instruments to be used, taking care that the wood be cut equally, and that the instrument be not pushed improperly, sometimes stronger than at others; and taking care also that the instrument used do not follow the work, but that it be kept firmly in the hand without yielding.

The young turner ought to endeavour to acquire the management of the gouge and the chisel, which are the instruments by far the most frequently used, and the most necessary in this art: by them, almost entirely, are the soft woods *turned*; for as for hard woods and other things, as box, ebony, horn, ivory, and the metals, they are hardly ever turned except by *shaving off*. In that case gravers are to be used with square, round, or triangular mouths (fig. 3, 4, 5.). They should be held horizontally while applied to the wood, and not obliquely as directed for the gouge and the chisel.

After the work is completely turned, it is next to be polished; and this cannot be done with the instruments hitherto mentioned. Soft woods, as pear-tree, hazle, maple, ought to be polished with shark skin or Dutch rushes. There are different species of sharks; some of which have a greyish, others a reddish skin. Shark skin is always the better to be a good deal used; at first it is too rough for polishing. The *Dutch-rush* is the *equisetum hyemale* of Linnæus, which grows in moist places among mountains, and is a native of Scotland; it has a naked, simple, round stem, about the thickness of a writing pen. The oldest plants are the best. Before using them they should be moistened a little, otherwise they break in pieces almost immediately, and render it exceedingly difficult to polish with them. They are particularly proper for smoothing the hard woods, as box, lignum vitæ, ebony, &c. After having cleaned up the piece well, it should be rubbed gently either with wax or olive-oil, then wiped clean and rubbed with its own raspings or with a cloth a little worn. Ivory, horn, silver, and brass, are polished with pumice-stone finely pounded and put upon leather or a linen cloth a little moistened: with this the piece is rubbed as it turns round in the lathe; and to prevent any dirt from adhering to any part of it, every now and then it is rubbed gently with a small brush dipt in water. To polish very finely, the workmen make use of tripoli, a particular kind of earth, and afterwards of putty or calx of tin. Iron and steel are polished with very fine powder of emery; this is mixed with oil, and put between two pieces of very tender wood, and then the iron is rubbed with it. Tin and silver are polished with a burnisher and that kind of red stone called in France *sanguine dure*. They may be polished also with putty, putting it dry into shammy-skin, or with the palm of the hand.

To succeed in turning iron, it is necessary to have a *lathe* exceedingly strong in all its parts, and exceedingly well fixed. The puppets should be short, and the *rest* well fixed very near the work: the back of the *rest* should be two or three lines lower than the iron to be turned.

The lathe and other instruments being prepared, it is necessary to determine the length and thickness of the iron to be turned according to the design which is to be executed, and to make a model of it in wood a little thicker than it ought to be: Then one exactly like this is to be forged of the best iron that can be procured; that is to say, it must not be new, but well prepared and well beaten with hammers; it must have no flaws, nor cracks, nor pimples. New iron, which has not been well beaten, often contains round drops of cast iron, called by the workmen *grains*, which blunt the edges of the gouges, chisels, and other instruments used for cutting; break them, or make them slide. The iron being forged according to the model, it should be annealed, that is, heated red hot and allowed to cool slowly on the coals till the fire go out of itself. Some people, to soften the iron, cover it over with clay and allow it to cool. The iron cylinder being thus made, it is next to be put upon the lathe, finding the centres as formerly directed, and boring a small hole in them that the iron many not escape from the points.

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The points should be oiled from time to time to prevent their being excessively heated and spoiled while the iron is turning. A *crotchet* is then to be applied to the iron to be turned, a little above its centre pretty gently, and by this means the inequalities of the cylinder will be taken off. Other instruments are then to be applied to mold the iron according to the model; and whenever any of them grow hot, they are to be plunged into a bason of water lying beside the workman. If the iron, after being properly turned, is to be bored like a gun barrel, one of the puppets is to be removed and another substituted in its place, having a square hole through it, into which the collar of the iron is to be fixed firmly, so as not to shake; then borers are to be applied, like those which locksmiths use to bore keys; and beginning with a small one, and afterwards taking larger ones, the hole is to be made as wide and deep as necessary; great care must be taken to hold the borers firm on the *rest*, otherwise there is danger of not boring the hole straight. The borer must be withdrawn from time to time to oil it and to clean the hole. Since it is difficult to make a hole quite round with borers alone, it is necessary to have also an instrument a good deal smaller than the hole, one of the sides of which is sharp, very well tempered, and a little hollow in the middle. This instrument being fixed in a pretty long handle, is to be applied with steadiness to the inner surface of the hole, and it will entirely remove every inequality that may have been there before its application.

We shall now describe the manner of cutting a screw upon our cylinder. Some persons make use of an instrument, consisting principally of a female screw, for this purpose: but this is rather an improper instrument; for if one presses too violently, or inclines it ever so little to the right or left, he runs the greatest risk of spoiling the screw. To avoid this danger, some persons use it only to trace out the lines of the screw, and afterwards finish it with a file. But there is a much better way of cutting a screw; and it is this. Take a tap for making a female screw, the threads of which have been cut very accurately, and exactly of the size of the screw which you want; and having put it in the opening which you have traced in the collar of the axis on which the screw is to be cut, solder it with tin, sal-ammoniac, and rosin, as exactly corresponding to the axis as possible. Take then a puppet with a hole cut into a corresponding female screw, into which the male screw is to be put. The axis on which the screw is to be cut must be placed exactly horizontally between the two puppets. The *rest* is then to be brought as near as possible to the place where the screw is to be cut, and a small hollow should be cut in that part of it which is exactly opposite to the place where the screw is to be cut, to hold your instrument firmly and prevent it from shaking. The instrument with which the screw is to be cut should be very sharp, and its point should make an angle of 60° with the screw to be cut; and if you wish the screw to be cut very deep, it should make an angle a little larger. The lathe being now put in motion, the tap fixed at the end of the axis will move gradually through the female screw in the puppet; and your instrument in the mean time will trace a similar male screw on the axis fixed in the lathe. Many persons, after having in this manner drawn the outlines of the screw, finish it with a screw-tale of three teeth corresponding exactly to the size of the screw, or with a triangular file; but this last method is rather improper.

This is the exactest method of cutting screws. There is another method described by F. Plumier, which may sometimes be of use. "Cut (says he) a small fillet of paper large enough to cover that part of the axis which you mean to cut into a screw; then mark upon the two borders of it, which join when it is rolled on the axis, the largeness of the teeth of the screw with a compass. Having thus marked the whole border at equal distances, draw a straight line from the first point of the border to the second, from the second to the third, and so on. You will have several oblique parallel lines equally distant from one another. Wrap the fillet of paper thus marked upon the part of the axis on which the screw is to be traced, so that the borders of it touch without overlapping each other: then all the extremities of these lines meeting mutually, will trace out a very exact screw; and this you will mark upon the axis by means of a knife formed into a kind of fine saw by the edge of another knife. This first trace you are carefully to enlarge with a small file till it becomes large enough to admit the edge of a three-cornered file; with which you cut a little; then, taking a proper screw-tale, you introduce it into the hollows already made; and turning the lathe, you are to follow the hollow of the screw with this instrument till the screw is finished."

For turning ovals, a lathe of somewhat a different construction is used. The axis or spindle, having on it the pulley over which the band-cord passes for turning the lathe, is fixed between the two puppets so as to turn round easily; one end of it passes through one of the puppets, and to it is firmly fixed a circular plate of brass, so that it turns round along with the spindle. Upon this plate two brazen segments of circles are fastened, the circumferences of which correspond to the circumference of the plate: their chords are parallel, and equally distant from the centre of the plate, so that they leave a distance between them. They have a groove in each of them: in these grooves another plate is placed which exactly fills up the space between the two grooves, but is shorter than the diameter of the larger circular plate on which it is laid. This plate is made to slide in the grooves. To its centre is fixed a short spindle, on which the piece of wood to be turned is fixed. When the lathe is set a-going, the circular plate moves round, and carries the piece along with it; the plate of brass on which the piece is fixed being fixed loosely in the grooves already described, slides down a little every time that the grooves become perpendicular to the floor (and there are particular contrivances to prevent it from sliding down too far); and by these two motions combined, the circular one of the large plate, and the straight one of the small, the circumference of the piece of wood to be turned necessarily describes an oval; and gouges or other tools being applied in the usual manner supported on the *rest*, it is cut into an oval accordingly. The small plate may be made to slide either more or less in the grooves; and by this contrivance the transverse diameter of the oval, or rather ellipse, may be made longer or shorter at pleasure. Another, and still simpler method, if possible, of turning ovals, is this: Take two ovals of metal, exactly of the size of the oval which you intend to make; fix them firmly on the spindle of the lathe so as to turn round with it: fix between them the wood to be turned; and then it is easy, by the help of chisels and other tools, to cut it, as the lathe goes into exactly the figure of the external ovals. Or an oval may be formed by placing the wood, or whatever is to receive that shape, obliquely on the lathe. There are several other ingenious methods of turning; but our bounds do not permit us to enter upon them. We shall therefore conclude this article with a number of receipts which every turner ought to know.

1. *The method of moulding boxes both of shell and horn.*— In the first place, form a proper mould, which must consist of two pieces, *viz.* of a circle about half an inch thick, which should slope a little in order to draw out the moulded shell the more easily; and a ring fitted to the outside of

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of the circle, ſo that both together make the ſhape of a box. Theſe two pieces being adjuſted, it is neceſſary to round the ſhell to be moulded of ſuch a ſize that, when moulded, it will be a little higher than the ring of the mould, that there may be no deficiency. The mould is then to be put into a preſs on a plate of iron, exactly under the ſcrew of the preſs; put then the ſhell upon the circle of the mould, ſo that its centre alſo is exactly oppoſite to the ſcrew of the preſs: then take a piece of wood formed into a truncated cone, and not ſo thick as the diameter of the circle of the mould, nor ſo deep as the ring: then put a plate of iron above the cone, and ſcrew down the preſs gently and cautiouſly till the whole is well fixed: then plunge the whole into a cauldron of boiling water placed above a fire. In 8 or 10 minutes the ſhell or horn will begin to ſoften; ſcrew the preſs a little firmer that the wooden cone may ſink into the ſoftened ſhell; repeat this from time to time till the cone is quite ſunk in the mould; then take out the preſs and plunge it into cold water. When it is cold, take the box now formed out of the mould, and put into the inſide of it a new mould or tin exactly of the form you wiſh the inſide of the box to be; do the ſame with the outſide, put it again into the preſs and plunge it into boiling water; ſcrew the preſs gradually till the box be faſhioned as you deſire.

2. *Method of preparing green wood ſo that it will not ſplit in the turning.*—Having cut your wood into pieces of a proper ſize, put it into a veſſel full of a ley made with wood aſhes. Boil it there about an hour; then, taking the cauldron off the fire, allow the ley to cool; then take out the wood and dry it in the ſhade.

3. *Method of giving an ebony-black to hard and fine woods.*—After forming the wood into the deſtined figure, rub it with aquafortis a little diluted. Small threads of wood will riſe in the drying, which you will rub off with pumice-ſtone. Repeat this proceſs again, and then rub the wood with the following compoſition: Put into a glazed earthen veſſel a pint of ſtrong vinegar, two ounces of fine iron-filings, and half a pound of pounded galls, and allow them to infuſe for three or four hours on hot cinders. At the end of this time augment the fire, and pour into the veſſel four ounces of copperas (ſulphat of iron), and a chopin of water having half an ounce of borax and as much indigo diſſolved in it; and make the whole boil till a froth riſes. Rub ſeveral layers of this upon your wood; and when it is dry, poliſh it with leather, on which you have put a little tripoli.

4. *Method of giving to plum-tree the colour of brazil wood.*—Slack lime with urine, and bedaub the wood over with it while it is hot: allow it to dry; then take off the coat of lime and rub it with ſhamoy ſkin well oiled. Or, ſteep your wood in water, having a quantity of alum diſſolved in it: then, having allowed brazil wood to diſſolve in water five or ſix hours, ſteep your wood in it, kept lukewarm during a night; and when it is dry, rub it, as before directed, with ſhamoy ſkin well oiled.

5. *Method of giving a fine black colour to wood.*—Steep your wood for two or three days in lukewarm water in which a little alum has been diſſolved; then put a handful of logwood, cut ſmall, into a pint of water, and boil it down to leſs than half a pint. If you then add a little indigo, the colour will be more beautiful. Spread a layer of this liquor quite hot on your wood with a pencil, which will give it a violet colour. When it is dry, ſpread on another layer; dry it again and give it a third: then boil verdegriſe at diſcretion in its own vinegar, and ſpread a layer of it on your wood: when it is dry, rub it with a bruſh, and then with oiled ſhamoy ſkin. This gives a fine black, and imitates perfectly the colour of ebony.

6. *Method of cleaning and whitening bones before uſing them.*—Having taken off with a ſaw the uſeleſs ends of the bones, make a ſtrong ley of aſhes and quick lime, and into a pailful of this ley put four ounces of alum, and boil the bones in it for an hour; then take the veſſel containing the ley off the fire and let it cool; then take out the bones and dry them in the ſhade.

7. *Method of ſoldering ſhells.*—Clean the two ſides of the ſhells which you wiſh to join together; then, having joined them, wrap them up in linen folded double and well moiſtened; then heat two plates of iron pretty hot that they may keep their heat for ſome time; and putting your ſhells rolled up between them under a preſs, which you muſt ſcrew very tight, leave them there till the whole is cold, and they will be ſoldered. If you do not ſucceed the firſt time, repeat the proceſs.

8. *Method of moulding ſhells.*—Put ſix pints of water into a kettle; add to it an ounce of olive or other oil; make the water boil; then put in your ſhell, and it will grow ſoft. Take it out and put it into a mould under a preſs, and it will take the figure you want. This muſt be done quickly; for if the ſhell cool ever ſo little, the proceſs will fail. It will not require much preſſure.

9. *Method of tinging bones and ivory red.*—Boil ſhavings of ſcarlet in water. When it begins to boil, throw in a quarter of a pound of aſhes made from the dregs of wine, which will extract the colour: then throw in a little rock alum to clear it, and paſs the water through a linen cloth. Steep your ivory or bone in aquafortis, and put it into the water. If you wiſh to leave white ſpots, cover the places deſtined for them with wax.

10. *To tinge ivory black.*—Steep the ivory during five or ſix days in water of galls with aſhes made with dried dregs of wine and arſenic; then give it two or three layers of the ſame black with which plum-tree is blackened, in order to imitate ebony. Or, diſſolve ſilver in aquafortis, and put into it a little roſe water. Rub the ivory with this, and allow it to dry in the ſun.

11. *Method of hardening wood to make pulleys.*—After finiſhing the pulley, boil it ſeven or eight minutes in olive oil, and it will become as hard as copper.

12. *To make Chineſe varniſh.*—Take of gum lac in grains four ounces; put it into a ſtrong bottle with a pound of good ſpirit of wine, and add about the bulk of a hazel nut of camphor. Allow them to mix in ſummer in the ſun, or in winter on hot embers for 24 hours, ſhaking the bottle from time to time. Paſs the whole through a fine cloth, and throw away what remains upon it. Then let it ſettle for 24 hours, and you will find a clear part in the upper part of the bottle, which you muſt ſeparate gently and put into another vial, and the remains will ſerve for the firſt layers.

TURNSTONE, in ornithology. See TRINGA.

TURPENTINE, a tranſparent viſcous ſubſtance, flowing either naturally or by inciſion from ſeveral unctuous or reſinous trees; as the terebinthus, pine, larch, fir, &c. See PINUS, p. 765; CHEMISTRY-*Index*; MATERIA MEDICA, *the Table*.

Oil of TURPENTINE. See CHEMISTRY *Index*, and PHARMACY, n° 174.

TURPETH, the cortical part of the root of a ſpecies of convolvulus, brought from the Eaſt Indies. It is accounted a pretty ſtrong cathartic; but it is very uncertain in its ſtrength, for ſometimes a doſe from a ſcruple to a dram purges violently, while at other times a much greater doſe produces very little effect.

Turquoiſe.

TURQUOISE, is the tooth of an animal penetrated with the blue calx of copper: it loſes its colour when heated;

it is opaque, and of a lamellar texture, and susceptible of a fine polish; its specific gravity is from 2.5 to 3.0; some are of a deep blue, some of a whitish blue, but become of a deeper when heated. This substance is found in Persia and Languedoc. The copper may be extracted from it by distilled vinegar. According to Reaumur (*Mem. Par.* 1715) nitrous acid will not dissolve that of Persia, though it will that of France, which shows a difference between them.

TURRETIN (Francis), minister and professor of divinity at Geneva, his native place, was born in 1623. Having studied at Geneva, Leyden, Saumur, Montauban, and Nismes, with great success, he was admitted into the ministry in 1648, and served at the same time the French and Italian churches at Geneva. Two years after, he was offered the professorship of philosophy, which he refused; but accepted the invitation of the church of Lyons. He was recalled to Geneva at a year's expiration, because he was wanted to give lectures in divinity; which he began in 1653. He was sent to Holland in 1661, to procure money which the city of Geneva had occasion for. He had in that journey all the success he could promise himself; and gained such a character there, that he was strongly importuned by the Walloon churches at the Hague and at Leyden to enter into their service. On his return he resumed the functions of his place, and continued there till his death with remarkable application. He died in 1687, with the character of a man of great merit; eloquent, judicious, laborious, learned, and zealous for orthodoxy. His works were published by his son John Alphonsus, in 3 and in 4 vols 4to.

TURRITIS, TOWER-MUSTARD, in botany: A genus of plants belonging to the class of *tetradynamia*, and to the order of *siliquosa*; and in the natural system ranging under the 39th order, *Siliquosæ*. The siliqua is very long and angulated; the calyx connivent and erect; the corolla is also erect. There are three species; two of which are natives of Great Britain, the glabra and hirsuta.

TURTLE, in ichthyology. See TESTUDO.

Turtle-Dove, in ornithology. See COLUMBA.

TUSCAN ORDER, in architecture. See ARCHITECTURE, n° 42.

Tuscan Earth, a yellowish kind of bole dug in many parts of Italy, particularly about Florence, where there is a stratum of it eight or ten feet thick, at the depth of five or six feet from the surface. It is supposed to have an astringent property.

TUSCANY, a duchy of Italy, which makes part of the ancient Hetruria, excepting some small detatched parts, is encompassed by a part of the Mediterranean, called here the *Tuscan Sea*; the ecclesiastical state; the duchy of Modena; and the republic of Lucca; its extent from north to south being about 116 English miles, and from east to west about 80.

Though some parts of it are mountainous, yet both the hills and dales are covered with vines, olives, citron, lemon, and orange trees, &c. The mountains yield also copper, iron, alum, &c. and some quarries of the finest marble and porphyry. Here is also plenty of corn, rice, saffron, honey, wax, wool, flax, hemp, with mineral waters, rich pasture, salt-pits, sulphur, alabaster, chalcedony, lapis lazuli, borax, amethysts, cornelians, jaspers, quicksilver, crystals, and black slate. In some places the elms and ashes yield manna.

The principal river in Tuscany is the Arno, which has its source in the Appennine mountains, and falls into the sea below Pisa. There are some other smaller rivers.

This duchy fell under the dominion of the Romans about 455 years before Christ. The Ostrogoths possessed themselves of it in the fifth century, and after them the Lombards, who were expelled by Charlemagne anno 800; in consequence of which it became subject to the German emperors, who appointed governors over it. At last the cities of Florence, Pisa, Sienna, and some others, during the contentions between the pope and the emperor, and their respective adherents, the Guelphs and Gibbelines withdrew themselves from the dominion of both, and erected themselves into separate commonwealths. In that of Florence, John de Medicis, a popular nobleman, so insinuated himself into the favour of his countrymen, that they invested him with sovereign power. Pope Pius V. conferred the title of *grand duke* on Cosmo de Medicis anno 1570, in whose family the duchy continued until the death of Gaston de Medicis, who died anno 1737. The duchy was then transferred to the duke of Lorrain, afterwards the emperor Francis I. in lieu of the dechy of Lorrain, which, by the peace of 1736, was given to king Stanislaus during his life, and then was to be annexed to France. Leopold, the second son of Francis I. and afterwards emperor of Germany, succeeded to this duchy. It is now enjoyed by Leopold's second son, brother to the present emperor of Germany, Francis II. The grand duke's annual revenues are computed at about 500,000l. sterling, arising chiefly from the tenths of all estates that are sold or alienated, and the ground-rents of the houses in Leghorn, and the duties on almost all manner of provisions.

The great duke is absolute in his dominions. His standing forces consist only of three regiments of foot and two of dragoons, and his marine of a few galleys and galeasses; but, in case of necessity, it is said he can bring 30,000 men into the field, and increase his marine with 20 men of war; but it does not appear how he can man them.

The principal places are Florence, Pisa, Leghorn, Sienna, Orbitello, Piombino, and Arezzo.

TUSK, or TORSK, in ichthyology. See GADUS.

TUSSILAGO, COLT'S FOOT, in botany: A genus of plants belonging to the class of *syngenesia*, and order of *polygamia superflua*; and in the natural system ranging under the 49th order, *Compositæ*. The receptacle is naked; the pappus simple; the scales of the calyx equal, of the same height as the disk, and somewhat membranaceous. There are 12 species; three of which are indigenous to Britain, the farfara, hybrida, and petasites.

The *farfara*, or common colt's foot, grows plentifully on the banks of rivulets, or in moist and clayey soils, in England and Scotland.—The leaves are smoked in the manner of tobacco, or a syrup or decoction of them and the flowers stand recommended in coughs and other disorders of the breast and lungs. It seems now to be almost entirely rejected. The downy substance under the leaves, boiled in a lixivium with a little saltpetre, makes excellent tinder. The *petasites*, or common butter-bur, is frequent in wet meadows and by the sides of rivers. Its leaves are the largest of any plant in Great Britain, and in heavy rains afford a seasonable shelter to poultry and other small animals. The root dug up in the spring is resinous and aromatic. A drachm of it in a dose has been sometimes given as a sudorific and alexipharmic; but as it possesses those virtues but in a small degree, it has lost its reputation in the shops.

TUTENAGO, an ore of zinc, containing commonly from 60 to 90 *per cent.* of zinc, the remainder iron, and a small proportion of clay.

TUTOR, in the civil law, is one chosen to look to the persons and estate of children left by their fathers and mothers in their minority. The different kinds of *tutors* established among the Romans, and the powers and duties of tutors, are described in *Ersk. Leg.* 1 T. XIII. sect. 1 and 2. to which the reader is referred. See also the article GUARDIAN.

Tutor || Twelfth-Day.

DIAN.—For the nature and effects of tutory in the Scotch law, which is founded on that of the Romans, see *Scotch Law*, Part III. Sect. 7.

TUTOR is also used in the English universities for a member of some college or hall, who takes on him the instructing of young students in the arts and faculties.

TUTTY, an argillaceous ore of zinc, found in Persia, formed on cylindrical moulds into tubulous pieces, like the bark of a tree, and baked to a moderate hardness; generally of a brownish colour, and full of small protuberances on the outside, smooth and yellowish within, sometimes whitish, and sometimes with a bluish cast. Like other argillaceous bodies, it becomes harder in a strong fire; and after the zinc has been revived and dissipated by inflammable additions, or extracted by acids, the remaining earthy matter affords, with oil of vitriol, an aluminous salt.

Tutty is celebrated as an ophthalmic, and frequently employed as such in unguents and collyria. See PHARMACY, n° 654.

TWEED, a river of Scotland, which rises on the confines of the shire of Clydesdale, and running eastward thro' Tweedale, and dividing the shire of Merse from Teviotdale and Northumberland, falls into the German Sea at Berwick. It abounds with salmon.

TWEEDALE, or PEEBLES, a county in the south of Scotland. It has already been described under the word PEEBLES; but in that article several inaccuracies were committed, which a gentleman of that county has been kind enough to point out, and which therefore we take this opportunity of correcting.

Tweedale is chiefly a grazing county, producing excellent mutton from healthy black-faced sheep. It is remarkable, that among this particular breed the rot or dropsical disease, and the trembling illness, are exceedingly rare, unless when they happen to be imported by stranger sheep.—The account which we formerly gave of the vast number of eels swarming in West-water Loch, and tumbling into the river Yarrow at particular seasons, is a mistake. At present no greater number of eels is seen there than in other rivers and lochs. This loch and Yarrow water are more than 20 miles asunder, and running different ways, so that the account at any rate was impossible. The lake on the borders of Annandale is at present called *Loch Skeen*, and not *Loch Gennet*; the cataract which it forms is called the *Grey Mare's Tail*: the fall is into Moffat water. Douglas of Cavers ought not to have been reckoned among the families of Tweedale, as that branch of the Douglases belongs to a different county. Our mistake proceeded from this circumstance—In very ancient times all the country washed by the Tweed went by the name of *Tweedale*, and the Douglases were wardens of that district. Peebles lies in N. Lat. 55. 38. W. Long. 3.

TWELFTH-DAY, the festival of the Epiphany, or the manifestation of Christ to the Gentiles; so called, as being the twelfth day, exclusive, from the nativity or Christmas-day.

Twilight || Tyn.

TWILIGHT, that light, whether in the morning before sun-rise, or in the evening after sun-set, supposed to begin and end when the least stars that can be seen by the naked eye cease or begin to appear.

TWINKLING *of the* STARS. See OPTICS, n° 21.

TWINS, two young ones delivered at a birth, by an animal which ordinarily brings forth but one.

TWITE, in ornithology. See FRINGILLA.

TYGER, or TIGER, in zoology. See FELIS.

TYLE, or TILE, in building, a sort of thin laminated brick used on the roofs of houses: or, more properly, a kind of fat clayey earth kneaded and moulded of a just thickness, dried and burnt in a kiln like brick, and used in the covering and paving of houses.

TYMPAN, among printers, a double frame belonging to the press, covered with parchment, on which the blank sheets are laid in order to be printed off. See *Printing-Press*.

TYMPANUM, in mechanics, a kind of wheel placed round an axis or cylindrical beam, on the top of which are two levers or fixed staves for the more easily turning the axis in order to raise a weight required. The tympanum is much the same with the peritrochium; but that the cylinder of the axis of the peritrochium is much shorter and less than the cylinder of the tympanum.

TYMPANUM, in anatomy. See ANATOMY, n° 141.

TYMPANY, in medicine. See MEDICINE, n° 337, and SURGERY, n° 265.

TYNDALE (William), a zealous English reformer, and memorable for having made the first English version of the Bible, was born on the borders of Wales some time before 1500. He was of Magdalene-hall in Oxford, where he distinguished himself by sucking in early the doctrines of Luther, and by as zealously propagating those doctrines among others. Afterwards he removed to Cambridge, and from thence went to live with a gentleman in Gloucestershire in the capacity of tutor to his children.—While he continued there, he showed himself so furious for Luther, and so inveterate to the pope, that he was forced, merely for the security of his person, to leave the place. He next endeavoured to get into the service of Tonstall bishop of Durham, but did not succeed. His zeal for Lutheranism made him desirous to translate the New Testament into English; and as this could not safely be done in England, he went into Germany, where, setting about the work, he finished it in 1527. He then began with the Old Testament, and finished the five books of Moses, prefixing discourses to each book, as he had done to those of the New Testament (A). At his first going over into Germany, he went into Saxony, and had much conference with Luther; and then returning to the Netherlands, made his abode chiefly at Antwerp.

Jortin's Life of Erasmus.

(A) An anecdote is told of Bishop Tonstal, which is amusing in itself, and does much honour to the Bishop's moderation. Tonstal being at Antwerp in 1529, he sent for one Packington an English merchant there, and desired him to see how many New Testaments of Tyndale's Translation he might have for money. Packington, who was a secret favourer of Tyndale, told him what the Bishop proposed. Tyndale was very glad of it; for, being convinced of some faults in his works, he was designing a new and more correct edition: but he was poor, and the former impression not being sold off, he could not go about it: so he gave Packington all the copies that lay in his hands; for which the Bishop paid the price, and brought them over, and burnt them publicly in Cheapside.—Next year, when the second edition was finished, many more were brought over; and one Constantine being taken in England, the lord chancellor, in a private examination, promised him that no hurt should be done him if he would reveal who encouraged and supported them at Antwerp; which he accepted of, and told them that the greatest encouragement they had was from the Bishop of London, who had bought up half the impression. This made all that heard of it laugh heartily, though more judicious persons discerned the great temper of that learned Bishop in it.

werp. During his peregrinations from one country to another, he ſuffered ſhipwreck upon the coaſt of Holland, and loſt all his books and papers. His tranſlations of the Scriptures being in the mean time ſent to England, made a great noiſe there; and, in the opinion of the clergy, did ſo much miſchief, that a royal proclamation was iſſued out, prohibiting the buying or reading ſuch tranſlation or tranſlations. But the clergy were not ſatisfied with this, they knew Tyndale capable of doing infinite harm, and therefore thought of nothing leſs than removing him out of the way. For this purpoſe one Philips was ſent over to Antwerp, who inſinuated himſelf into his company, and under the pretext of friendſhip betrayed him into cuſtody. He was ſent to the caſtle of Filford, about 18 miles from Antwerp; and though the Engliſh merchants at Antwerp did what they could to procure his releaſe, and letters were alſo ſent from lord Cromwell and others out of England, yet Philips beſtirred himſelf ſo heartily, that he was tried and condemned to die. He was firſt ſtrangled by the hands of the common hangman, and then burned near Filford caſtle, in 1536. While he was tying to the ſtake, he cried with a fervent and loud voice, "Lord, open the king of England's eyes."

TYPE (τυπος), an impreſſion, image, or repreſentation of ſome model, which is termed the *antitype*. In this ſenſe the word occurs often in the writings of divines, who employ it to denote that prefiguration of the great events of man's redemption which they have found or fancied in the principal tranſactions recorded in the Old Teſtament.

That the death of Chriſt for the ſins of men, and his reſurrection from the dead for their juſtification, were prefigured in the ritual worſhip inſtituted by Moſes, is indeed incontrovertible *; but when divines conſider as a type every thing mentioned in the Hebrew Scriptures, in which an active imagination can diſcover the ſlighteſt reſemblance or analogy to any circumſtance in the life, or death, or reſurrection, of Chriſt, they expoſe the whole doctrine of *types* to the ridicule of unbelievers, and do a real injury to that cauſe which it is their profeſſed intention to ſerve. To contend, as ſome of them have done, that the extraction of Eve from the ſide of Adam, while he was in a deep ſleep, was intended as a type of the Roman ſoldier's piercing our Saviour's ſide while he ſlept the ſleep of death; or that the envy of the ſons of Jacob to their brother Joſeph, was typical of the envy of the Scribes and Phariſees to Jeſus the Meſſiah, is to burleſque the Scriptures, and inſult reaſon.

* ee *Epiſt.* he *Heb.* lim.

The nature of types ſeems indeed to be very little underſtood even by thoſe who pretend to have ſtudied them with care. They are generally compared to prophecies having a double ſenſe, and are thought to have been ſo contrived as to give information of the future events to which they pointed; but the information which they gave of Chriſtianity muſt have been exceedingly obſcure to thoſe who lived before the coming of Chriſt, however plain it may appear to us who can now compare the type with the antitype. A different opinion has indeed been maintained, not only by myſtical cabbaliſts, who will maintain any thing from which common ſenſe revolts, but alſo by writers who, when treating of other ſubjects, have ſhown that they poſſeſſed very ſound underſtandings. One of the ableſt defenders of revelation, ſpeaking of the purpoſe for which the paſſover was inſtituted, aſks, "What is the price and worth of a lamb, whoſe blood infallibly gives life to thoſe who are tinged with it, and the non-aſperſion or neglect of which is ſufficient to condemn Jew and Gentile to death without diſtinction?" Taking it for granted that this queſtion is capable of no anſwer but one favourable to the concluſion which he wiſhes to draw from it, he then proceeds in the following words: "Though the Meſſiah was not already come, who could doubt but that ſuch a myſtery *typified him*, ſince he was to be the Saviour and Deliverer of his people? and who would not be prepared to believe that he will deliver his people, and ſave them by the *effuſion of his blood*, when it is obvious that it is to the immolation of a lamb, and the aſperſion of its blood, that all Iſrael owe their lives and liberties?"

Lully's Principles of the Chriſtian Religion.

That the ſacrifice of the paſchal lamb for the ſafety of the Iſraelites was typical of the ſacrifice of the Lamb of God for the ſins of the world, and that the reſemblance or analogy of the type to the antitype was in many reſpects exceedingly ſtriking, are facts known to every Chriſtian; but they could not poſſibly be known to the ancient Hebrews before it was revealed to them that Chriſt was to ſuffer. At the inſtitution of the paſſover, nothing was ſaid from which the great body of the people could infer that they were to be redeemed from death and ſin by the blood of the Meſſiah, as their fathers had in Egypt been delivered from the deſtroying angel by the blood of the immolated lamb. We readily agree with the ingenious writer, that in the blood of a lamb there is no worth to propitiate the eternal God, and from him to purchaſe life for the man who is ſprinkled with it; but the Iſraelites, at the era of their departure from Egypt, held opinions very different from his and ours. They thought groſsly of the Deity, and believed, with their ſuperſtitious maſters, that he put the higheſt value on animal ſacrifices. In the New Teſtament Chriſt is called our *Paſſover*, and ſaid to have been ſacrificed for us. Chriſtians therefore cannot doubt but that the Jewiſh ſacrifice of the paſchal lamb was emblematical of the great ſacrifice ſlain on the croſs; but as the majority of the ancient Hebrews were ignorant of all the circumſtances of reſemblance between the type and antitype, we cannot conceive how they ſhould have dreamed of a future paſſover of which their own was but an empty figure.

Some learned men indeed ſeem to imagine, that when the rites of the law were inſtituted, the people were taught to conſider them as of no value in themſelves, but merely as ſhadows of good things to come, and that by means of theſe ſhadows a diſtinct and even ſteady view was given to them of the ſubſtance; but this is a ſuppoſition which receives no ſupport from Scripture. That Abraham, who rejoiced to ſee Chriſt's day, and ſeeing it was glad; that Moſes, who was directed to make all things relating to the tabernacle according to the pattern ſhowed to him in the mount; and that ſuch other individuals as, like him, could look up to a God inviſible, and perform at once a worſhip purely ſpiritual; that theſe men were admoniſhed that the ritual law was only the ſhadow of a future and more perfect diſpenſation—cannot, we think, be queſtioned. Nay, that Abraham, Moſes, and a few others, may have had as accurate notions of Chriſtianity as we have at preſent, is a poſition which we feel not ourſelves inclined to controvert; but that the great body of the Hebrew nation was taught from the beginning to conſider their law as imperfect, or as deriving any little value which it had from its being emblematical of a purer worſhip to be revealed in the fulneſs of time, is a ſuppoſition which cannot be admitted without confounding all the divine diſpenſations.

The law was a ſchoolmaſter given to the poſterity of Jacob, to guard them from idolatry, and to train them by degrees for the coming of Chriſt. That it might anſwer this purpoſe the more effectually, prophets were raiſed up from time to time to point out its ſecret and ſpiritual meaning, as the people became able to receive it; and no reaſon can be aſſigned for the introduction of ſo burdenſome and carnal a ritual between the fall and the clear revelation of redemption, but becauſe mankind at large were not at that

period

period capable of a more spiritual and refined worship. See THEOLOGY, Part II. Sect. iv.

If this be so, how absurd is it to suppose that the ancient Israelites saw through their sacrifices the future sacrifice of Christ, and the simple, though sublime, worship of the Christian church; that when their law promised temporal rewards to the obedient, they looked for heavenly ones through the Messiah; and that when they were offering a sin-offering for their transgressions, they had their eyes fixed on the cross of Christ, being aware that the blood of bulls and of goats could never take away sin? Had the Israelites, at their deliverance from Egyptian bondage, been capable of all this faith, it is not to be supposed that the Father of Mercies would have laid upon them such a yoke of ordinances; for that would have been in effect to say, though you are capable of worshipping me in spirit and in truth, according to the dispensation which shall be revealed to your posterity, yet I command you to observe a multifarious ritual, which you *know* to be preparatory to that dispensation, and *of no real value in itself*!

The law therefore had only the *shadow* of good things to come, and not such an image of them, as that merely from beholding the type mankind could acquire an accurate notion of the antitype. It was indeed so contrived as naturally to lead the thinking part of the nation to the hopes of future redemption; but without the illustrations of the prophets it could not of itself have made them comprehend the means by which that redemption was to be effected. Between the types and the antitypes, the shadow and the substance, the resemblance, or, to speak more properly, the analogy, is so striking, that no unprejudiced person can now entertertain a doubt but that the law and the gospel are parts of one great scheme of providence, which, commencing with the fall, was completed by the effusion of the Holy Spirit on the day of pentecost. But it would be as equitable to condemn a Bacon or a Newton to spend his time in the amusements of children, as it would have been to place the Jews under the ritual law, had they been capable of acquiring from the shadows of that law adequate notions of the substance of Christianity.

TYPE, among letter-founders and printers, the same with letter. See LETTER.

TYPE is also used to denote the order observed in the intension and remission of fevers, pulses, &c.

TYPHA, CAT'S TAIL, in botany: A genus of plants belonging to the class of *monœcia*, and order of *triandria*; and in the natural system ranging under the 2d order, *Calamariæ*. The amentum of the male flower is cylindrical; the calyx is tripetalous, but scarcely distinguishable; there is no corolla. The female has a cylindrical amentum below the male; the calyx is composed of villous hair; there is no corolla, and only one seed fixed in a capillary pappus. There are two species, both natives of Britain; the latifolia and angustifolia.

1. *Latifolia*, great cat's tail, or reed mace, is frequent in ponds and lakes. The stalk is six feet high; the leaves a yard long, hardly an inch wide, convex on one side: the amentum, or cylindrical club, which terminates the stalk, is about six inches long, of a dark brown or fuscous colour. Cattle will sometimes eat the leaves, but Schreiber thinks them noxious: the roots have sometimes been eaten in salads, and the down of the amentum used to stuff cushions and matresses. Linnæus informs us, that the leaves are used by the coopers in Sweden to bind the hoops of their casks.

2. *Angustifolia*, narrow-leaved cat's tail, is found in pools and ditches. The leaves are semi-cylindrical, and the male and female spike are remote and slender.

TYPHON. See WHIRLWIND.

TYPHON, the devil of the ancient Egyptians. See POLYTHEISM, n° 29.

TYPOGRAPHY, the art of printing. See PRINTING.

TYRANNION, a celebrated grammarian in Pompey's time, was of Amisus in the kingdom of Pontus. He was the scholar of Dionysius of Thrace at Rhodes. He fell into the hands of Lucullus, when that general of the Roman army defeated Mithridates, and seized his dominions. This captivity of Tyrannion was no disadvantage to him, since it procured him an opportunity of being illustrious at Rome, and raising a fortune. He spent it, among other things, in making a library of above 30,000 volumes. He died very old, being worn out with the gout. His care in collecting books contributed very much to the preservation of Aristotle's works.

TYRANT, among the ancients, denoted simply a king or monarch; but the ill use which several persons invested with that sacred character made of it, has altered the import of the word; and tyrant now carries with it the idea of an unjust or cruel prince, who invades the people's liberty, and rules in a more despotic manner than the laws of nature or of the country allow.

TYRE, formerly a celebrated city of Asia, on the coast of Syria, situated under the 54th degree of east longitude, and 32d of north latitude. It was built, according to some writers, 2760 years before the Christian era. There were two cities of that name; the one called *Palætyrus*, situated on the continent; and the other the city of *Tyre*, built on an island about half a mile from the shore. It was about 19 miles in circumference, including Palætyrus; the town on the island was about four miles round. The buildings of Tyre were very magnificent; the walls were 150 feet high, and broad in proportion. This city was at one period the most famous commercial city in the world. Of its commercial transactions, the most particular account that is to be found in any ancient writer has been given by the prophet Ezekiel, which at the same time conveys a magnificent idea of the extensive power of that state. It resisted Nebuchadnezzar king of Babylon for 13 years; at the end of which, wearied with endless efforts, the inhabitants resolved to place the sea between them and their enemy, and passed accordingly into the island. The new city stood out against Alexander the Great for seven months; and before he could take it, he was obliged to fill up the strait which separated the island from the continent. It was repaired afterwards by Adrian, and became the metropolis of the province. It afterwards fell into the hands of the Arabs; and after being taken by Baldwin II. king of Jerusalem, it was destroyed by the sultan of Egypt in 1289, and abandoned, never more to rise from its ruins. An excellent account of its situation and modern state may be found in Volney's Travels, vol. ii. It now consists of a small village, composed of wretched huts, containing about 50 or 60 poor families. The words of Ezekiel are literally fulfilled, "And they shall make a spoil of their riches." (Ezek. xxvi. 12, 13, 14). Mr Bruce saw this queen of the nations converted into a place for fishers to dry their nets in. Its harbour, formerly so famous for its shipping, is now almost choaked up. It is called *Sour* or *Tsour* by the Orientals.

TYRIAN DYE. See MUREX and PURPURA.

TYRONE, a county of Ireland, in the province of Ulster, 46 miles in length and 37 in breadth; bounded on the north by Londonderry, on the east by Armagh and Lough-Neagh, on the south by Fermanagh, and on the west by Donnegal. It is a rough and rugged country, but tolerably fruitful; contains 12,683 houses, 30 parishes, 4 baronies, 4 boroughs, and sends 10 members to parliament. The principal town is Dungannon.

U, V.

U or u, the 20th letter and 5th vowel of our alphabet, is formed in the voice by a round configuration of the lips, and a greater extrusion of the under one than in forming the letter o, and the tongue is also more cannulated. The sound is short in *curst*, *must*, *tun*, *tub*; but is lengthened by a final *e*, as in *tune*, *tube*, &c. In some words it is rather acute than long; as in *brute*, *flute*, *lute*, &c. It is mostly long in polysyllables; as in *union*, *curious*, &c. but in some words it is obscure, as in *nature*, *venture*, &c. This letter in the form of V or v, is properly a consonant, and as such is placed before all the vowels; as in *vacant*, *venal*, *vibrate*, &c. Though the letters v and u had always two sounds, they had only the form v till the beginning of the fourth century, when the other form was introduced, the inconvenience of expressing two different sounds by the same letter having been observed long before. In numerals V stands for five; and with a dash added at top, thus $\bar{V}$, it signifies 5000.

In abbreviations, amongst the Romans, V. A. stood for *veterani assignati*; V. B. *viro bono*; V. B. A. *viri boni arbitratu*; V. B. F. *vir bonæ fidei*; V. C. *vir consularis*; V. C. C. F. *vale, conjux charissime, feliciter*; V. D. D. *voto dedicatur*; V. G. *verbi gratia*; Vir. Ve. *virgo vestalis*; VL. *videlicet*; V. N. *quinto nonarum*.

VACCINIUM, the WHORTLE-BERRY, or *Bilberry*, in botany: A genus of plants of the class of *octandria*, and order of *monogynia*; and arranged in the natural system under the 18th order, *Bicornes*. The calyx is superior; the corolla monopetalous; the filaments inserted into the receptacle; the berry quadrilocular and polyspermous. There are 15 species; the most remarkable of which are,

1. The *myrtillus*, black whorts, whortle-berries, or bilberries, growing in woods and on heaths abundantly. The flowers frequently vary, with five segments at the rim, and with ten stamina. The berries when ripe are of a bluish black colour; but a singular variety with white berries, was discovered by the duke of Athol, growing in the woods, about mid way between his two seats of Dunkeld and Blair. The berries have an astringent quality. In Arran and the Western Isles they are given in diarrhœas and dysenteries with good effect. The Highlanders frequently eat them in milk, which is a cooling agreeable food; and sometimes they make them into tarts and jellies, which last they mix with whisky, to give it a relish to strangers.—They dye a violet colour; but it requires to be fixed with alum. The grous feed upon them in the autumn.

2. The *uliginosum*, or great bilberry-bush, is found in low moist grounds, and almost at the summits of the Highland mountains. The leaves are full of veins, smooth and glaucous, especially on the under side; the berries are eatable, but not so much esteemed as the preceding; as they are apt, if eaten in any quantity, to give the headach.

3. The *vitis idæa*, or red whortle-berries, frequent in dry places, in heaths, woods, and on mountains. The berries have an acid cooling quality, useful to quench the thirst in fevers. The Swedes are very fond of them made into the form of a rob or jelly, which they eat with their meat as an agreeable acid, proper to correct the animal alkali.

4. The *oxycoccus*, cran berries, moss berries, or moor-berries, frequent on peat-bogs in the Lowlands, but not so common in the Highlands of Scotland. The stalks are long, slender, woody, weak, and trailing; the leaves small, acutely oval, obtuse, undivided, their edges reflected back, and grow alternate; two or three flowers grow singly on long red footstalks out of the extremity of the branches; the flowers are red, divided deeply into four acute segments, which are reflexed quite backwards; the filaments are downy; the antheræ longer, and longer than the stamens; the berries red, and about the size of the hawthorn berries. At Longtown, on the borders of Cumberland, they are made so considerable an article of commerce, that, at the season when they are ripe, not less than 20 l. or 30 l.'s worth are sold by the poor people each market day for five or six weeks together, which are afterwards dispersed over different parts of the kingdom for making the well-known cranberry tarts.

VACUUM, in philosophy, denotes a space empty or devoid of all matter or body.

It has been a matter of much dispute among philosophers whether there be in nature a perfect vacuum, or space void of all matter; but if bodies consist of material solid atoms, it is evident that there must be vacuities, or motion would be impossible (See METAPHYSICS, n° 193.). We can even produce something very near a vacuum in the receiver of an air pump and in the Torricellian tube (see PNEUMATICS, *passim*); and it is very doubtful whether the particles of the densest bodies known be in perfect contact. See OPTICS, n° 63—68.

VADIUM, a pledge in law, is either *vivum* or *mortuum*.

Vadium Vivum, or *Living Pledge*, is when a man borrows a sum (suppose 200 l.) of another; and grants him an estate, as of 20 l. *per annum*, to hold till the rents and profits shall repay the sum so borrowed. This is an estate conditioned to be void as soon as such sum is raised. And in this case the land or pledge is said to be living: it subsists, and survives the debt; and, immediately on the discharge of that, results back to the borrower.

Vadium Mortuum, or *Dead Pledge*. See MORTGAGE.

VAGABOND, or VAGRANT, one who wanders illegally, without a settled habitation. Such persons are cognizable by the laws. See IDLENESS.

VAGINA, properly signifies a sheath or scabbard; and the term *vagina* is used in architecture for the part of a terminus, because resembling a sheath out of which the statue seems to issue.

VAGINA, in anatomy, a canal reaching from the external orifice, or os pudendi, of women to the uterus.

VAILLANT (John Foy), a physician and great medallist, to whom, according to Voltaire, France was indebted for the science of medals, and Louis XIV. for one half of his cabinet, was born at Beauvais in 1632. Through the means of the minister Colbert he travelled into Italy, Greece, Egypt, and Persia, to collect medals for the royal cabinet; and returned with so many as made the king's cabinet superior to any in Europe. In one of his voyages the ship he sailed in was fallen upon and taken by an Algerine corsair. After a captivity of near five months he was permitted to return to France, and received at the same time 20 gold medals which had been taken from him. He embarked in a vessel bound for Marseilles, and was carried on with a favourable wind for two days, when another corsair appeared, which, in spite of all the sail they could make, bore down upon them within the reach of cannon shot. Mr

Vaillant

Vair ‖ Valentinians.

Vaillant, dreading the miſeries of a freſh ſlavery, reſolved, however, to ſecure the medals which he had received at Algiers, and in order thereto ſwallowed them. But a ſudden turn of the wind freed them from this adverſary, and caſt them upon the coaſts of Catalonia; where, after expecting to run aground every moment, they at length fell among the ſands at the mouth of the Rhone. Mr Vaillant got to ſhore in a ſkiff, but felt himſelf extremely incommoded with the medals he had ſwallowed, which might weigh altogether five or ſix ounces, and therefore did not paſs like Scarborough waters. He had recourſe to a couple of phyſicians, who were a little puzzled with the ſingularity of his caſe; however, nature relieved him from time to time, and he found himſelf in poſſeſſion of the greateſt part of his treaſure when he got to Lyons. Here he explained, with much pleaſure to his friends, thoſe medals which were already come to hand, as well as thoſe which were daily expected; among which laſt was an Otho, valuable for its rarity.—He was much careſſed on his return; and when Louis XIV gave a new form to the academy of inſcriptions in 1701, Mr Vaillant was firſt made aſſociate, and then penſionary. He wrote ſeveral works relating to ancient coins, and died in 1706.

VAIR, or VAIRE, a kind of fur, formerly uſed for lining the garments of great men and knights of renown. It is repreſented in engraving by the figures of little bells reverſed, ranged in a line. See HERALDRY, Chap. II. Sect. 2.

VAIRY, in heraldry, expreſſes a coat, or the bearings of a coat, when charged or chequered with vairs.

VALAIS, a valley in Swiſſerland, which extends from the ſource of the river Rhone to the lake of Geneva. It is near 100 miles in length, but the breadth is very unequal. It is bounded on the north by the Alps, which ſeparate it from the cantons of Bern and Uri, on the eaſt by the mountains of Forche, on the ſouth by the duchy of Milan and the Val d'Aoſte, and on the weſt by Savoy and the republic of Geneva. The inhabitants profeſs the Roman Catholic religion, and are ſubject to the ſwelling of the throat called *bronchocele*; and idiots are ſaid to abound among them more than in any other place of the globe. They are naturally hardy, enterpriſing, and good-natured. It is ſurrounded on all ſides by very high mountains, moſt of which are covered with ſnow and ice that never thaw. However, the ſoil is fertile in corn, wine, and good fruit. The muſcat-wine, which is produced here, is excellent, and well known all over Europe. There are mineral waters, plenty of game, and ſome mines. This country comprehends 55 large pariſhes, to which one biſhop only belongs, whoſe ſee is at Sion the capital. The mountains afford good paſture for their cattle in ſummer, and their harveſt continues from May to October; it being ſooner or later according to the ſituation of the place.

VALANTIA, in botany: A genus of plants in the order *monœcia*, of the claſs *polygamia*, and in the natural ſyſtem arranged under the 41ſt order, the *aſperifoliæ*. There is ſcarcely any calyx; the corolla is monopetalous, flat, fourparted; the ſtamina four, with ſmall antheræ: the hermaphrodite flowers have a piſtillum with a large germen, a bifid ſtyle, the length of the calyx, and one ſeed; the piſtilla of the male flowers are hardly diſcernible. There are eight ſpecies, only one of which is a native of Britain, the *cruciata*; the ſtalks of which are ſquare, the whole plant hairy, the leaves oval and verticillate, four in a whirl; the flowers are yellow, and grow on ſhort peduncles out of the alæ of the leaves. The roots, like thoſe of the galiums, to which it is nearly related, will dye red. It is aſtringent, and was once uſed as a vulnerary.

VALENCIA, a province of Spain, which has the title of a kingdom; and is bounded on the eaſt and ſouth by the Mediterranean ſea, on the north by Catalonia and Arragon, and on the weſt by New Caſtile and the kingdom of Murcia. It is about 165 miles in length, and 63 in breadth. It is one of the moſt populous and agreeable parts of Spain, and where they enjoy almoſt a perpetual ſpring. The great number of rivers wherewith it is watered renders it extremely fertile, particularly in fruits and wine. There are very rugged mountains in it, which contain mines of alum and other minerals.

VALENCIA, a city of Spain, and capital of the kingdom of the ſame name. It contains about 12,000 houſes, beſides thoſe of the ſuburbs and the ſummer-houſes round it. It has an univerſity, and an archbiſhop's ſee; and was taken from the Moors by the Chriſtians in the 13th century. The town is handſome, and adorned with very fine ſtructures. It is not very ſtrong, though there are ſome baſtions along the ſides of the walls. They have manufactures in wool and ſilk, which bring in great ſums to the inhabitants. It is ſeated on the river Guadalaviar, over which there are five handſome bridges; and it is about three miles from the ſea, where there is a harbour, 110 miles north of Murcia, and 165 eaſt by ſouth of Madrid. This city ſurrendered to the earl of Peterborough in the year 1705; but it was loſt again in 1707. W. Long. 0. 10. N. Lat. 39. 23.

VALENCIENNES, an ancient, ſtrong, and conſiderable city of France, in the department of the North and late province of Hainault. It contains about 20,000 ſouls. The Scheld divides it into two parts. It is a very important place: the citadel and fortifications, the work of Vauban, were conſtructed by order of Louis XIV. who took this town from the Spaniards. It was confirmed to him by the treaty of Nimeguen, in 1678. In 1793, it ſurrendered to the allies after a ſevere ſiege, but was afterwards abandoned; and is now in the poſſeſſion of the French republicans. Beſides lace, this city is noted for manufactories of woollen ſtuffs and very fine linens. It is 20 miles weſt-ſouth-weſt of Mons, 17 north-eaſt of Cambray, and 120 north-eaſt by north of Paris. E. Long. 3. 37. N. Lat. 50. 21.

VALENS (Flavius), emperor of the Eaſt, a great patron of the Arians. Killed by the Goths in the year 379. See CONSTANTINOPLE, n° 76.

VALENTINIAN I. emperor of the Weſt, a renowned warrior, but a tyrant over his ſubjects. See ROME, n° 523.

VALENTINIAN II. emperor of the Weſt, a prince celebrated for his virtues, and above all for his moderation; yet a conſpiracy was formed againſt him by Arbogaſtes, the commander in chief of his armies; and he was ſtrangled in the year 392. See ROME, n° 546.

VALENTINIANS, in church-hiſtory, a ſect of Chriſtian heretics, who ſprung up in the ſecond century, and were ſo called from their leader Valentinus.

The Valentinians were only a branch of the Gnoſtics, who realized or perſonified the Platonic ideas concerning the Deity, whom they called *Pleroma* or *Plenitude*. Their ſyſtem was this: the firſt principle is Bythos, *i. e.* Depth, which remained many ages unknown, having with it Ennoe or Thought, and Sige or Silence; from theſe ſprung the Nous or Intelligence, which is the only ſon, equal to and alone capable of comprehending the Bythos; the ſiſter of Nous they called *Aletheia* or *Truth*; and theſe conſtituted the firſt quaternity of æons, which were the ſource and original of all the reſt: for Nous and Aletheia produced the World and Life; and from theſe two proceeded Man and the Church. But beſides theſe 8 principal æons, there were 22 more; the laſt of which, called *Sophia*, being deſirous to arrive at the knowledge of Bythos, gave herſelf a great deal of uneaſineſs, which

which created in her Anger and Fear, of which was born Matter. But the Horos or Bounder stopped her, preserved her in the Pleroma, and restored her to Perfection. Sophia then produced the Christ and the Holy Spirit, which brought the æons to their last perfection, and made every one of them contribute their utmost to form the Saviour. Her Enthymese, or Thought, dwelling near the Pleroma, perfected by the Christ, produced every thing that is in the world by its divers passions. The Christ sent into it the Saviour, accompanied with angels, who delivered it from its passions, without annihilating it: from thence was formed corporeal matter. And in this manner did they romance concerning God, nature, and the mysteries of the Christian religion.

VALERIAN, or VALERIANUS, (Publius Licinius), emperor of Rome, remarkable for his captivity and cruel treatment by Sapor I. king of Persia. See ROME, n° 491.

VALERIANA, in botany: A genus of plants belonging to the class *triandria* and order *monogynia*, and in the natural system arranged under the 48th order, *aggregatæ*. There is hardly any calyx; the corolla is monopetalous, gibbous at the base, situated above the germen; there is only one seed. There are 21 species, only four of which are natives of Britain, the *officinalis*, the *locusta*, the *rubra*, the *dioica*; of these only the officinalis is useful. The root of this plant is perennial: the stalk is upright, smooth, channelled, round, branched, and rises from two to four feet in height: the leaves on the stem are placed in pairs upon short broad sheathes; they are composed of several lance-shaped, partially dentated, veined, smooth pinnæ, with an odd one at the end, which is the largest: the floral leaves are spear-shaped and pointed; the flowers are small, of a white or purplish colour, and terminate the stem and branches in large bunches. It flowers in June, and commonly grows about hedges and woods.

Woodville's Medical Botany.

It is supposed to be the φυ of Dioscorides and Galen, by whom it is mentioned as an aromatic and diuretic: it was first brought into estimation in convulsive affections by Fabius Columna, who relates that he cured himself of an epilepsy by the root of this plant: we are told, however, that Columna suffered a relapse of the disorder; and no further accounts of the efficacy of valerian in epilepsy followed till those published by Dominicus Panarolus fifty years afterwards, in which three cases of its success are given. To these may be added many other instances of the good effects of valerian root in this disease, since published by Cruger, Schuchmann, Riverius, Sylvius, Marchant, Chomel, Sauvages, Tissot, and others.

The advantages said to be derived from this root in epilepsy caused it to be tried in several other complaints termed *nervous*, particularly those produced by increased mobility and irritability of the nervous system, in which it has been found highly serviceable. Bergius states its virtues to be antispasmodic, diaphoretic, emmenagogue, diuretic, anthelmintic. The root in substance is most effectual, and is usually given in powder from a scruple to a dram: its unpleasant flavour may be concealed by a small addition of mace. A tincture of valerian in proof spirit and in volatile spirit are ordered in the London Pharmacopœia.—Cats are very fond of the smell of this root, and seem to be intoxicated by it.

VALERIUS MAXIMUS, a Latin historian, sprung from the families of the Valerii and Fabii, which made him take the name of *Valerius Maximus*. He studied polite literature, and afterwards followed Sextus Pompey to the wars. At his return he composed an account of the actions and remarkable sayings of the Romans and other great men; and dedicated that work to the emperor Tiberius. Many of the learned think that this is the same that is now extant, and bears the name of Valerius Maximus; but others maintain, that what we have now is only an abridgment of the work written by this celebrated historian, and that this abridgment was made by one Nepotian of Africa. However, this work is well written, and contains a great number of memorable actions performed by the Greeks and Romans that are worthy of being read.

VALET, a French term, used as a common name for all domestic men servants employed in the more servile offices, as grooms, footmen, coachmen, &c. But with us it is only used in the phrase *valet de chambre*, which is a servant whose office is to dress and undress his master, &c.

VALETTA, a city of Malta, and capital of the island (see MALTA, n° 26). It is situated in E. Long. 14. 34. N. Lat. 35. 54.

VALETUDINARY, among medical writers, denotes a person of a weak and sickly constitution, and frequently out of order.

VALID, in law, an appellation given to acts, deeds, transactions, &c. which are clothed with all the formalities requisite to their being put into execution, and to their being admitted in a court of justice.

VALLADOLID, an ancient, large, and handsome city of Spain, in Old Castile, and capital of a principality of the same name, with a bishop's see and an university. It is surrounded with strong walls, embellished with handsome buildings, large public squares, piazzas, and fountains. It is large and populous, containing 11,000 houses, with fine long and broad streets, and large high houses, adorned with balconies. The market-place, called *El Campo*, is 700 paces in circumference, surrounded with a great number of convents, and is the place where the fairs are kept. There is another square in the middle of the city, surrounded with handsome brick houses, having under them piazzas, where people may walk dry in all weathers. Within these piazzas merchants and tradesmen keep their shops. All the houses are of the same height, being four stories; and there are balconies at every window, of iron gilt. In the whole there are 70 monasteries and nunneries; the finest of which is that of the Dominicans, remarkable for its church, which is one of the most magnificent in the city. The kings resided a long while at this place; and the royal palace, which still remains, is of very large extent, though but two stories high; within are fine paintings of various kinds, and at one of the corners a curious clock, made in the same manner as that of Strasburg. The house of the inquisition is an odd sort of structure, for there are no windows, but a few holes to let in the light. The environs of the city are a fine plain, covered with gardens, orchards, vineyards, meadows, and fields. It is seated on the rivers Escurva and Pesuerga, in W. Long. 4. 25. N. Lat. 41. 50.

VALUE, in commerce, denotes the price or worth of any thing.

VALVE, in hydraulics, pneumatics, &c. is a kind of lid or cover of a tube or vessel so contrived as to open one way, but which, the more forcibly it is pressed the other way, the closer it shuts the aperture; so that it either admits the entrance of a fluid into the tube or vessel, and prevents its return; or admits its escape, and prevents its re-entrance.

VALVE, in anatomy, a thin membrane applied on several cavities and vessels of the body, to afford a passage to certain humours going one way, and prevent their reflux towards the place from whence they came.

VAMPYRE, a species of bat. See VESPERTILIO.

VAN, a term derived from the French *avant*, or *avaunt*, signifying before or foremost of any thing; thus we say, the van-guard of the army, &c.

VANBRUGH (Sir John), a celebrated English dramatic writer and architect, was descended of a family in Che-

ſhire which came from France, though by his name he appears to have been originally of Dutch extraction. He was born about the middle of the reign of Charles II. and received a liberal education. His firſt comedy, called the *Relapſe*, or *Virtue in Danger*, was acted in the year 1697 with great applauſe; which gave him ſuch encouragement, that he wrote eleven more comedies. He was the friend of Mr Congreve, whoſe genius was naturally turned for dramatic performances; and theſe two gave new life to the Engliſh ſtage, and reſtored its reputation, which had been for ſome time ſinking: but their making vicious perſons their moſt amiable and ſtriking characters, and their bordering too much on obſcenity, could be of no ſervice to the cauſe of virtue; and therefore it was not without reaſon that they were attacked by Mr Collier, in his piece on the Immorality and Profaneneſs of the Stage. However, either the reputation Sir John gained by his comedies, or his ſkill in architecture, procured him very conſiderable advantages. He was appointed Clarencieux king at arms, which he afterwards diſpoſed of. In 1716 he was appointed ſurveyor of the works at Greenwich hoſpital; he was likewiſe made comptroller general of his majeſty's works, and ſurveyor of all the gardens and waters. He was an able architect; but his performances in that way are eſteemed heavy. Under his direction were raiſed Blenheim-houſe in Oxfordſhire, Claremont in Surry, and his own houſe at Whitehall. He died of a quinſy in 1726.

VANDELLIA, in botany; a genus of plants belonging to the claſs *didynamia* and order *angioſpermia*. The calyx is ſubquadrifid; the corolla ringent; the two exterior filaments proceed from the diſc of the lip of the corolla; the antheræ are connected; the capſule is unilocular and polyſpermous. There is only one ſpecies known, the *diffuſa*.

VAN-DIEMEN'S LAND. See DIEMEN.

VANDYCK (Sir Anthony), a celebrated painter, was born at Antwerp in the year 1599. It is ſaid that Vandyck's mother was paſſionately fond of embroidery, that ſhe excelled in it, and embroidered ſeveral hiſtorical ſubjects with ſuch ſurpriſing ſkill, that they have been eſteemed maſterpieces by proficients in that art. Being deſirous to have her ſon inſtructed in the firſt rudiments of grammar, ſhe began by ſending him to ſchool to learn reading and writing. As he had ink, paper, and pens, at command, he amuſed himſelf more with drawing figures and other ſlight ſketches, than with making letters. One day his maſter having threatened to whip one of his ſchool-fellows, Vandyck poſitively aſſured him, that he need not fear his maſter's threats, as he would take care to prevent his receiving the threatened correction.—"How ſo?" replied his ſchool-fellow. "I'll paint (replied Vandyck) a face on your poſteriors;" which he did with ſuch ſkill, that when the maſter drew up the curtain, he laughed ſo immoderately that he forgave the culprit. After giving ſeveral early proofs of his excellent genius, he became the diſciple of the illuſtrious Rubens. In the church of the Auguſtines at Antwerp, at the high altar, is a celebrated picture of Rubens, repreſenting, in one part, the Virgin Mary ſitting with the child Jeſus in her lap, and in another part ſeveral ſaints, male and female, ſtanding. The breaſt of one of theſe, St Sebaſtian, is ſaid to have been painted by Vandyck when he was only a diſciple of Rubens. This great maſter being engaged one day abroad, his diſciples went into his painting-room, where, after having been ſome time employed in admiring his works, they began to play or romp in ſuch a manner, that the breaſt of St Sebaſtian, which was not yet dry, was bruſhed away by a hat thrown at random. This accident put an end to their play: they were very anxious to reſtore it, fearing that if Rubens diſcovered it they ſhould all be diſcarded. At length it was agreed that Anthony ſhould undertake to mend the ſaint's breaſt. In ſhort, taking his maſter's pallet and bruſhes, he ſucceeded ſo well, that his companions imagined Rubens would overlook it. They were miſtaken; for Rubens at his return knew immediately that ſome one had touched upon his performance: calling his diſciples, he aſked them why any one had dared to meddle with his painting? They were ſome time doubtful whether they ſhould confeſs or deny the fact. Threats at length prevailed: they owned that Vandyck had thrown his hat upon it. Upon this, cloſeting Vandyck, inſtead of chiding him, he told him, that "it was proper and even neceſſary for him to travel into Italy, the only ſchool that produced excellent painters; and that, if he would take his advice, he would arrive at the higheſt perfection." Vandyck replied, that "he was very deſirous of it; but that his purſe was not equal to ſuch a journey, and that he feared he ſhould be obliged to ſell his hat on the road." Rubens aſſured him that that ſhould be his concern; and accordingly, a few days after, he made him a preſent of a purſe full of piſtoles, and added to that gift a dapple grey horſe, of great beauty, to carry him thither. In return for this, Vandyck painted his maſter a chimney-piece; and afterwards ſet out for Italy, about the year 1621, being then about 21 or 22 years of age. Having ſtaid a ſhort time at Rome, he removed to Venice, where he attained the beautiful colouring of Titian, Paul Veroneſe, and the Venetian ſchool, which appeared from the many excellent pictures he drew at Genoa.

After having ſpent a few years abroad, he returned to Flanders, with ſo noble, ſo eaſy, and natural a manner of painting, that Titian himſelf was hardly his ſuperior; and no other maſter could equal him in portraits. Soon after his return, he accidentally met with D. Teniers, who accoſted him with great politeneſs, and aſked him whether he had much buſineſs ſince he came from Rome? "What buſineſs, think you, can I have had time to do (replied Vandyck)? I am only juſt arrived here. Would you believe, that I offered to draw that fat brewer's picture who juſt paſſed by us for two piſtoles, and that the looby laughed in my face, ſaying it was too dear? I aſſure you, that if the cards do not turn up better, I ſhall make no long ſtay at Bruſſels." Soon after this, he painted thoſe two famous pictures, the Nativity and a dying Chriſt; the firſt in the pariſh church, the ſecond in that of the Capuchins, at Termond.

When he was in Holland he was very deſirous to ſee Francis Hals the painter, who had great reputation then for portraits. On entering his room, he aſked to have his picture drawn. Hals, who knew Vandyck only by fame, undertook it, and went to work. The latter ſeeing his head finiſhed, roſe up, ſaying, that it was a ſtriking likeneſs. Afterwards he propoſed to Hals, that if he would ſit in return, he would alſo draw his picture; to which Hals having agreed, merely from curioſity, exclaimed, on ſeeing his picture ſo ſoon finiſhed, "Thou art the devil, or elſe Vandyck." This picture of Hals has been engraved by Coſter at the Hague.

Vandyck, finding he could not make a fortune in his own country, took a reſolution of going over into England. Accordingly he borrowed ſome guineas of Teniers, and ſet out, furniſhed with letters of recommendation. His ſuperior genius ſoon brought him into great reputation; and above all, he excelled in portraits, which he drew with an inconceivable facility, and for which he charged a very high price, according to the inſtructions which had been given him on that head. It is affirmed, that for ſome of them he received 400 guineas apiece. He ſoon found himſelf loaded with honours and riches; and as he had a noble and generous heart, he made a figure ſuitable to his fortune. He married one of the faireſt ladies of the Engliſh court, a daughter of the lord

Ruthven,

Ruthven, earl of Gowry; and, though she had but little fortune, maintained her with a grandeur answerable to her birth. He himself was generally richly dressed; his coaches and equipage were magnificent, and his retinue was numerous; his table was elegant, and plentifully furnished; and he often entertained his guests after dinner with a concert performed by the best English musicians of London. In short, his house was so frequented by persons of the greatest quality of both sexes, that his apartments rather resembled the court of a prince than the lodgings of a painter. Notwithstanding this expence, he amassed great wealth; when a chemist had the art to insinuate himself into his esteem, and inspired him with a desire of converting copper into gold: but the secret had no other effect, than making him convert his gold into smoke. Rubens being informed of it, wrote to his disciple: he acknowledged his error, and corrected it. At length Vandyck being at an early age subject to the gout, it undermined him by degrees, and carried him to the grave in the year 1641, at the age of 42. He was buried in St Paul's; and left to his heirs a considerable estate, which some have made to amount to 40,000l. sterling.

VANE, a thin slip of bunting hung to the mast-head, or some other conspicuous place in the ship, to show the direction of the wind. It is commonly sewed upon a wooden frame called the *stock*, which contains two holes whereby to slip over the spindle, upon which it turns about as the wind changes.

VANILLA, or VANILLO. See EPIDENDRUM.

VAPOUR, in philosophy, the particles of bodies rarefied by heat, and thus rendered specifically lighter than the atmosphere, in which they rise to a considerable height. See EVAPORATION, DAMP, GAS, &c.

Many kinds of vapour are unfriendly to animal life, but the most noxious are those which arise from metallic substances. In the smelting and refining of lead, a white vapour arises, which, falling upon the grass in the neighbourhood, imparts a poisonous quality to it, so that the cattle which feed there will die; and in like manner stagnant waters impregnated with this vapour will kill fish. In some places the earth exhales vapours of a very noxious quality; such as the Grotto del Cani, and other places in Italy, where a mephitic vapour constantly hovers overs the surface of the ground, proving instantly fatal to such animals as are immersed in it. In some parts of the world there have been instances of people killed, and almost torn to pieces, by a vapour suddenly bursting out of the earth under their feet.

Of the aqueous vapour raised from the earth by the sun's heat are formed the clouds; but though these are commonly at no great distance from the earth, we cannot from thence determine the height to which the vapours ascend. Indeed, considering the great propensity of water, and even quicksilver, to evaporate in the most perfect vacuum we can make, it is by no means probable that any limit can be fixed for this ascent. See WEATHER.

VAPOURS, noxious, method of dissipating. The following ingenious method of dissipating the noxious vapours commonly found in wells and other subterraneous places, is related in the Transf. Philadel. by Mr Robinson of Philadelphia the inventor. "After various unsuccessful trials (says he), I was led to consider how I could convey a large quantity of fresh air from the top to the bottom of the well, supposing that the foul would necessarily give way to the pure air. With this view I procured a pair of smith's bellows, fixed in a wooden frame, so as to work in the same manner as at the forge. This apparatus being placed at the edge of the well, one end of a leathern tube (the hose of a fire-engine) was closely adapted to the nose of the bellows, and the other end was thrown into the well, reaching within one foot of the bottom. At this time the well was so infected, that a candle would not burn at a short distance from the top; but, after blowing with my bellows only half an hour, the candle burned bright at the bottom; then, without further difficulty, I proceeded in the work, and finished my well. Wells are often made in a very slight manner, owing to the difficulty of working in them, and there have been several fatal instances of the danger attending the workmen; but, by the above method, there is neither difficulty nor danger in completing the work with the utmost solidity. It is obvious, that in cleansing vaults, and working in any other subterraneous place, subject to damps as they are called, the same method must be attended with the same beneficial effect."

VAPOURS, in medicine, a disease properly called *hyps*, or the *hypochondriacal disease*; and in men particularly, the *spleen*. See MEDICINE, n° 276 and 321.

VAPOUR-Bath, in chemistry, a term applied to a chemist's bath or heat, wherein a body is placed so as to receive the fumes of boiling water. It consists of two vessels, disposed over one another in such manner as that the vapour raised from the water contained in the lower heats the matter inclosed in the upper. It is very commodious for the distilling of odoriferous waters, and the drawing of spirit of wine.

We also use the term *vapour-bath*, when a sick person is made to receive the vapours arising from some liquid matter placed over a fire. Many contrivances have been proposed for this purpose; and their expediency and utility are best known to those who are conversant in this business. A late writer has suggested a new construction of vapour baths; and the whole apparatus is reduced to a tin-boiler, tin pipes wrapped in flannel, and a deal box with a cotton cover, for the reception of the body and circulation of the vapour.

VARI, in medicine, little, hard, and ruddy tumors, which frequently infest the faces of young persons of a hot temperament of body.

VARIATION *of the Compass*, is the deviation of the magnetic or mariner's needle from the meridian or true north and south line. On the continent it is called the *declination* of the magnetic needle; and this is a better term, for reasons which will appear by and by.

Our readers know, that the needle of a mariner's compass is a small magnet, exactly poised on its middle, and turning freely in a horizontal direction on a sharp point, so that it always arranges itself in the plane of the magnetic action. We need not add any thing on this head to what has been delivered in the articles COMPASS and *Azimuth* COMPASS.

About the time that the polarity of the magnet was first observed in Europe, whether originally, or as imported from China, the magnetic direction, both in Europe and in China, was nearly in the plane of the meridian. It was therefore an inestimable present to the mariner, giving him a sure direction in his course through the pathless ocean. But by the time that the European navigators had engaged in their adventurous voyages to far distant shores, the deviation of the compass needle from the meridian was very sensible even in Europe; and it is somewhat surprising that the Dutch and Portuguese navigators did not observe it on their own coasts. The son of Columbus positively says, that it was observed by his father in his first voyage to America, and made his companions so anxious lest they should not find the way back again to their own country, that they mutinied and refused to proceed. It is surprising that any should doubt of its being known to this celebrated navigator, because he even endeavours to account for it by supposing the needle always to point to a fixed point of the heavens, different from the pole of the world, which he calls

Variation. the *point attractive*. It is at any rate certain that Gonzales Oviedo and Sebastian Cabot observed it in their voyages. Indeed it could not possibly escape them; for in some parts of their several tracks the needle deviated above 25 degrees from the meridian; and the rudest dead reckoning, made on the supposition of the needle pointing due north and south, must have thrown the navigators into the utmost confusion. It would indeed be very difficult for them, unprepared for this source of error, to make any tolerable guess at its quantity, till they got to some place on shore, where they could draw a meridian line. But we know that spherical trigonometry was at that time abundantly familiar to the mathematicians of Europe, and that no person pretended to take the command of a ship bound to a distant port that was not much more informed in this science than most masters of ships are now-a-days. It could not be long, therefore, before the methods were given them for discovering the variation of the compass by observation of AMPLITUDES and AZIMUTHS, as is practised at present (see each of these articles). But the deviation of the compass from the meridian was not generally allowed by mathematicians, who had not yet become sensible of the necessity of quitting the Aristotelean trammels, and investigating nature by experiments. They rather chose to charge the navigators with inaccuracy in their observations than the schoolmen with error in principles. Pedro de Medina at Valladolid, in his *Arte de Naviggar*, published in 1545, positively denies the variation of the compass. But the concurring reports of the commanders of ships on distant voyages, in a few years, obliged the landsmen in their closets to give up the point; and Martin Cortez, in a treatise of navigation, printed at Seville before 1556, treats it as a thing completely established, and gives rules and instruments for discovering its quantity. About the year 1580 Norman published his discovery of the *dip* of the needle, and speaks largely of the horizontal deviation from the plane of the meridian, and attributes it to the attraction of a point, not in the heavens, but in the earth, and describes methods by which he hoped to find its place. To the third, and all the subsequent editions of Norman's book (called the *new attractive*), was subjoined a dissertation by Mr Burroughs, comptroller of the navy, on the variation of the compass, in which are recorded the quantity of this deviation in many places; and he laments the obstacle which it causes to navigation by its total uncertainty previous to observation. The author indeed offers a sort of rule for computing it *a priori*, founded on some conjecture as to its cause; but, with the modesty and candour of a gentleman, acknowledges that this is but a guess, and intreats all navigators to be assiduous in their observations, and liberal in communicating them to the public; conjuring them to consider, that an interested regard to their own private advantage, by concealing their knowledge, may prove the shipwreck of thousands of brave men. Accordingly observations were liberally contributed from time to time, and were published in the subsequent treatises on navigation.

But in 1635 the mariners were thrown into a new and great perplexity, by the publication of a *Discourse mathematical on the variation of the Magnetical Needle*, by Mr Henry Gillebrand, Gresham professor of astronomy. He had compared the variations observed at London by Burroughs, Gunter, and himself, and found that the north end of the mariner's needle was gradually drawing more to the westward. For Norman and Burroughs had observed it to point about $11\frac{1}{4}$ degrees to the east of the north in 1580; Gunter found its deviation only $6\frac{1}{4}$ in 1622, and he himself had observed only 4 in 1634; and it has been found to deviate more and more to the westward ever since, as may be seen from the following little table in Waddington's Navigation.

London.

1576	Norman	11° 15′ East.
1580	Burroughs	11.17
1622	Gunter	6.12
1634	Gillebrand	4. 5
1662		0. 0
1666	Sellers	0.34 West
1670		2.06
1672		2.30
1700		9.40
1720		13.—
1740		16.10
1760		19.30
1774		22.20
1778	Phil. Trans.	22.11

Mr Bond, teacher of mathematics in London, and employed to take care of and improve the impressions of the popular treatises of navigation, about the 1650, declared, in a work called the "Seaman's Kalendar," that he had discovered the true progress of the deviation of the compass; and published in another work, called the "Longitude Found," a table of the variation for 50 years. This was, however, a very gratuitous sort of prognostication, not founded on any well-grounded principles; and though it tallied very well with the observations made in London, which showed a gradual motion to the westward at the rate of —.12′ annually, by no means agreed with the observations made in other places. See Phil. Trans. 1668.

But this glad news to navigators soon lost its credit: for the inconsistency with observation appeared more and more every day, and all were anxious to discover some general rule, by which a near guess at least might be made as to the direction of the needle in the most frequented seas. Mr Halley, one of the first geometers and most zealous philosophers of the last century, recommended the matter in the most earnest manner to the attention of government; and, after much unwearied solicitation, obtained a ship to be sent on a voyage of discovery for this very purpose. He got the command of this ship, in which he repeatedly traversed the Atlantic Ocean, and went as far as the 50th degree of southern latitude. See his very curious speculations on this subject in the Phil. Trans. 1683 and 1692.

After he had collected a prodigious number of observations made by others, and compared them with his own, he published in 1700 a synoptical account of them in a very ingenious form of a sea-chart, where the ocean was crossed by a number of lines passing through those planes where the compass had the same deviation. Thus, in every point of one line there was no variation in 1700; in every point of another line the compass had 20 degrees of east variation; and in every point of a third line it had 20° of west variation. These lines have since been called *Halleyan lines*, or curves. This chart was received with universal applause, and was undoubtedly one of the most valuable presents that science has made to the arts. But though recommended with all the earnestness which its importance merited, it was offered with the candour and the caution that characterises a real philosopher ardently zealous for the propagation of true knowledge. Its illustrious author reminds the public of the inaccuracy of observations collected from every quarter, many of them made by persons not sufficiently instructed, nor provided with proper instruments; many also without dates, and most of them differing in their dates, so that some reduction was necessary for all, in order to bring them to a common epoch; and this must be made without having

VARIATION.

Plate DXIII.

Fig. 1.

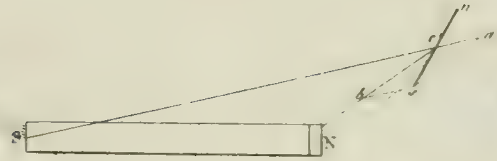


Fig. 2.

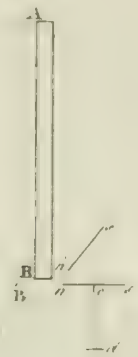
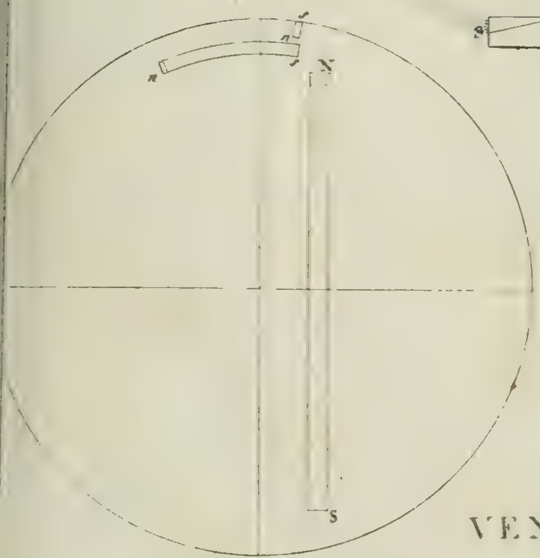


Fig. 3.



VENTILATOR.

Fig. 1.

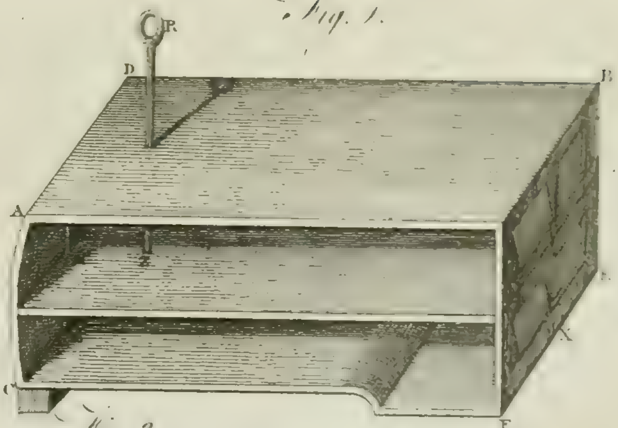


Fig. 2.

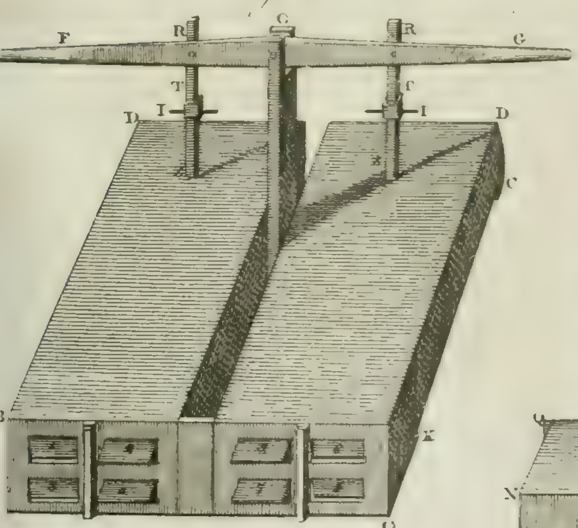
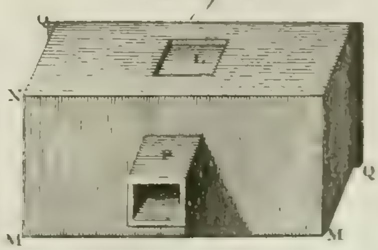


Fig. 3.



having an unquestionable principle on which to proceed. He said, that he plainly saw that the change of variation was very different in different places, and in the same place at different times: and confesses that he had not discovered any general principle by which these changes could be connected.

Halley's *Variation Chart*, however, was of immense use; but it became gradually less valuable, and in 1745 was exceedingly erroneous. This made Messrs Mountaim and Dodson, fellows of the Royal Society, apply to the admiralty and to the great trading companies for permission to inspect their records, and to extract from them the observations of the variations made by their officers. They got all the assistance they could demand; and, after having compared above 50,000 observations, they composed new variation charts, fitted for 1745 and 1756.

The polarity of the magnetic needle, and a general tho' intricate connection between its positions in all parts of the world, naturally causes the philosopher to speculate about its cause. We see that Cortez ascribed it to the attraction of an eccentric point, and that Bond thought that this point was placed not in the heavens, but in the earth. This notion made the basis of the famous Theory of Magnetism of Dr Gilbert of Colchester, the first specimen of experimental philosophy which has been given to the public. It was published about the year 1600: he was an intimate acquaintance of the great experimental philosopher lord Bacon, and proceeded entirely according to the plan laid down by that illustrious leader in his *Novum Organum Scientiarum*.

Gilbert asserted that the earth was a great magnet, and that all the phenomena of the mariner's compass were the effects of this magnetism. He showed at least that these phenomena were precisely such as would result from such a constitution of the earth; that is, that the positions of the mariner's needle in different parts of the earth were precisely the same with those of a small magnet similarly situated with respect to a very large one. Although he had made more magnetic experiments than all that had gone before him put together, still the magnetical phenomena were but scantily known till long after. But Gilbert's theory (for so it must be truly esteemed) of the magnetical phenomena is now completely confirmed. The whole of it may be understood from the following general proposition.

Plate XLI. Let NS (fig. 1.) be a magnet, of which N is the north and S the south pole: Let *n s* be any oblong piece of iron, poised on a point *c* like a compass needle. It will arrange itself in a position *n c s* precisely the same with that which would be assumed by a compass needle of the same size and shape, having *n* for its north and *s* its south pole. And while the piece of iron remains in this position, it will be in all respects a magnet similar to the real compass needle. The pole *n* will attract the south pole of a small magnetised needle, and repel its north pole. If a paper be held over *n s*, and fine iron filings be strewed on it, they will arrange themselves into curves issuing from one of its ends and terminating at the other, in the same manner as they will do when strewed on a paper held over a real compass needle. But this magnetism is quite temporary; for if the piece of iron *n s* be turned the other way, placing *n* where *s* now is, it will remain there, and will exhibit the same phenomena. We may here add, that if *n s* be almost infinitely small in comparison of NS, the line *n s* will be in such a position that if *s a*, *s b*, be drawn parallel to N*c*, S*c*, we shall have *s a* to *s b* as the force of the pole N to the force of the pole S. And this is the true cause of that curious disposition of iron-filings when strewed round a magnet. Each fragment becomes a momentary magnet, and arranges itself in the true magnetic direction; and when so arranged, attracts the two adjoining fragments, and cooperates with the forces, which also arrange them. We throw this out to the ingenious mechanician as the foundation of a complete theory of the magnetical phenomena. When the filings are infinitely fine, the curves N*c*S have this property, that, drawing the tangent *n c s*, we always have *s a* : *s b* = force of N : force of S; and thus we may approximate at pleasure to the law of magnetic attraction and repulsion. The public may expect to have soon a theory of magnetism founded on this principle, and applied with the completest success to every phenomenon yet observed. Variation.

Now, to apply this theory to the point in hand.—Let *n s* (fig. 2.) be a small compass needle, of which *n* is the north and *s* the south pole: let this needle be poised horizontally on the pin *c d*; and let *n' s'* be the position of the *dipping needle*. Take any long bar of common iron, and hold it upright, or nearly so, as represented by AB. The lower end B will repel the pole *n* and will attract the pole *s*, thus exhibiting the properties of a north pole of the bar AB. Keeping B in its place, turn the bar round B' as a centre, till it come into the position A'B' nearly parallel to *n' s'*. You will observe the compass needle *n s* attract the end B' with either pole *n* or *s*, when B'A' is in the position B'*a* perpendicular to the direction *n' s'* of the dipping neeedle: and when the bar has come into the position B'A', the upper end B' will show itself to be a south pole by attracting *n* and repelling *s*. This beautiful experiment was exhibited to the Royal Society in 1673 by Mr Hindshaw.

From this it appears, that the great magnet in the earth induces a momentary magnetism on soft iron precisely as a common magnet would do. Therefore (says Dr Gilbert) it induces permanent magnetism on magnetisable ores of iron, such as loadstones, in the same manner as a great loadstone would do; and it affects the magnetism already imparted to a piece of tempered steel precisely as any other great magnet would.

Therefore the needle of the mariner's compass in every part of the world arranges itself in the magnetic direction, so that, if poised as a dipping needle should be, it will be a tangent to one of the curves N*c*S of fig. 1. The horizontal needle being so poised as to be capable of playing only in a horizontal plane, will only arrange itself *in the plane* of the triangle N*c*S. That end of it which has the same magnetism with the south pole S of the great magnet included in the earth will be turned towards its north pole N. Therefore what we call the north pole of a needle or magnet really has the magnetism of the south pole of the great primitive magnet. If the line NS be called the axis, and N and S the poles of this great magnet, the plane of any one of these curves N*c*S will cut the earth's surface in the circumference of a circle, great or small according as the plane does or does not pass through the centre of the earth.

Dr Halley's first thought was, that the north pole of the great magnet or loadstone which was included in the bowels of the earth was not far from Baffin's Bay, and its south pole in the Indian ocean south-west from New Zealand. But he could not find any positions of these two poles which would give the needle that particular position which it was observed to assume in different parts of the world; and he concluded that the great terrestrial loadstone had four irregular poles (a thing not unfrequent in natural loadstones, and easily producible at pleasure), two of which are stronger and two weaker. When the compass is at a great distance from the two north poles, it is affected so as to be directed nearly in a plane passing through the strongest. But if we approach it much more to the weakest, the greater vicinity will compensate for the smaller absolute force of the weak pole, and occasion considerable irregularities. The appearances are favourable to this opinion. If this be the case

2

constitution of the great magnet, it is almost a desperate task to ascertain by computation what will be the position of the needle. Halley seems to have despaired; for he was both an elegant and a most expert mathematician, and it would have cost *him* little trouble to ascertain the places of two poles only, and the direction which these would have given to the needle. But to say what would be its position when acted on by four poles, it was necessary to know the law by which the magnetic action varied by a variation of distance; and even when this is known, the computation would have been exceedingly difficult.

In order to account for the change of variation, Dr Halley supposes this internal magnet not to adhere to the external shell which we inhabit, but to form a nucleus or kernel detached from it on all sides, and to be so poised as to revolve freely round an axis, of which he hoped to discover the position by observation of the compass. The philosopher will find nothing in this ingenious hypothesis inconsistent with our knowledge of nature. Dr Halley imagined that the nucleus revolved from east to west round the same axis with the earth. Thus the poles of the magnet would change their positions relatively to the earth's surface, and this would change the direction of the compass needle.

The great Euler, whose delight it was always to engage in the most difficult mathematical researches and computations, undertook to ascertain the position of the needle in every part of the earth. His dissertation on this subject is to be seen in the 13th volume of the Memoirs of the Royal Academy of Berlin, and is exceedingly beautiful, abounding in those analytical *tours d'adresse* in which he surpassed all the world. He has reduced the computation to a wonderful simplicity.

He found, however, that four poles would engage him in an analysis which would be excessively intricate, and has contented himself with computing for two only; observing that this supposition agrees so well with observation, that it is highly probable that this is the real constitution of the terrestrial magnet, and that the coincidence would have been perfect if he had hit on the due positions of the two poles. He places one of them in lat. 76° north, and long. 96° west from Teneriffe. The south pole is placed in lat. 58° south, and long. 158° west from Teneriffe. These are their situations for 1757.—Mr Euler has annexed to his dissertation a chart of Halleyan curves suited to these assumptions, and fitted to the year 1757.

It must be acknowledged, that the *general* course of the variations according to this theory greatly resembles the real state of things; and we cannot but own ourselves highly indebted to this great mathematician for having made so fine a first attempt. He has improved it very considerably in another dissertation in the 22d volume of these memoirs. But there are still such great differences, that the theory is of no service to the navigator, and it only serves as an excellent model for a farther prosecution of the subject. Since that time another large variation chart has been published, fitted to a late period; but the public has not sufficient information of the authorities or observations on which it is founded.

The great object in all these charts is to facilitate the discovery of a ship's longitude at sea. For the lines of variation being drawn on the chart, and the variation and the latitude being observed at sea, we have only to look on the chart for the intersection of the parallel of observed latitude and the Halleyan curve of observed variation. This intersection must be the place of the ship. This being the purpose, the Halleyan lines are of great service; but they do not give us a ready conception of the direction of the needle. We have always to *imagine* a line drawn through the point, cutting the meridian in the angle corresponding to the Halleyan line. We should learn the general magnetic affections of the globe much better if a number of magnetic meridians were drawn. These are the intersections of the earth's surface with planes passing through the magnetical axis, cutting one another in angles of 5° or 10°. This would both show us the places of the magnetic poles much more clearly, and would, in every place, show us at once the direction of the needle. In all those places where these magnetical curves touch the meridians, there is no variation; and the variation in every other place is the angle contained between these magnetical meridians and the true ones.

The program of a work of this kind has been published by a Mr Churchman, who appears to have engaged in the investigation with great zeal and considerable opportunities. He had been employed in some operations connected with surveys of the back settlements in North America. It is pretty certain that the north magnetic pole (or point, as Mr Churchman chooses to call it) is not far removed from the stations given it by Halley and Euler; and there seems no doubt but that in the countries between Hudson's Bay and the western coasts of North America the needle will have every position with respect to the terrestrial meridian, so that the north end of a compass-needle will even point due south in several places. Mr Churchman has solicited assistance from all quarters, to enable him to traverse the whole of that inhospitable country with the compass in his hand. It were greatly to be wished that our gracious sovereign, who has always shown such a love for the promotion of nautical science, and who has so munificently contributed to it, already enriching the world with the most valuable discoveries, and thus laying posterity under unspeakable obligations; it were greatly to be wished that he would put this almost finishing stroke to the noble work, and enable Mr Churchman, or some fitter person, if such can be found, to prosecute this most interesting inquiry. Almost every thing that can be desired would be obtained by a few *well-chosen* observations made in those regions. It would be of immense advantage to have the *dips* ascertained with great precision. These would enable us to judge at what depth under the surface the pole is situated; for the well informed mechanician, who will study seriously what we have said about the magnetical curves, will see that a compass needle, when compared with the great terrestrial magnet, is but as a particle of iron-filings compared to a very large artificial magnet. Therefore, from the position of the dipping needle, we may infer the place of the pole, if the law of magnetic action be given; and this law may be found by means of other experiments which we could point out.

Mr Churchman has adopted the opinion of only two poles. According to him, the north pole lies (in 1800) in Lat. 58° N. and Long. 134° west from Greenwich, very near Cape Fair-weather; and the south pole lies in Lat. 58° S. and Lon. 165° E. from Greenwich. He also imagines that the north pole has moved to the eastward, on a parallel of latitude, about 65° since the beginning of last century (from 1600), and concludes that it makes a revolution in 1096 years. The southern pole has moved less, and completes its revolution in 2289 years. This motion he ascribes to some influences which he calls *magnetic tides*, and which he seems to consider as celestial. This he infers from the changes of variation. He announces a physical theory on this subject, which, he says, enables him to compute the variation with precision for any time past or to come; and he even gives the process of trigonometrical computation illustrated by examples. But as this publication (entitled *The Magnetic Atlas*, published for the Author, by Darton and Harvey, 1794) is only a program, he expresses himself obscurely,

fcurely, and fomewhat enigmatically, refpecting his theory, waiting for encouragement to make the obfervations which are neceffary for completing it. He has, in the mean time, accompanied his account of the theory with a chart, in the form of guffets, for covering a globe of 15 inches diameter, objecting very juftly to the great diftortion which Wright's charts occafion in every part near the poles. This diftortion is fuch as totally to change the appearance of the curves in thofe very places where their appearance and magnitude are of the greateft moment.

Mr Churchman has alfo accompanied his work with the returns which he has received from feveral perfons eminent for their rank or learning, to whom he had applied for encouragement and affiftance. They are polite, but, we think, not fo encouraging as fuch zeal in fuch a caufe had good reafon to expect. We acknowledge that there are circumftances which juftify caution in promifes of this nature. His profers are very great, and not qualified with any doubt. Some of his proofs are not very convincing, and there are fome confiderable defects in the fcientific part. He fpeaks in fuch terms of the magnetic influences as plainly lead us to conclude that they refemble, in effect at leaft, the ordinary actions of magnets. He fpeaks of the influence of one pole being greater than that of the other; and fays, that in this cafe the magnetic equator, where the needle will be parallel to the axis, will not be in the middle between the poles. This is true of a common magnet. He muft therefore abide by this fuppofition in its other confequences. The magnetic meridians muft be planes paffing through this axis, and therefore muft be circles on the furface of the earth. This is incompatible with the obfervations; nay, his charts are fo in many places, particularly in the Pacific Ocean, where the variations by his chart are three times greater than what has been obferved.—His parallels of dip are ftill more different from obfervation, and are incompatible with any phenomena that could be produced by a magnet having but two poles. His rules of computation are exceedingly exceptionable. He has in fact but one example, and that fo particular, that the mode of computation will not apply to any other. This circumftance is not taken notice of in the enunciation of his firft problem; and the reader is made to imagine that he has got a rule for computing the variation, whereas all the rules of calculation are only running in a circle. The variation computed for the port of St Peter and Paul in Kamtfchatka, by the rule, is ten times greater than the truth. This is like the artifice of a book maker. We do not meet with any addition to our knowledge on the fubject. The author feems to know fomething of Euler's merit; but inftead of profecuting the fubject in his way, he gives us an uninterefting account of the furmifes of a number of obfcure writers about the difficulty of the tafk; and we think that Mr Churchman has left us as much in the dark as ever. The obfervation of the connection of the polarity of the needle with the aurora borealis occurred to the writer of this article as early as 1759, when a midfhipman on board the Royal William in the River St Laurence. Some of the gentlemen of the quarter-deck are ftill alive, and may remember this circumftance being pointed out to them one evening, when at anchor off the Ifle aux Coudres, during a very brilliant aurora borealis. The point of the heavens to which all the rays of light converged was precifely that which was oppofite to the fouth end of the dipping-needle. The obfervation was inferted in the St James's Chronicle, and afterwards (about 1776) in the London Chronicle, with a requeft to navigators to take notice of it, and communicate their obfervations.

For our own part, we have little hopes of this problem ever being fubjected to accurate calculation. We believe, indeed, that there is a cofmical change going on in the earth, which will produce a progreffive change in the variation of the needle: and we fee none more likely than Dr Halley's notion. There is nothing repugnant to our knowledge of the univerfe on the fuppofition of a magnetic nucleus revolving within this earth; and it is very eafy to conceive a very fimple motion of revolution, which fhall produce the very motion of the fenfible poles which Mr Churchman contends for. We need only fuppofe that the magnetical axis of this nucleus is not its axis of revolution. It may not even bifect that axis; and this circumftance will caufe the two poles to have different degrees of motion in relation to the fhell which furrounds it.

But this regular progrefs of the magnet within the earth may produce very irregular motions of the compafs needle, by the intervention of a third body fufceptible of magnetifm. The theory of which we have juft given a hint comes here to our affiftance. Suppofe NS (fig. 3.) to reprefent the primitive magnet in the earth, and *n s* to be a ftratum of iron-ore fufceptible of magnetifm. Alfo let *n′ s′* be another fmall mafs of a fimilar ore; and let their fituations and magnitudes be fuch as is exhibited in the figure. The fact will be, that *n* will be the north pole and *s* the fouth pole of the great ftratum, and *n′* and *s′* will be the north and fouth poles of the fmall mafs or loadftone. Any perfon may remove all doubts as to this, by making the experiment with a magnet NS, a piece of iron or foft tempered fteel *n s*, and another piece *n′ s′*. The well informed and attentive reader will eafily fee, that by fuch interventions every conceivable anomaly may be produced. While the great magnet makes a revolution in any direction, the needle will change its pofition gradually, and with a certain regularity; but it will depend entirely on the fize, fhape, and fituation, of thefe intervening maffes of magnetifable iron-ore, whether the change of variation of the compafs fhall be fuch as the primitive magnet alone would have produced, or whether it fhall be of a kind wholly different.

Now, that fuch intervening difturbances *may* exift, is paft contradiction. We know that even on the film of earth which we inhabit, and with which only we are acquainted, there are extenfive ftrata or otherwife difpofed maffes of iron-ores in a ftate fufceptible of magnetifm; and experiments made on bars of hard tempered fteel, and on bits of fuch ores, affure us that the magnetifm is not induced on fuch bodies in a moment, but propagated gradually along the mafs.—That fuch difturbances do actually exift, we have many relations. There are many inftances on record of very extenfive magnetic rocks, which affect the needle to very confiderable diftances. The ifland of Elba in the Mediterranean is a very remarkable inftance of this. The Ifland of Cannay alfo, on the weft of Scotland, has rocks which affect the needle at a great diftance.

A fimilar effect is obferved near the Feroe Iflands in the North Sea; the compafs has no determined direction when brought on fhore. *Journ. des Sçavans*, 1675, p. 174.

In Hudfon's Straits, in latitude 63°, the needle has hardly any polarity. *Ellis's Voyage to Hudfon's Bay*.

Bouguer obferved the fame thing in Peru. Nay, we believe that almoft all rocks, efpecially of whin or trappe ftone, contain iron in a proper ftate.

All this refers only to the thin cruft through which the human eye has occafionally penetrated. Of what may be below we are ignorant; but when we fee appearances which tally fo remarkably with what would be the effects of great maffes of magnetifed bodies, modifying the general and regularly progreffive action of a primitive magnet, whofe exiftence and motion is inconfiftent with nothing that we know

of

Variation. of this globe, this manner of accounting for the observed change of variation has all the probability that we can desire. Nay, we apprehend that very considerable changes may be produced in the direction of the compass needle even without the supposition of any internal motion. If the great magnet resembles many load stones we are acquainted with, having more than two poles, we know that these poles will act on each other, and gradually change each other's force, and consequently the direction of the compass. This process, to be sure, tends to a state of things which will change no more. —But the period of human history, or of the history of the race of Adam, may make but a small part of the history of this globe; and therefore this objection is of little force.

There can be no doubt of the operation of the general terrestrial magnetism on every thing susceptible of magnetic properties; and we cannot hesitate to explain in this way many changes of magnetic direction which have been observed. Thus, in Italy, Father de la Torré observed, that during a great eruption of Vesuvius the variation was 16° in the morning, at noon it was 14°, and in the evening it was 10°, and that it continued in that state till the lava grew so dark as no longer to be visible in the night; after which it slowly increased to 13½, where it remained. Daniel Bernoulli found the needle change its position 45′ by an earthquake. Professor Muller at Manheim observed that the declination of the needle in that place was greatly affected by the earthquake in Calabria. Such streams of lava as flowed from Hekla in the last dreadful eruption must have made a transference of magnetic matter that would considerably affect the needle. But no observations seem to have been made on the occasion; for we know that common iron-stone, which has no effect on the needle, will, by mere cementation with any inflammable substance, become magnetic. In this way Dr Knight sometimes made artificial loadstones.—But these are partial things, and not connected with the general change of variation now under consideration.

We have said so much on this subject, chiefly with the view of cautioning our readers against too sanguine expectations from any pretensions to the solution of this great problem. We may certainly gather from these observations, that even although the theory of the variation should be completed, we must expect (by what we already know of magnetism in general) that the disturbances of the needle, by local causes intervening between it and the great influence by which it is chiefly directed, may be so considerable as to affect the position of the compass needle in a very sensible manner: for we know that the metallic substances in the bowels of the earth are in a state of continual change, and this to an extent altogether unknown.

There is another irregularity of the mariner's needle that we have taken no notice of, namely, the daily variation. This was first observed by Mr George Graham in 1722 (*Philosophical Transactions*, n° 383), and reported to the Royal Society of London. It usually moves (at least in Europe) to the westward from 8 morning till 2 P. M. and then gradually returns to its former situation. The diurnal variations are seldom less than 0° 5′, and often much greater. Mr Graham mentions (*Philosophical Transactions*, n° 428) some observations by a Captain Hume, in a voyage to America, where he found the variation greatest in the afternoon. This being a general phenomenon, has also attracted the attention of philosophers. The most detailed accounts of it to be met with are those of Mr Canton, in *Philosophical Transactions*, Vol. LI. Part 1. p. 399, and those of Van Swinden, in his *Treatise on Electricity and Magnetism*.

It appears from Canton's observations, that although there be great irregularities in this diurnal change of position of the mariner's needle, there is a certain average, which is kept up with considerable steadiness. The following table shows the average of greatest daily change of position in the different months of the year, observed in Mr Canton's house, Spital Square, in 1759.

January	7′. 8″	July	13′.14″
Feburary	8 .58	August	12.19
March	11 .27	Sept.	11.43
April	12 .26	October	10.36
May	13 .—	Nov.	8. 9
June	13 .21	Dec.	6.58

Mr Canton attempts to account for these changes of position, by observing that the force of a magnet is weakened by heat. A small magnet being placed near a compass needle, ENE from it, so as to make it deflect 45° from the natural position, the magnet was covered with a brass vessel, into which hot water was poured. The needle gradually receded from the magnet ¼ths of a degree, and returned gradually to its place as the water cooled. This is confirmed by uniform experience.

The parts of the earth to the eastward are first heated in the morning, and therefore the force of the earth is weakened, and the needle is made to move to the westward. But as the sun warms the western side of the earth in the afternoon, the motion of the needle must take the contrary direction.

But this way of explaining by a change in the force of the earth supposes that the changing cause is acting in opposition to some other force. We do not know of any such. The force, whatever it is, seems simply to produce its own effect, in deranging the needle from the direction of terrestrial magnetism. If Æpinus's theory of magnetic action be admitted, *viz.* that a bar of steel has magnetism induced on it by propelling the quiescent and mutually repelling particles of magnetic fluid to one end, or attracting them to the other, we may suppose that the sun acts on the earth as a magnet acts on a piece of soft iron, and in the morning propels the fluid in the north-west parts. The needle directs itself to this constipated fluid, and therefore it points to the eastward of the magnetic north in the afternoon. And (to abide by the same theory) this induced magnetism will be somewhat greater when the earth is warmer; and therefore the diurnal variation will be greatest in summer. This change of position of the constipated fluid must be supposed to bear a very small ratio to the whole fluid, which is naturally supposed to be constipated in one pole of the great magnet in order to give it magnetism. Thus we shall have the diurnal variation a very small quantity. This is departing, however, from the principle of Mr Canton's explanation; and indeed we cannot see how the weakening the general force of the terrestrial magnet should make any change in the needle in respect to its direction; nor does it appear probable that the change of temperature produced by the sun will penetrate deep enough to produce any sensible effect on the magnetism. And if this be the cause, we think that the derangements of the needle should vary as the thermometer varies, which is not true. The other method of explaining is much better, if Æpinus's theory of magnetic attraction and repulsion be just; and we may suppose that it is only the secondary magnetism (*i. e.* that of the magnetisable menerals) that is sensibly affected by the heat; this will account very well for the greater mobility of the fluid in summer than in winter.

A great objection to either of these explanations is the prodigious diversity of the diurnal variations in different places. This is so very great, that we can hardly ascribe the diurnal variation to any change in the magnetism of the primitive

Variation, Variety.

primitive terrestrial magnet, and must rather look for its cause in local circumstances. This conclusion becomes more probable, when we learn that the deviation from the meridian and the deviation from the horizontal line are not affected at the same time. Van Swinden ascribes them solely to changes produced on the needles themselves. If their magnetism be greatly deranged by the sun's position, it may throw the magnetic centre away from the centre of the needle's motion, and thus may produce a very small change of position. But if this be the cause, we should expect differences in different needles. Van Swinden says, that there are such, and that they are very great; but as he has not specified them, we cannot draw any conclusion.

But, besides this regular diurnal variation, there is another, which is subjected to no rule. The aurora borealis is observed (in Europe) to disturb the needle exceedingly, sometimes drawing it several degrees from its position. It is always observed to increase its deviation from the meridian, that is, an aurora borealis makes the needle point more westerly. This disturbance sometimes amounts to six or seven degrees, and is generally observed to be greatest when the aurora borealis is most remarkable.

This is a very curious phenomenon, and we have not been able to find any connection between this meteor and the position of a magnetic needle. It is to be observed, that a needle of copper or wood, or any substance besides iron, is not affected. We long thought it an electric phenomenon, and that the needle was affected as any other body balanced in the same manner would be; but a copper needle would then be affected. Indeed it may still be doubted whether the aurora borealis be an electric phenomenon. They are very frequent and remarkable in Sweden; and yet Bergman says, that he never observed any electric symptoms about them, though in the mean time the magnetic needle was greatly affected.

We see the needle frequently disturbed both from its general annual position, and from the change made on it by the diurnal variation. This is probably the effect of auroræ boreales which are invisible, either on account of thick weather or day-light. Van Swinden says, he seldom or never failed to observe auroræ boreales immediately after any anomalous motion of the needle; and concluded that there had been one at the time, though he could not see it. Since no needle but a magnetic one is affected by the aurora borealis, we may conclude that there is some natural connection between this meteor and magnetism. This should farther incite us to observe the circumstance formerly mentioned, *viz.* that the south end of the dipping needle points to that part of the heavens where the rays of the aurora appear to converge. We wish that this were diligently observed in places which have very different variation and dip of the mariner's needle.

For the diurnal and this irregular variation, consult the Dissertations of Celsius and of Hiorter, in the *Memoirs of Stockholm*; Wargentin, *Philosophical Transactions*, Vol. 48. Braun (*Comment. Petropol. Novi*, T. V. VII. IX); Graham and Canton as above.

VARIETY, a change, succession, or difference, in the appearance or nature of things; in opposition to *uniformity*.

Variety, in botany, is a change in some less essential part or quality; as colour, size, pubescence or age.—Externally; by the plaiting or interweaving of the branches—by bundling or uniting of several stalks into one broad flat one; by the greater breadth, or narrowness, or curling of leaves—by becoming awnless, or smooth, or hirsute. Internally; by becoming mutilated in the corolla; or having one larger than ordinary—by luxuriancy, multiplication, or

Variety, Varnish.

fulness—by becoming proliferous, or crested—by bearing bulbs instead of seeds—or being viviparous.

The usual causes of variation are, climate, soil, exposure, heat, cold, winds, culture.

VARIOLA, the Small-pox. See Medicine, n° 222—224.

VARIX, in medicine, the dilatation of a vein, arising from the too great abundance or thickness of the blood.

VARNISH, a clear limpid fluid, capable of hardening without losing its transparency, used by painters, gilders, &c. to give a lustre to their works, to preserve them and defend them from the air.

A coat of varnish ought to possess the following properties: 1. It must exclude the action of the air; because wood and metals are varnished to defend them from decay and rust. 2. It must resist water; for otherwise the effect of the varnish could not be permanent. 3. It ought not to alter such colours as are intended to be preserved by this means. It is necessary therefore that a varnish should be easily extended or spread over the surface, without leaving pores or cavities; that it should not crack or scale; and that it should resist water. Now resins are the only bodies that possess these properties. Resins consequently must be used as the bases of varnish. The question which of course presents itself must then be, how to dispose them for this use? and for this purpose they must be dissolved, as minutely divided as possible, and combined in such a manner that the imperfections of those which might be disposed to scale may be corrected by others.

Resins may be dissolved by three agents. 1. By fixed oil. 2 By volatile oil. 3. By alcohol. And accordingly we have three kinds of varnish: the fat or oily varnish, essential varnish, and spirit varnish. Before a resin is dissolved in a fixed oil, it is necessary to render the oil drying. For this purpose the oil is boiled with metallic oxides; in which operation the mucilage of the oil combines with the metal, while the oil itself unites with the oxigene of the oxide. To accelerate the drying of this varnish, it is necessary to add oil of turpentine. The essential varnishes consist of a solution of resin in oil of turpentine. The varnish being applied, the essential oil flies off, and leaves the resin. This is used only for paintings. When resins are dissolved in alcohol, the varnish dries very speedily, and is subject to crack; but this fault is corrected by adding a small quantity of turpentine to the mixture, which renders it brighter, and less brittle when dry.

We shall now give the method of preparing a number of varnishes for different purposes.

A Varnish for Toilet-boxes, Cases, Fans, &c.—Dissolve two ounces of gum mastich and eight ounces of gum sandarach in a quart of alcohol; then add four ounces of Venice turpentine.

A Varnish for Wainscots, Cane-chairs, Iron-chairs, Grates.—Dissolve in a quart of alcohol eight ounces of gum sandarach, two ounces of seed lac, four ounces of rosin; then add six ounces of Venice turpentine. If the varnish is wished to produce a red colour, more of the lac and less of sandarach should be used, and a little *dragon's blood* should be added. This varnish is so thick that two layers of it are equal to four or five of another.

A Varnish for Fiddles and other Musical Instruments.—Put four ounces of gum sandarach, two ounces of lac, two ounces of gum mastich, an ounce of gum elemi, into a quart of alcohol, and hang them over a slow fire till they are dissolved; then add two ounces of turpentine.

Varnish in order to employ Vermilion for painting Equipages.—Dissolve in a quart of alcohol [illegible] of sandarach,

Varniſh. three ounces of gum lac, and four ounces of roſin; afterwards add ſix ounces of the cheapeſt kind of turpentine; mix with it a proper quantity of vermilion when it is to be uſed.

Gold-coloured Varniſh.—Pound ſeparately four ounces of ſtick lac, four ounces of gamboge, four ounces of dragon's blood, four ounces of anotta, and one ounce of ſaffron: put each of them ſeparately into a quart of alcohol, and expoſe them for five days in a narrow mouthed bottle to the ſun, or keep them during that time in a very warm room, ſhaking them every now and then to haſten the ſolution. When they are all melted, mix them together. More or leſs of each of theſe ingredients will give the different tints of gold according as they are combined. In order to make ſilver imitate gold exactly when covered with this varniſh, the quantity of ingredients muſt be ſomewhat greater. The method of gilding ſilver-leaf, &c. with this varniſh is as follows: The ſilver-leaf being fixed on the ſubject, in the ſame manner as gold-leaf, by the interpoſition of proper glutinous matters, the varniſh is ſpread upon the piece with a bruſh or pencil. The firſt coat being dry, the piece is again and again waſhed over with the varniſh till the colour appears ſufficiently deep. What is called *gilt leather*, and many picture-frames, have no other than this counterfeit gilding. Waſhing them with a little rectified ſpirit of wine affords a proof of this; the ſpirit diſſolving the varniſh, and leaving the ſilver leaf of its own whiteneſs. For plain frames, thick tin-foil may be uſed inſtead of ſilver. The tin-leaf, fixed on the piece with glue, is to be burniſhed, then poliſhed with emery and a fine linen cloth, and afterwards with putty applied in the ſame manner: being then lacquered over with the varniſh five or ſix times, it looks very nearly like burniſhed gold. The ſame varniſh, made with a leſs proportion of the colouring materials, is applied alſo on works of braſs; both for heightening the colour of the metal to a reſemblance with that of gold, and for preſerving it from being tarniſhed or corroded by the air.

Oil Varniſhes.—Gum copal and amber are the ſubſtances principally employed in oil varniſhes; they poſſeſs the properties neceſſary for varniſhes, ſolidity and tranſparency.—The copal being whiteſt, is uſed for varniſhing light, the amber for dark colours. It is beſt to diſſolve them before mixing them with the oil, becauſe by this means they are in leſs danger of being ſcorched, and at the ſame time the varniſh is more beautiful. They ſhould be melted in a pot on the fire; they are in a proper ſtate for receiving the oil when they give no reſiſtance to the iron ſpatula, and when they run off from it drop by drop. The oil employed ſhould be a drying oil, and perfectly free from greaſe. It ſhould be poured into the copal or amber by little and little, conſtantly ſtirring the ingredients at the ſame time with the ſpatula. When the oil is well mixed with the copal or amber, take it off the fire; and when it is pretty cool, pour in a greater quantity of the eſſence of turpentine than the oil that was uſed. After the varniſh is made, it ſhould be paſſed through a linen cloth. Oil varniſhes become thick by keeping; but when they are to be uſed, it is only neceſſary to pour in a little eſſence of turpentine, and to put them for a little on the fire. The turpentine is neceſſary in oil varniſhes to make them dry properly; generally twice as much of it is uſed as of oil. Leſs is neceſſary in ſummer than in winter. Too much oil hinders the varniſh from drying; but when too little is uſed, it cracks and does not ſpread properly. We ſhall ſubjoin the moſt uſeful oil varniſhes:

White Copal Varniſh.—On 16 ounces of melted copal pour four, ſix, or eight ounces of linſeed oil, boiled and quite free from greaſe. When they are well mixed, take them off the fire (not forgetting to ſtir them properly); and when pretty cool, pour in 16 ounces of the eſſence of Venice turpentine. Paſs the varniſh through a cloth.—Amber varniſh is made in the ſame way.

Black Varniſh for Coaches and Iron Work.—This varniſh is compoſed of bitumen of Paleſtine, roſin, and amber, melted ſeparately, and afterwards mixed; the oil is then added, and afterwards the turpentine, as directed above. The uſual proportions are, 12 ounces of amber, two ounces of roſin, two ounces of bitumen, ſix of oil, and 12 of the eſſence of turpentine.—Golden-coloured varniſh may be made alſo by ſubſtituting linſeed oil for alcohol.

Eſſential Oil Varniſhes.—The only eſſential oil varniſhes uſed are for pictures. Picture varniſhes ſhould be white, light, and quite tranſparent, which will preſerve the colours without giving them any diſagreeable tint; and it ſhould be poſſible to take them off the picture without injuring it. They are uſually made of gum maſtich and turpentine diſſolved together in ſome eſſential oil. The varniſh is paſſed through a cloth, and allowed to clarify. It is applied cold to the picture.

Varniſh for Glaſs, in order to preſerve it from the Rays of the Sun.—Pulveriſe a quantity of gum adragant, and let it diſſolve for 24 hours in the white of eggs well beat up; then rub it gently on the glaſs with a bruſh.

Varniſhes before they are uſed ſhould be carefully kept from duſt, which would ſpoil them; and they ſhould be kept in a veſſel quite clean and dry. When uſed, they ſhould be lifted lightly with a bruſh, and ſpread upon a ground altogether free from dirt and moiſture. The ſubſtance, after being varniſhed, ſhould be expoſed to the heat of the ſun, or placed in a warm room covered with a glaſs caſe, to keep out all filth. Oil varniſhes require more heat than alcohol varniſhes. The varniſh ſhould be put on very quickly, making great ſtrokes with the pencil or bruſh, taking care that theſe ſtrokes never croſs one another; it ſhould be ſpread equally, and never thicker than a leaf of paper; a ſecond coat ſhould not be put on till the firſt is quite dry. If the varniſh, after being put on, becomes dull and uneven, it muſt be taken off entirely, and new varniſh put on.

When wainſcot is to be varniſhed, it is firſt painted of a wooden colour. This colour is made by infuſing in water either red or yellow ochre (according to the colour wiſhed for), terra ombria (a kind of ochre) and white lead; into this as much as neceſſary is put of *parchment paſte.* Two thin coats of this are to be put on, and, after they are quite dry, the varniſh.

Varniſhes are poliſhed with pumice-ſtone and tripoli earth. The pumice-ſtone muſt be reduced to an impalpable power, and put upon a piece of ſerge moiſtened with water; with this the varniſhed ſubſtance is to be rubbed lightly and equally. The tripoli muſt alſo be reduced to a very fine powder, and put upon a clean woollen cloth moiſtened with olive oil, with which the poliſhing is to be performed. The varniſh is then to be wiped with ſoft linen, and, when quite dry, cleaned with ſtarch or Spaniſh white, and rubbed with the palm of the hand or with a linen cloth.

To recover colours or varniſh, and to take off the dirt and filth which may adhere to them, a ley is uſed made of potaſh and the aſhes of lees of wine. Take 48 ounces of potaſh, and 16 of the above-mentioned aſhes, and put them into ſix quarts of water, and the ley is made: inſtead of the aſhes an equal quantity of potaſh would probably do as well. To clean dirty colours, dilute ſome of this ley with four times its quantity of water, and rub the picture with it; then waſh it with river water; and when dry, give it a

coat

coat or two of varniſh. In order to take off a varniſh, waſh it with the above mentioned ley, then with water, and then lift it off the ſubſtance on which it was with any iron inſtrument.—We ſhall finiſh this article with a deſcription of the famous Chineſe varniſh.

The Chineſe varniſh is not a compoſition, but a reſin which exudes from a tree called in China *tſi-chu*, "varniſh tree." This tree grows in ſeveral provinces of the ſouthern parts of China. The Chineſe take the following method of propagating this tree: In ſpring they chooſe a vigorous ſhoot about a foot in length, which proceeds immediately from the trunk; and coat over the lower part, by which it adheres to the tree, with a kind of yellow earth, at leaſt three inches in thickneſs. This coat is carefully covered with a mat, to defend it from rain and the injuries of the air. Towards the autumnal equinox they detach a little of the earth, to obſerve in what condition the ſmall roots are, which begin to ſpring forth from the ſhoot. If they find that the filaments which compoſe them are of a reddiſh colour, they judge it is time to make an amputation; but they defer it if the roots are white, becauſe this colour ſhows that they are yet too tender: they then cloſe up the coat again, and wait till the ſpring following. When the ſhoot is ſeparated from the trunk of the tree, it is put into the earth; but in whatever ſeaſon it is planted, whether in ſpring or autumn, great care muſt be taken to put plenty of cinders into the hole prepared for it; without this precaution the ants would deſtroy the yet tender roots, or at leaſt deprive them of all their moiſture, and cauſe them to decay.

The Chineſe do not procure varniſh from the tſi-chu until its trunk is nearly five inches in diameter, which ſize it ſeldom attains to before ſeven or eight years. Varniſh extracted from a tree ſmaller or of leſs age would not have the ſame body and ſplendor. This liquor diſtils only in the night-time, and during the ſummer ſeaſon. To cauſe the gum to flow, they make ſeveral rows of inciſions round the trunk, the number of which is proportioned to the vigour of the tree. The firſt row is ſeven inches from the earth, and the reſt are at the ſame diſtance one from the other, and continue to the top of the trunk, and even ſometimes on the boughs which are of a ſufficient ſtrength and ſize. The Chineſe uſe a crooked iron for making theſe inciſions, which muſt run a little obliquely, and be equal in depth to the thickneſs of the bark; they make them with one hand, and with the other hold a ſhell, the edges of which they inſert into the opening, where it remains without any ſupport. Theſe inciſions are made towards evening, and next morning they collect the varniſh which has fallen into the ſhells; the following evening they are again inſerted, and this operation is continued until the end of ſummer. A thouſand trees yield almoſt in one night 20 pounds of varniſh.

While the varniſh diſtils, it exhales a malignant vapour, the bad effects of which can only be prevented by preſervatives and great precaution. The merchant who employs the workmen is obliged to keep by him a large vaſe filled with rape-oil, in which a certain quantity of thoſe fleſhy filaments have been boiled that are found in hog's lard, and which do not melt. When the workmen are going to fix the ſhells to the trees, they carry ſome of this oil along with them, and rub their face and hands with it, which they do with greater care when they collect in the morning the varniſh that has diſtilled during night. After eating, they waſh their whole bodies with warm water, in which the bark of the cheſnut-tree, fir-wood, cryſtalliſed ſaltpetre, and ſome other drugs, have been boiled. When they are at work near the trees, they put upon their heads a ſmall cloth bag in which there are two holes, and cover the fore-part of their bodies with a kind of apron made of doe-ſkin, which is ſuſpended from their necks with ſtrings, and tied round them with a girdle. They alſo wear boots, and have coverings on their arms, made of the ſame kind of ſkin. The labourer who ſhould attempt to collect varniſh without uſing this precaution, would ſoon be puniſhed for his raſhneſs, and the moſt dreadful effects would enſue. The diſorder ſhows itſelf by tetters, which become of a bright red colour, and ſpread in a very ſhort time; the body afterwards ſwells, and the ſkin burſts and appears covered with an univerſal leproſy. The unhappy wretch could not long endure the excruciating pains which he feels, did he not find a ſpeedy remedy in thoſe preſervatives which are uſed againſt the malignant and noxious exhalations of the varniſh.

The ſeaſon of collecting varniſh being ended, the merchant puts it into ſmall caſks cloſely ſtopped. A pound of it newly made coſts him about one ſhilling and eight pence Sterling; but he gains *cent. per cent.* upon it, and ſometimes more, according to the diſtance of the place to which he tranſports it.

Beſides the luſtre and beauty which that varniſh gives to many of the Chineſe manufactures, it has alſo the property of preſerving the wood upon which it is laid, eſpecially if no other matter be mixed with it. It prevents it from being hurt either by dampneſs or worms.

Every workman has a particular art and method of uſing the varniſh. This work requires not only much ſkill and dexterity, but alſo great attention, to obſerve the proper degree of fluidity which the gum ought to have, as it muſt be neither too thick nor too liquid when it is laid on. Patience above all is neceſſary in thoſe who wiſh to ſucceed. To be properly varniſhed, a work muſt be done at leiſure; and a whole ſummer is ſcarcely ſufficient to bring it to perfection. It is therefore rare to ſee any of thoſe cabinets which are imported to us from Canton ſo beautiful and durable as thoſe manufactured in Japan, Tong-king, and Nan-king, the capital of the province of Kiang-nan: not that the artiſts do not employ the ſame varniſh; but as they work for Europeans, who are more eaſily pleaſed, they do not take the trouble of giving the pieces which come from their hands all the poliſh they are capable of receiving.

There are two methods of laying on the varniſh; the ſimpleſt is, when it is immediately laid on the wood. The work is firſt poliſhed, and then daubed over with a kind of oil which the Chineſe call *tong-yeou*. When this oil is dry, it receives two or three coats of varniſh; which remain ſo tranſparent, that all the ſhades and veins of the wood may be ſeen through them. If the artiſt is deſirous of entirely concealing the ſubſtance on which they are laid, nothing is neceſſary but to add a few more coats; theſe give the work a ſhining ſurface, the ſmoothneſs of which equals that of the moſt beautiful ice. When the work is dry, various figures are painted upon it in gold and ſilver, ſuch as flowers, birds, trees, temples, dragons, &c. A new coat of varniſh is then ſometimes laid over theſe figures, which preſerves them, and adds much to their ſplendor. The ſecond method requires more preparation. The Chineſe workmen fix to the wood by means of glue a kind of paſteboard, compoſed of paper, hemp, lime, and other ingredients, well beaten, that the varniſh may incorporate with them. Of this they make a ground perfectly ſmooth and ſolid, over which the varniſh is laid in thin coats, that are left to dry one after the other.

It often happens, that the luſtre of varniſhed tables and other pieces of furniture is inſenſibly deſtroyed by tea and warm liquors. "The ſecret of reſtoring to varniſh its ſhi-

ning black colour (says a Chinese author) is to expose it for one night to a white hoar-frost, or to cover it some time with snow." For a method of imitating *Chinese varnish*, see Turning.

Varnish also signifies a sort of shining coat, wherewith potter's ware, delft ware, china-ware, &c. are covered, which gives them a smoothness and lustre. Melted lead is generally used for the first, and smalt for the second. See Glazing.

Varnish, among medalists, signifies the colours antique medals have acquired in the earth.

The beauty which nature alone is able to give to medals, and art has never yet attained to counterfeit, enhances the value of them: that is, the colour which certain soils in which they have a long time lain tinges the metals withal: some of which are blue, almost as beautiful as the torquoise; others with an inimitable vermilion colour; others with a certain shining polished brown, vastly finer than Brasil figures.

The most usual varnish is a beautiful green, which hangs to the finest strokes without effacing them, more accurately than the finest enamel does on metals.

No metal but brass is susceptible of this; for the green rust that gathers on silver always spoils it, and it must be got off with vinegar or lemon juice.

Falsifiers of medals have a false or modern varnish, which they use on their counterfeits, to give them the appearance or air of being antique. But this may be discovered by its softness; it being softer than the natural varnish, which is as hard as the metal itself.

Some deposit their spurious metals in the earth for a considerable time, by which means they contract a sort of varnish, which may impose upon the less knowing; others use sal ammoniac, and others burnt paper.

VARRO (Marcus Terentius), the most learned of all the Romans, was born 28 years B. C. He was a senator of the first distinction, both for birth and merit; and bore many great offices. He was an intimate friend of Cicero; and this friendship was confirmed and immortalized by a mutual dedication of their learned works to each other. Thus Cicero dedicated his Academic Questions to Varro; and Varro dedicated his treatise on the Latin tongue to Cicero. In the civil wars he was zealously attached to Pompey; but after his defeat soon submitted to Cæsar, who was reconciled to him. Afterwards he applied his whole time to letters, and had the charge of the Greek and Latin libraries at Rome. He was above 70 when Antony proscribed him; however, he found means to escape and save his life, though he could not save some of his works and his library from being plundered by the soldiers. After this storm was over, he pursued his studies as usual; and Pliny relates, that he continued to study and to write when he was 88 years of age. He was 80 when he wrote his three books *De re Rustica*, which are still extant. Five of his books *De lingua Latina*, which he addressed to Cicero, are also extant. There remain, too, divers fragments of his works, particularly of his Menippean Satires, which are medleys of prose and verse; and Scalliger has collected some of his epigrams from among the *Catalecta Virgilii*. His books *De lingua Latina*, and *De re Rustica*, were printed with the notes of Joseph Scaliger, Turnebus, and Victorius, by Henry Stephens at Paris, 1573, in 8vo, and have been published separately since among the *Auctores de lingua Latina*, and the *Auctores de re Rustica*.

There was another Varro of antiquity, called *Atacinus*, who was born about 10 years after the first, at a small town near Narbonne. Though infinitely below the Roman in learning, he was at least as good, if not a better, poet; which perhaps has made Lilius Gyraldus and other critics confound them. He composed many works in verse; some fragments of which were collected, and published with those of other ancient poets, at Lyons in 1603. His chief works were, A poem on the war with the Sequani, a people of Gaul; and the Astronomics, that went under the name of Planciades the grammarian. But the *Argonautics*, in four books, was what gained him the greatest reputation: and though indeed nothing but a translation of Apollonius Rhodius, yet was so well done as to be commended by Quintilian.

VARRONIA, in botany: A genus of plants belonging to the class of *pentandria*, and to the order of *monogynia*; and arranged in the natural system under the 41st order, *Asperifoliæ*. The corolla is quinquifid; the fruit a drupa, with a quadrilocular kernel. There are six species; none of which are natives of Britain.

VASCULAR, something consisting of divers vessels, as arteries, veins, &c.

VASE, a term frequently used for ancient vessels dug from under ground, or otherwise found, and preserved in the cabinets of the curious. In architecture, the appellation *vase* is also given to those ornaments placed on corniches, sochles, or pedestals, representing the vessels of the ancients, particularly those used in sacrifice, as incense-pots, flower-pots, &c. See *Portland-Vase*.

VASSAL, in our ancient customs, signified a tenant or feudatory; or person who vowed fidelity and homage to a lord, on account of some land, &c. held of him in fee; also a slave or servant, and especially a domestic of a prince.—*Vassalus* is said to be *quasi inferior socius*: as the vassal is inferior to his master, and must serve him; and yet he is in a manner his companion, because each of them is obliged to the other. See *Feodal-System*.

VATICAN, a magnificent palace of the pope, in Rome, which is said to consist of several thousand rooms: but the parts of it most admired are the grand staircase, the pope's apartment, and especially the library, which is one of the richest in the world, both in printed books and manuscripts.

VAUBAN (Sebastian le Prestre, seigneur de), marshal of France, and the greatest engineer that country ever produced, was born in 1633. He displayed his knowledge of fortification in the course of many sieges, and his services were rewarded with the first military honours. He was made governor of Lisle in 1668, commissary-general of the fortifications of France in 1678, governor of the maritime parts of Flanders in 1689, and a marshal of France in 1703. He died in 1707, after having brought the arts of attacking and defending fortified places to a degree of perfection unknown before. His writings on these subjects are in the highest esteem.

VAUDOIS, Valdenses, or *Waldenses*, in ecclesiastical history, a name given to a sect of reformers, who made their first appearance about the year 1160.

The origin of this famous sect, according to Mosheim, was as follows: Peter, an opulent merchant of Lyons, surnamed *Valdensis*, or *Validisius*, from Vaux or Waldum, a town in the marquisate of Lyons, being extremely zealous for the advancement of true piety and Christian knowledge, employed a certain priest called *Stephanus de Evisa*, about the year 1160, in translating from Latin into French the four Gospels, with other books of Holy Scripture, and the most remarkable sentences of the ancient doctors, which were so highly esteemed in this century. But no sooner had he perused these sacred books with a proper degree of attention, than he perceived that the religion which was now taught in the Roman church, differed totally from that which was originally inculcated by Christ and his apostles.

Struck with this glaring contradiction between the doctrines of the pontiffs and the truths of the Gospel, and animated with zeal, he abandoned his mercantile vocation, distributed his riches among the poor (whence the Waldenses were called *poor men of Lyons*), and forming an association with other pious men, who had adopted his sentiments and his turn of devotion, he began in the year 1180 to assume the quality of a public teacher, and to instruct the multitude in the doctrines and precepts of Christianity.

Soon after Peter had assumed the exercise of his ministry, the archbishop of Lyons, and the other rulers of the church in that province, vigorously opposed him. However, their opposition was unsuccessful; for the purity and simplicity of that religion which these good men taught, the spotless innocence that shone forth in their lives and actions, and the noble contempt of riches and honours which was conspicuous in the whole of their conduct and conversation, appeared so engaging to all such as had any sense of true piety, that the number of their followers daily increased.—They accordingly formed religious assemblies, first in France, and afterwards in Lombardy, from whence they propagated their sect throughout the other provinces of Europe with incredible rapidity, and with such invincible fortitude, that neither fire, nor sword, nor the most cruel inventions of merciless persecution, could damp their zeal, or entirely ruin their cause.

The attempts of Peter Waldus and his followers were neither employed nor designed to introduce new doctrines into the church, nor to propose new articles of faith to Christians. All they aimed at was, to reduce the form of ecclesiastical government, and the manners both of the clergy and people, to that amiable simplicity and primitive sanctity that characterised the apostolic ages, and which appear so strongly recommended in the precepts and injunctions of the divine Author of our holy religion. In consequence of this design, they complained that the Roman church had degenerated, under Constantine the Great, from its primitive purity and sanctity. They denied the supremacy of the Roman pontiff, and maintained, that the rulers and ministers of the church were obliged, by their vocation, to imitate the poverty of the apostles, and to procure for themselves a subsistence by the work of their hands. They considered every Christian as, in a certain measure, qualified and authorised to instruct, exhort, and confirm the brethren in their Christian course, and demanded the restoration of the ancient penitential discipline of the church, *i. e.* the expiation of transgressions by prayer, fasting, and alms, which the new-invented doctrine of indulgences had almost totally abolished. They at the same time affirmed, that every pious Christian was qualified and entitled to prescribe to the penitent the kind or degree of satisfaction or expiation that their transgressions required; that confession made to priests was by no means necessary, since the humble offender might acknowledge his sins, and testify his repentance, to any true believer, and might expect from such the counsel and admonition which his case demanded. They maintained, that the power of delivering sinners from the guilt and punishment of their offences belonged to God alone; and that indulgences of consequence were the criminal inventions of sordid avarice. They looked upon the prayers and other ceremonies that were instituted in behalf of the dead, as vain, useless, and absurd, and denied the existence of departed souls in an intermediate state of purification; affirming, that they were immediately, upon their separation from the body, received into heaven, or thrust down to hell. These, and other tenets of a like nature, composed the system of doctrine propagated by the Waldenses. It is also said that several of the Waldenses denied the obligation of infant-baptism, and that others rejected water-baptism entirely; but Wall has laboured to prove that infant-baptism was generally practised among them.

Their rules of practice were extremely austere; for they adopted as the model of their moral discipline the sermon of Christ on the mount, which they interpreted and explained in the most rigorous and literal manner, and consequently prohibited and condemned in their society all wars, and suits of law, and all attempts towards the acquisition of wealth, the inflicting of capital punishments, self-defence against unjust violence, and oaths of all kinds.

During the greatest part of the 17th century, those of them who lived in the valleys of Piedmont, and who had embraced the doctrine, discipline, and worship of the church of Geneva, were oppressed and persecuted, in the most barbarous and inhuman manner, by the ministers of Rome. This persecution was carried on with peculiar marks of rage and enormity in the years 1655, 1656, and 1696, and seemed to portend nothing less than the total extinction of that unhappy nation. The most horrid scenes of violence and bloodshed were exhibited in this theatre of papal tyranny; and the few Waldenses that survived were indebted for their existence and support to the intercession made for them by the English and Dutch governments, and also by the Swiss cantons, who solicited the clemency of the duke of Savoy in their behalf.

VAULT, in architecture, an arched roof, so contrived that the stones which form it sustain each other.

Vaults are on many occasions to be preferred to soffits or flat ceilings, as they give a greater height and elevation, and are besides more firm and durable.

VAYER. See Mothe.

VAYVODE, or Vaivode. See Waywode.

UBES (St), a sea-port town of Portugal, in the province of Estremadura, seated on a bay of the Atlantic Ocean, 21 miles south of Lisbon. It stands on an eminence, with a very strong castle built on a rock. The soil about it is fertile in corn, wine, and fruits; and it is furnished with good fish from the sea, and a small lake in the neighbourhood. Here they make great quantities of fine salt, which is carried to the American plantations. E. Long. 8. 54. N. Lat. 38. 22.

UBIQUITARIANS, formed from *ubique*, "every where," in ecclesiastical history, a sect of Lutherans which rose and spread itself in Germany; and whose distinguishing doctrine was, that the body of Jesus Christ is every where, or in every place.

Brentius, one of the earliest reformers, is said to have first broached this error, in 1560. Luther, in the heat of his controversy with Zuinglius, had thrown out some unguarded expressions, that seemed to imply a belief of the omnipresence of the body of Christ; but he became sensible afterwards, that this opinion was attended with great difficulties, and particularly that it ought not to be made use of as a proof of Christ's corporeal presence in the eucharist. However, after the death of Luther, this absurd hypothesis was renewed, and dressed up in a specious and plausible form by Brentius, Chemnitius, and Andræas, who maintained the communication of the properties of Christ's divinity to his human nature. It is indeed obvious, that every Lutheran who believes the doctrine of consubstantiation (see *Supper of the Lord*), whatever he may pretend, must be an Ubiquitarian.

UBIQUITY, Omnipresence; an attribute of the Deity, whereby he is always intimately present to all things; gives the *esse* to all things; knows, preserves, and does all in all things.

UDDER, in comparative anatomy, that part in br-

wherein the milk is prepared, answering to the mammæ or breasts in women. See COMPARATIVE ANATOMY, n 44.

VEDAS, the sacred books of the Hindoos, believed to be revealed by God, and called *immortal*. They are considered as the fountain of all knowledge human and divine, and are four in number; of which we have the following account in the first volume of the Asiatic Researches: The *Rigveda* consists of five sections; the *Yajurveda* of eighty-six; the *Samaveda* of a thousand; and the *Atharvaveda* of nine; with eleven hundred *sac'ha's*, or branches, in various divisions and subdivisions. The *Veda's* in truth are infinite; but have been long reduced to this number and order: the principal part of them is that which explains the duties of man in a methodical arrangement; and in the fourth is a system of divine ordinances.

From these are reduced the four *Upavedas*, the first of which was delivered to mankind by BRAHMA, INDRA, DHANWANTARI, and five other deities; and comprizes the theory of disorders and medicines, with the practical methods of curing diseases.

The second consists of music, invented for the purpose of raising the mind by devotion to the felicity of the Divine nature; the third treats of the fabrication and use of arms; and the fourth of *sixty-four* mechanical arts. Of however little value we may esteem the mechanical arts of the Hindoos, and however despicable their theological system may really be, the *Upaveda*, which treats of diseases and the method of curing them, surely deserves to be studied by every European physician practising in India. There are indeed a great number of medical books in the Shanscrit language worthy of attention; for though the theories of their authors may be groundless and whimsical, they contain the names and description of many Indian plants and minerals, with their uses, discovered by *experience*, in the cure of diseases.

VEDETTE, in war, a centinel on horseback, with his horse's head towards the place whence any danger is to be feared, and his carabine advanced, with the butt-end against his right thigh. When the enemy has encamped, there are vedettes posted at all the avenues, and on all the rising grounds, to watch for its security.

To VEER *and* HAUL, to pull a rope tight, by drawing it in and slackening it alternately, till the body to which it is applied acquires an additional motion, like the increased vibrations of a pendulum, so that the rope is straitened to a greater tension with more facility and dispatch. This method is particularly used in hauling the bowlines.

The wind is said to veer and haul when it alters its direction, and becomes more or less fair. Thus it is said to veer aft and to haul forward.

VEER, *Ter-Veer*, anciently *Camp-Veer*, a town of Zealand in the United Provinces, standing at the mouth of the East Schelde, about four miles from Middleburgh, and eight from Flushing. Veer, in Dutch, signifies a passage or ferry over an arm of the sea or a river; and as there was once a ferry here over the Schelde to the village of Compen, on the island of North Beveland, the town thereby got the name of *Veer*, *Camp-Veer*, and *Ter-Veer*. It is well fortified, and formerly enjoyed a good trade, especially to Scotland; the natives enjoying particular privileges here. The harbour is very good, and the arsenal the best furnished in the world. Hence the Veres, anciently earls of Oxford, are said to have derived both their origin and name.

VEERING, or WEARING, the operation by which a ship, in changing her course from one board to the other, turns her stern to windward. Hence it is used in opposition to TACKING, wherein the head is turned to the wind and the stern to leeward. See SEAMANSHIP, Vol. XVII. p. 219.

VEGA (Lopez de), a celebrated Spanish poet. He was the son of Felix de Vega and Francisca Fernandez, who were both descended from honourable families, and lived in the neighbourhood of Madrid. Our poet was born in that city on the 25th of November 1562. He was, according to his own expression, a poet from his cradle; and beginning to make verses before he had learned to write, he used to bribe his elder school-fellows with part of his breakfast, to commit to paper the lines he had composed. Having lost his father while he was yet still a child, he engaged in a frolic very natural to a lively boy, and wandered with another lad to various parts of Spain, till, having spent their money, and being conducted before a magistrate at Segovia for offering to sell a few trinkets, they were sent home again to Madrid. Soon after this adventure, our young poet was taken under the protection of Geronimo Manrique, bishop of Avila, and began to distinguish himself by his dramatic compositions, which were received with great applause by the public, though their author had not yet completed his education; for, after this period, he became a member of the university of Alcala, where he devoted himself for four years to the study of philosophy. He was then engaged as secretary to the duke of Alva, and wrote his Arcadia in compliment to that patron: who is frequently mentioned in his occasional poems. He quitted that employment on his marriage with Isabel de Urbina, a lady (says his friend and biographer Perez de Montalvan) beautiful without artifice, and virtuous without affectation. His domestic happiness was soon interrupted by a painful incident:—Having written some lively verses in ridicule of a person who had taken some injurious freedom with his character, he received a challenge in consequence of his wit; and happening, in the duel which ensued, to give his adversary a dangerous wound, he was obliged to fly from his family, and shelter himself in Valencia. He resided there a considerable time; but connubial affection recalled him to Madrid. His wife died in the year of his return. His affliction on this event led him to relinquish his favourite studies, and embark on board the Armada which was then preparing for the invasion of England. He had a brother who served in that fleet as a lieutenant; and being shot in an engagement with some Dutch vessels, his virtues were celebrated by our afflicted poet, whose heart was peculiarly alive to every generous affection. After the ill success of the Armada, the disconsolate Lopez de Vega returned to Madrid, and became secretary to the Marquis of Malpica, to whom he has addressed a grateful sonnet. From the service of this patron he passed into the household of the Count of Lemos, whom he celebrates as an inimitable poet. He was once more induced to quit his attendance on the great, for the more inviting comforts of a married life. His second choice was Juana de Guardio, of noble birth and singular beauty. By this lady he had two children, a son who died in his infancy, and a daughter named *Feliciana*, who survived her father. The death of his little boy is said to have hastened that of his wife, whom he had the misfortune to lose in about seven years after his marriage. Having now experienced the precariousness of all human enjoyments, he devoted himself to a religious life, and fulfilled all the duties of it with the most exemplary piety: still continuing to produce an astonishing variety of poetical compositions. His talents and his virtues procured him many unsolicited honours. Pope Urban VIII. sent him the cross of Malta, with the title of Doctor in Divinity, and appointed him to a place of profit in the Apostolic Chamber; favours for which he

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expressed his gratitude by dedicating his *Corona Tragica* (a long poem on the fate of Mary Queen of Scots) to that liberal pontiff. In his 73d year he felt the approaches of death, and prepared himself for it with the utmost composure and devotion. His last hours were attended by many of his intimate friends, and particularly his chief patron the Duke of Sessa, whom he had made his executor; leaving him the care of his daughter Feliciana, and of his various manuscripts. The manner in which he took leave of those he loved was most tender and affecting. He said to his disciple and biographer Montalvan, That true fame consisted in being good; and that he would willingly exchange all the applauses he had received to add a single deed of virtue to the actions of his life. Having given his dying benediction to his daughter, and performed the last ceremonies of his religion, he expired on the 25th of August 1635.

VEGETATION, in physiology, the act whereby plants receive nourishment and growth.

The process of nature in the vegetation of plants is very accurately delivered by Malpighi: The egg or seed of the plant being excluded out of the ovary, called *pod* or *husk*, and requiring further fostering and brooding, is committed to the earth; which having received it into her fertile bosom, not only does the office of incubation by her own warm vapours and exhalation, joined with the heat of the sun, but by degrees supplies what the seed requires for its further growth; as abounding everywhere with canals and sinuses, wherein the dew and rain water, impregnated with fertile salts, glide, like the chyle and blood in the arteries, &c. of animals. This moisture meeting with a new-deposited seed, is percolated, or strained through the pores or pipes of the outer rind or husk, corresponding to the secundines of the fœtuses, on the inside whereof lies one or more, commonly two, thick seminal leaves, answering to the placenta in women, and the cotyledons in brutes.

These seed-leaves consist of a great number of little vesiculæ, or bladders, with a tube corresponding to the navel-string in animals. In these vesiculæ is received the moisture of the earth, strained through the rind of the seed; which makes a slight fermentation with the proper juice before contained therein. This fermented liquor is conveyed by the umbilical vessel to the trunk of the little plant; and to the germ or bud which is contiguous thereto: upon which a vegetation and increase of the parts succeed.

Such is the procedure in the vegetation of plants: which the illustrious author exemplifies in a grain of wheat, as follows: The first day the grain is sown it grows a little turgid; and the secundine, or husk, gapes a little in several places: and the body of the plant, being continued by the umbilical vessel to a conglobated leaf (which is called the *pulp* or *flesh* of the seed, and is what constitutes the flower) swells; by which means, not only the germ or sprout (which is to be the future stem) opens, and waxes green, but the roots begin to bunch out; whence the placenta, or seed-leaf, becoming loose, gapes. The second day, the secundine or husk, being broke through, the stem, or top of the future straw, appears on the outside thereof, and grows upward by degrees; in the mean time, the seed-leaf guarding the roots becomes turgid with its vesiculæ, and puts forth a white down. And the leaf being pulled away, you see the roots of the plants bare; the future buds, leaves, and rest of the stalk, lying hid. Between the roots and the ascending stem the trunk of the plant is knit by the navel-knot to the flower-leaf, which is very moist, though it still retains its white colour and its natural taste. The third day, the pulp of the conglobated, or round leaf, becomes turgid with the juice which it received from the earth fermenting with its own.

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Thus the plant increasing in bigness, and its bud or stem becoming taller, from whitish turns greenish; the lateral roots also break forth greenish and pyramidal from the gaping sheath, which adheres chiefly to the plant; and the lower root grows longer and hairy, with many fibres shooting out of the same.

Indeed there are hairy fibres hanging all along on all the roots, except on their tips; and these fibres are seen to wind about the saline particles of the soil, little lumps of earth, &c. like ivy; whence they grow curled. Above the lateral roots there now break out two other little ones.

The fourth day, the stem mounting upwards, makes a right angle with the seminal leaf: the last roots put forth more; and the other three growing larger, are clothed with more hairs, which straitly embrace the lumps of earth; and where they meet with any vacuity, unite into a kind of network.

From this time forward the root pushes with more regularity downward, and the stalk upward, than before. There is, however, this great difference in their growth, that the stalk and branches find no resistance to their shooting up, while the roots find a great deal to their shooting downward, by means of the solidity of the earth; whence the branches advance much faster and farther in their growth than the roots; and these last often finding the resistance of a tough earth unsurmountable, turn their course, and shoot almost horizontally.

From a number of experiments made by Mr Gough, and related by him in the fourth volume of the Manchester Transactions, it appears, that seeds will not vegetate without air; and that during their vegetation, they absorb oxygen, part of which they retain, and that carbonic acid is formed with the rest. These facts were ascertained in the following manner: He put several parcels of steeped peas and barley, at different times, into phials, which were left to stand for three or four minutes in spring water, of the heat of 46, 5°, to reduce them to a known temperature. They were then securely corked, and removed into a room, the temperature of which was never less than 53°. After remaining from four to six days in this situation, they were again placed in the same spring water, and opened in an inverted position, care being taken that the barometer stood at the time nearly where it did at first. When a cork was thus drawn, a quantity of water rushed in immediately, more than was sufficient to fill the neck. The air being passed through lime water, contracted very sensibly, and precipitated the lime. The residuum, freed in this manner from carbonic acid, extinguished a lighted taper like water; and this it did repeatedly. He made one of these experiments with more attention than the rest, from which it appeared, that four ounces, one dram, forty grains, by measure, of atmospheric air, lost one-sixth of its original bulk, by being confined five days with one ounce of steeped barley. It is plain, from this experiment, that seeds in the act of vegetation take oxygen from the atmosphere, part of which they retain, and reject the rest charged with carbon. The substance of the seed-lobes is hereby changed, an additional quantity of oxygen being introduced into their composition; and a part of their carbon lost. This change, in the proportion of their elementary principles, generates sugar, as is evident from the process of malting. But sugar and carbonic acid are more soluble in water than the farinaceous oxyd. They therefore combine with the humidity in the capillary tubes of the seed, and find a ready passage to the germ, the vegetative principle of which they call into action by a stimulus suited to its nature. A nutritious liquor being thus prepared by the decomposition of the seed-lobes, and distributed through the infant plant,

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its organs begin to exert their specific actions, by decompounding the nourishment conveyed to them, and forming new oxyds from the elementary principles of it, for the increase of the vessels and fibres; and in this manner the first stage of vegetation commences.

Mr Gough has ascertained, that a germ in the act of vegetation requires to be continually excited by the stimulus of oxygen; but that as soon as the seed lobes are exhausted, the young plant is in a state to derive its nutrition from the ground; and then (and not till then) it finds itself in a situation capable of making future advances, unassisted by the stimulus of respirable air.

The infant sprout at first suffers only a suspension of its energy from the absence of pure air; but if this necessary support be withheld too long, it perishes by the putrefactive fermentation.

The lively green which the stems and leaves of plants receive from the action of light, cannot be imparted to them, provided the energy of the vegetative principle in them be suspended: for after permitting a number of peas to produce both extremities of their sprouts in wet sand covered from the light by an earthen pot, Mr Gough placed five of them, on the 29th of April, in an inverted glass jar, containing azot confined by water; and three in another jar, in which a portion of common air was also inclosed by the same means. On the 30th the upper extremities of the sprouts of the parcel last mentioned were green; but though the experiment was prolonged to the 2d of May, those in the other glass did not exhibit any perceptible alteration in size or colour. Two of them were now placed in a glass filled with atmospheric air, where they were left unobserved to the 5th, at the end of which time the germs had vegetated considerably; the lower parts of them still remained white, but their opposite extremities had changed to their proper green. Hence it may be safely inferred, that greenness cannot be imparted to the sprouts of seeds without the joint action of light and oxygen; in which they are very different from the shoots that frequently proceed from maturer plants, when secluded from the atmosphere: for, as these grow freely in close glass vessels, placed in a window, and containing water and azot, the parts which are recently produced continue to vegetate, in consequence of their connection with the parent stock, and acquire the colour in question without the assistance of respirable air. See PLANT, TREE, GERMINATION, BOTANY, &c.

VEGETATIVE SOUL, among philosophers, denotes that principle in plants by virtue of which they vegetate, or receive nourishment and grow. See the preceding article.

VEHICLE, in general, denotes any thing that carries or bears another along; but is more particularly used in pharmacy for any liquid serving to dilute some medicine, in order that it may be administered more commodiously to the patient.

VEII (anc. geog.), a city of Etruria, the long and powerful rival of Rome; distant about 100 stadia, or 12 miles, to the north-west; situated on a high and steep rock. Taken after a siege of 10 years by Camillus, six years before the taking of Rome by the Gauls: and thither the Romans, after the burning of their city, had thoughts of removing; but were dissuaded from it by Camillus (Livy). It remained standing after the Punic war; and a colony was there settled, and its territory assigned to the soldiers. But after that it declined so gradually, as not to leave a single trace standing. Famous for the slaughter of the 300 Fabii on the Cremera (Ovid). The spot on which it stood lies near Isola, in St Peter's patrimony (Holstenius).

VEIL, a piece of stuff, serving to cover or hide any thing.

In the Romish churches, in time of Lent, they have veils or curtains over the altar, crucifix, images of saints, &c.

A veil of crape is wore on the head by nuns, as a badge of their profession: the novices wear white veils, but those who have made the vows black ones. See the article NUN.

VEIN, in anatomy, is a vessel which carries the blood from the several parts of the body to the heart. See ANATOMY, n° 123.

VEIN, among miners, is that space which is bounded with woughs, and contains ore, spar, canck, clay, chirt, croil, brownhen, pitcher-chirt, cur, which the philosophers call the *mother of metals*, and sometimes *soil of all colours*. When it bears ore, it is called a *quick vein*; when no ore, a *dead vein*.

VELA, a remarkable cape on the coast of Terra Firma, in South America. W. Long. 71. 25. N. Lat. 12. 30.

VELARIUS, in antiquity, an officer in the court of the Roman emperors, being a kind of usher, whose post was behind the curtain in the prince's apartment, as that of the chancellor's was at the entry of the ballustrade; and that of the ostiarii at the door. The velarii had a superior of the same denomination, who commanded them.

VELEZ-DE-GOMARA, a town of Africa, in the kingdom of Fez, and in the province of Eriff. It is the ancient ACARTH. With a harbour and a handsome castle, where the governor resides. It is seated between two high mountains, on the coast of the Mediterranean Sea. W. Long. 4. 0. N. Lat. 35. 10.

VELITES, in the Roman army, a kind of ancient soldiery, who were armed lightly with a javelin, a cask, cuirass, and shield.

VELLEIUS PATERCULUS. See PATERCULUS.

VELLUM, is a kind of parchment, that is finer, evener, and more white than the common parchment. The word is formed from the French *velin*, of the Latin *vitulinus*, "belonging to a calf."

VELOCITY, in mechanics, swiftness; that affection of motion whereby a moveable is disposed to run over a certain space in a certain time. It is also called *celerity*, and is always proportional to the space moved. Huyghens, Leibnitz, Bernoulli, Wolfius, and the foreign mathematicians, hold, that the momenta or forces of falling bodies, at the end of their falls, are as the squares of their velocities into the quantity of matter; the English mathematicians, on the contrary, maintain them to be as the velocities themselves into the quantity of matter. See QUANTITY, n° 11 and 14, &c.

VELVET, a rich kind of stuff, all silk, covered on the outside with a close, short, fine, soft shag, the other side being a very strong close tissue.

The nap or shag, called also the *velveting*, of this stuff, is formed of part of the threads of the warp, which the workman puts on a long narrow-channelled ruler or needle, which he afterwards cuts, by drawing a sharp steel tool along the channel of the needle to the ends of the warp. The principal and best manufactories of velvet are in France and Italy, particularly in Venice, Milan, Florence, Genoa, and Lucca: there are others in Holland, set up by the French refugees; whereof that at Haerlem is the most considerable: but they all come short of the beauty of those in France, and accordingly are sold for 10 or 15 *per cent.* less. There are even some brought from China; but they are the worst of all.

VENAL, or VENOUS, in anatomy, something that bears

ring a relation to the veins. This word is also used for something bought with money, or procured by bribes.

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VENEERING, Vaneering, or *Fineering*, a kind of marquetry, or inlaying, whereby several thin slices or leaves of one wood, of different kinds, are applied and fastened on a ground of some common wood.

There are two kinds of inlaying: the one, which is the more ordinary, goes no farther than the making of compartiments of different woods; the other requires much more art, and represents flowers, birds, and the like figures. The first kind is what we properly call *veneering*; the latter we have already described under Marquetry.

The wood intended for veneering is first sawed out into slices or leaves, about a line thick: in order to saw them, the blocks or planks are placed upright in a kind of vice or sawing-press: the description of which may be seen under the article just referred to. These slices are afterwards cut into slips, and fashioned divers ways, according to the design proposed; then the joints being carefully adjusted, and the pieces brought down to their proper thickness, with several planes for the purpose, they are glued down on a ground or block of dry wood, with good strong English glue. The pieces thus joined and glued, the work, if small, is put in a press; if large, it is laid on the bench, covered with a board, and pressed down with poles, or pieces of wood, one end whereof reaches to the ceiling of the room, and the other bears on the boards. When the glue is quite dry they take it out of the press and finish it; first with little planes, then with divers scrapers, some whereof resemble rasps, which take off dents, &c. left by the planes. When sufficiently scraped, the work is polished with the skin of a sea-dog, wax, and a brush and polisher of shave-grass: which is the last operation.

VENEREAL, something belonging to venery; as the lues venerea, &c. See Medicine-*Index*.

VENERY, is used for the act of copulation, or coition, of the two sexes.

VENESECTION, or Phlebotomy, in surgery. See Surgery, n°

VENETIAN Bole, a fine red earth used in painting, and called in the colour shops *Venetian red*.—It is dug in Carinthia, and sent from Venice to all parts of the world; but the use of it here is very much superseded by a bright colcothar of vitriol.

VENICE, a celebrated city of Italy, and capital of a republic of the same name, situated on the Lagunes or Small Islands, about five miles from the continent; in E. Long. 13°. N. Lat. 45. 40.

tion The name of Venice is evidently derived from *Venetia*, one of the Roman provinces of Italy; and this again from the *Henetians*, a people of Paphlagonia, who settled in that part of the country. The city is said to have been founded about the year 451 or 452; when Attila, having destroyed the cities of Aquileia, Verona, Mantua, Trevigio, &c. such of the inhabitants as escaped the slaughter fled to the islands on their coast, and there took up their residence. Historians are profuse in their commendations of the virtue of the Venetians during the infancy of their city; and Cassiodorus informs us, that one would have taken the inhabitants rather for an assembly of philosophers, living at their ease and cultivating the duties of religion, than for what they really were, a distressed and confused rabble who had escaped from the calamities of war. Nothing remarkable, however, occurs in the history of Venice for some time, excepting the change of government from the consular to the tribunitial form, which happened about 30 years after the building of the city. The republic first began to be of consequence after the destruction of Padua by the Lombards.

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About this time they were become masters of a fleet and a body of land-forces. They engaged in a quarrel with the Lombards, of which we know not the particulars. In a short time, however, they distinguished themselves against the Istrian pirates, who had committed depredations on their coasts, and the Tergestines, or inhabitants of Trieste, who had suddenly carried off a number of the citizens of Venice. These exploits procured them a considerable degree of reputation and esteem among their neighbours; and by improving every opportunity of increasing their trade, and augmenting the number of manufactures, &c. the city very soon arrived at a high pitch of affluence and power. In the war carried on by Justinian with the Goths in Italy, the Venetians gave considerable assistance to Narses the Roman general, insomuch that he expressed his gratitude by several rich presents, some high marks of distinction, and particularly by building two fine churches dedicated to the saints Theodore and Germinian; the oldest public buildings, beside St Mark's and St Peter's, in Venice.

Venice.

4 Roman general Narses, and honoured by [illegible] that account.

From the time of Justinian to the year 697, historians are silent with regard to the Venetian affairs. A great revolution now took place in the government: the tribunes having abused their power were abolished; and in their stead was elected a *doge* or duke, in whom was vested the supreme authority. He was to represent the honour and majesty of the state; to have respect and distinction paid him beyond what the tribunes, or even the consuls, enjoyed: he was to assemble and preside at the great council; to have a casting vote in all disputed points; to nominate to all offices, places, and preferments; and lastly, to enjoy the same authority in the church as in the state. This form of government was changed in 737, for what reason we know not, and a supreme magistrate chosen, with the title of *master of the horse* or *general of the forces*. His power was to continue only for a year, the shortness of its duration being thought a sufficient security against the abuse of it. But in five years afterwards the doges were restored, and Giovanni Fabritio, the fourth and last master of the horse, was deposed, and his eyes put out, but for what fault we know not.

5 Election of a doge or duke.

6 Changes of government.

Under the doges, the power and wealth of the Venetian republic continued to increase. In 764 the Heracleans and Jesulans, subjects to the republic, having formed some designs against the state, put themselves under the protection of Charlemagne. That conqueror, not finding it convenient to give them present assistance, settled them in Malamoc until he could give them more effectual succour. The Venetians, however, disregarding the protection of that powerful monarch, attacked and instantly drove them out of the place where he had settled them. Incensed at this, Charlemagne ordered his son Pepin to declare war against the republic. This was immediately done; but the blow was for some time diverted by Astolphus king of the Lombards, who, committing great devastations in the territories of the pope, obliged Pepin to come to the assistance of his holiness. However, after having afforded the necessary succour to the pope, Pepin prosecuted the war with Venice. The event is uncertain: all we know is, that about this time the Venetians declared themselves a free and independent state; which makes it probable that his success had not been great. But in 804 the war was renewed with the utmost fury. Pepin having quarrelled with Nicephorus the Greek emperor, and finding Obelerio the Venetian doge inclined to favour his adversary, determined to exterminate the very name of the republic. After having laid waste the province of Venetia, he led his army directly to Venice, blocking the city up at the same time by his fleet. The Venetians were not disheartened at the number of their enemies,

7 Quarrel with Charlemagne.

8 Pepin declares war against the republic.

9 The Venetians declare themselves independent.

10 The city [illegible] by Pepin.

Venice.

nies, the reputation of Pepin, or the civil dissensions among themselves; their animosities were laid aside, and a strict union formed against the common enemy: the chief command was given to Valentin, as Obelerio was supposed too much attached to Pepin to act with that good-will and chearfulness the service of his country required. The Venetians, notwithstanding the most obstinate defence, the most vigorous sallies, and their selling every inch of ground at an incredible expence of blood, were at length reduced to that part of the city south of the Rialto; this stream, and their own bravery, being now their only defence. While Pepin was preparing to lay a bridge over the canal, they resolved, as a last effort, to attack Pepin's fleet, and to vanquish or die in defence of their liberty. Embarking all the troops they could spare, they bore down, with the advantage of the wind and tide, upon the enemy, and began the attack with such fury, as obliged the French admiral to give way. The lightness of their ships, and the knowledge of the soundings, gave the Venetians every advantage they could

12 wish: the enemy's fleet was run aground, and the greater part of their troops perished in attempting to escape; the ships were all, to a few, either taken or destroyed. During this action at sea, Pepin resolved to assault the city by land, not doubting but the garrison was so weakened by the number of forces they had sent on board the fleet, as to be able to make but a slight resistance. Having for this purpose thrown a bridge over the Rialto, he was marching his troops across it, when he found himself attacked on every side by the Venetians from their boats, and others who had posted themselves on the bridge. The battle was long, bloody, and doubtful, until the Venetians employed all their power to break down the bridge; which at last yielding to their obstinate endeavours, a prodigious slaughter of the French ensued: however, they fought like men in despair, seeing no hopes of safety but in victory; but all communication being cut off with the troops on shore, they were to a man

13 either killed or drowned. The number of slain was so great, that the space between the Rialto and Malamoc was covered with dead bodies, and has ever since gone by a name ex-

14 pressive of the prodigious slaughter. Pepin was so struck with the intrepidity of the Venetians, that he raised the siege, abandoned the enterprise, and concluded a peace with the republic: he afterwards came to Venice to intercede for Obelerio, that he might be restored; which the Venetians granted, more out of respect to the request of so great a prince, than love to the unhappy Obelerio. The people had a notion that Obelerio had encouraged Pepin to declare

15 war upon the republic, and that a correspondence between them was carried on during the siege: Pepin was therefore no sooner withdrawn, than the populace seizing upon Obelerio, tore his body in pieces, and scattered his limbs and bowels about the city. His wife shared the same fate; for as she was the sister of Pepin, it was not doubted but her influence was the cause of her husband's perfidy.

16 In 839 we find the Venetians engaged in an alliance offensive and defensive against the Saracens with Michael the Greek emperor. A fleet of 60 galleys was immediately equipped, who joined the Grecian fleet and engaged the enemy: but during the heat of the engagement, the Greeks having basely deserted their allies, the Venetians were so completely defeated, that scarce a single vessel remained to carry the news of their misfortune to Venice. This defeat threw the city into the utmost consternation, as it was not doubted that the Saracens would immediately lay siege to the capital; but from these fears they were soon relieved, by certain intelligence that the Saracens had gone to Ancona, which they had pillaged and destroyed. The Narentines, however, a piratical people, no sooner heard of the defeat of the Venetians, than they laid waste the coasts of Dalmatia, and ravaged the country for a considerable way; at the same time that the city was distracted by internal dissensions and tumults, in one of which the doge was murdered.

It was not till the year 881 that the Venetian affairs were thoroughly re-established. By the prudent and vigorous administration of Orso Particiaco the power of the Saracens was checked, the Narentines utterly defeated, and peace and domestic tranquillity restored. From this time the republic continued to flourish; and in 906 her reputation for arms became famous all over the world by a great victory gained over the Huns, who had invaded Italy, defeated Berengarius, and threatened the country with total destruction. For a long time after, we meet with no remarkable transactions in the Venetian history; but in general the republic increased in wealth and power by its indefatigable application to maritime affairs and to commerce. About the year 1040 it was ordained that no prince should associate a colleague with him in the supreme power, a statute which has ever since continued unaltered.

Towards the close of the 11th century, Venice began to make a very considerable figure among the Italian states, and to carry on wars with several of them. In 1085, the republic was by the emperor of Constantinople invested with the sovereignty of Dalmatia and Croatia, which, however, had been held long before by right of conquest. As soon as the Croisade was preached up, the Venetians fitted out a fleet of 200 sail against the infidels; but before this armament was in a condition to put to sea, war broke out with Pisa. The doge Vitalis Michael took upon him the command of the fleet, which, after having defeated the Pisans in a bloody action at sea, he set sail for Smyrna, and from thence to Ascalon, at that time besieged by the Christians. To his valour was owing the conquest of this city, as well as that of Joppa and Tiberias; but before he had time to push his good fortune further, he was recalled on account of an invasion of the Normans of Dalmatia. Here he was equally successful: the Normans were everywhere defeated; and Michael returned home loaded with booty; but died soon after, to the great grief of all his subjects. He was succeeded by Ordelapho Faliero, under whom the Venetians assisted Baldwin in the siege of Ptolemais, and are said to have been the chief instruments of its conquest; and Baldwin, in recompense for the services of the republic, invested her with the sovereignty of that city, which he endowed with many extraordinary privileges, in order to render his present more valuable. This good fortune, however, was counterbalanced by a rebellion in Dalmatia and Croatia. The former was reduced; but, in a battle with the Croatians, the doge was killed, and his army entirely defeated: by which disaster the Venetians were so much dispirited, that they clapped up a peace on the best terms they could, giving up all thoughts of Croatia for the present.

Under the government of Domenico Micheli, who succeeded Ordelapho, the pope's nuncio arrived at Venice, and excited such a spirit of enthusiasm among all ranks and degrees of men, that they strove who should be first enrolled for the holy war. The doge, having fitted out a fleet of 60 galleys, sailed with it to Joppa, which place the Saracens were at that time besieging. The garrison was reduced to the last extremity when the Venetian fleet arrived, surprised, and defeated that of the enemy with great slaughter; soon after which the Saracens raised the siege with precipitation. Tyre was next besieged, and soon was obliged to capitulate; on which occasion, as well as on the taking of Ascalon, the Venetians shared two-thirds of the spoils. But in the mean time the emperor of Constantinople, jealous of the increasing power and wealth of the republic,

republic, resolved to make an attack upon Venice, now weakened by the absence of the doge and such a powerful fleet. But the senate, having timely notice of the emperor's intentions, recalled the doge, who instantly obeyed the summons. Stopping at Rhodes, in his way home to refresh and water the fleet, the inhabitants refused to furnish him with the necessaries he demanded. Incensed at this denial, he levelled their city with the ground; and from thence sailing to Chios, he laid waste and destroyed the country, carrying off the body of St Isidore, in those days accounted an inestimable treasure. After this he seized on the islands of Samos, Lesbos, Andros, and all those in the Archipelago belonging to the emperor; and having reduced Zara, Spalatro, and Trahu, places in Dalmatia which had revolted during his absence, he returned in triumph to Venice, where he was received with great joy.

The Venetians now became very formidable throughout all Europe. The Sicilians, Paduans, with the states of Verona and Ferrara, felt the weight of their power; and in 1173 they ventured to oppose Frederic Barbarossa emperor of Germany. The occasion of this quarrel was, that pope Alexander had taken shelter in Venice in order to avoid the resentment of Barbarossa, who had conceived an implacable aversion against him. The Venetians dispatched ambassadors to him: but he answered them in a rage, "Go tell your prince and people, that Frederic the Roman emperor demands his enemy, who is protected by them. If they send him not instantly bound hand and foot, he will overturn every law, human and divine, to accomplish his revenge; he will bring his army before their city, and fix his victorious standards in the market-place, which shall float in the blood of its citizens." On the return of the ambassadors with this terrible menace, it was agreed to equip a fleet with all expedition, and prepare for repelling the attacks of such a formidable and haughty enemy. But before the armament could be prepared, Otho, the emperor's son, arrived before the city with a fleet of 75 galleys. The doge Sebastiano Ziani sailed out with the few vessels he had got equipped, to give the enemy battle. The fleets met off the coast of Istria, and a terrible engagement ensued, in which the imperial fleet was totally defeated, Otho himself taken prisoner, and 48 of his ships destroyed. On the doge's return, the pope went out to meet him, and presented him with a ring, saying, "Take this, Ziani, and give it to the sea, as a testimony of your dominion over it. Let your successors annually perform the same ceremony, that posterity may know that your valour has purchased this prerogative, and subjected this element to you, even as a husband subjecteth his wife." Otho was treated with the respect due to his rank; and soon conceived a great friendship for Ziani. At last, being permitted to visit the imperial court on his parole, he not only prevailed on his father to make peace with the Venetians, but even to visit their city, so famed for its commerce and naval power. He was received with all possible respect, and on his departure attended to Ancona by the doge, the senate, and the whole body of the nobility. During this journey he was reconciled to the pope; and both agreed to pay the highest honours to the doge and republic.

In the beginning of the 13th century, the Venetians, now become exceedingly powerful and opulent, by reason of the commerce which they carried on with the richest countries of the world, were invited by young Alexis, son to the emperor of Constantinople, to his father's assistance, who had been deposed by a rebellious faction. In conjunction with the French, they undertook to restore him, and easily succeeded. But the old emperor dying soon after, his son was elected in his room, and a few days after murdered by his own subjects; on which the empire was seized by Mirtzuphlus, a man of mean birth, who had been raised by the favour of old Isaac. As the allied army of French and Venetians was encamped without the city, Mirtzuphlus resolved immediately to drive them out of his dominions, and for that purpose attempted to surprise their camp; but being repulsed, he shut himself up in the city, which he resolved to stand a siege. The allies conducted it with such vigour, that the usurper was obliged to fly; and though the citizens held out after his desertion, they were obliged in less than three months to capitulate. This proved a source of greater acquisition to Venice than all that had yet happened. All the chief offices of the city were filled up with Venetians, in recompense for their services: the allies entered Thrace, and subdued it; Candia, and all the Greek islands, also fell under the dominion of the republic.

In the mean time the Genoese, by their successful application to commerce, having raised themselves in such a manner as to be capable of rivalling the Venetians, a long series of wars took place between the republics; in which the Venetians generally had the advantage, though sometimes they met with terrible overthrows. These expensive and bloody quarrels undoubtedly weakened the republic in the main, notwithstanding its successes. In the year 1348, however, the Genoese were obliged to implore the protection of Visconti duke of Milan, in order to support them against their implacable enemies the Venetians. Soon after this, in the year 1352, the latter were utterly defeated, with such loss, that it was thought the city itself must have fallen into the hands of the Genoese, had they known how to improve their victory. This was in a short time followed by a peace; but from this time the power of the republic began to decline. Continual wars with the states of Italy, with the Hungarians, and their own rebellious subjects, kept the Venetians employed so that they had no leisure to oppose the Turks, whose rapid advances ought to have alarmed all Europe. After the destruction of the eastern empire, the Turks came more immediately to interfere with the republic. The consequences are related under the article TURKEY. Whatever valour might be shown by the Venetians, or whatever successes they might boast of, it is certain that the Turks ultimately prevailed; so that for some time it seemed scarce possible to resist them. What contributed also greatly to the decline of the republic, was the discovery of a passage to the East Indies by the Cape of Good Hope in 1497. To this time the greatest part of the East India goods imported into Europe passed thro' the hands of the Venetians; but as soon as the above-mentioned discovery took place, the carriage by the way of Alexandria almost entirely ceased. Still, however, the Venetian power was strong; and in the beginning of the 16th century they maintained a war against almost the whole power of France, Germany, and Italy; but soon after we find them entering into an alliance with some Italian states and the king of France against the emperor. These wars, however, produced no consequences of any great moment; and in 1573 tranquillity was restored by the conclusion of a peace with the Turks. Nothing of consequence happened in the affairs of the Venetian republic till the year 1645, when the Turks made a sudden and unexpected descent on the island of Candia. The senate of Venice did not display their usual vigilance on this occasion. They had seen the immense warlike preparations going forward, and yet allowed themselves to be amused by the grand seignior's declaring war against Malta, and pretending that the armament was intended against that island. The troops landed without opposition, and the town of Canea was taken after an obstinate defence.

Venice.

30 Constantinople taken by the French and Venetians.

32 Wars between the Venetians and Genoese.

34 The Genoese put themselves under the protection of the duke of Milan.

35 Causes of the decline of the Venetian power.

36 Candia invaded by the Turks.

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Venice.

37 Extraordinary methods taken by the Venetians to carry on the war.

This news being brought to Venice, excited an universal indignation against the Turks; and the senate resolved to defend to the utmost this valuable part of the empire. Extraordinary ways and means of raising money were fallen upon: among others, it was proposed to sell the rank of nobility. Four citizens offered 100,000 ducats each for this honour; and, notwithstanding some opposition, this measure was at last carried. Eighty families were admitted into the grand council, and to the honour and privileges of the nobility. What an idea does this give of the wealth of the inhabitants of Venice?

38 Remarkable siege of the capital of Candia.

The siege of Candia, the capital of the island of that name, is, in some respects, more memorable than that of any town which history, or even which poetry, has recorded. It lasted 24 years. The amazing efforts made by the republic of Venice astonished all Europe; their courage interested the gallant spirits of every nation: volunteers from every country came to Candia to exercise their valour, to acquire knowledge in the military art, and assist a brave people whom they admired.

39 Desperate valour of the Venetians.

During this famous siege, the Venetians gained many important victories over the Turkish fleet. Sometimes they were driven from the walls of Candia, and the Turkish garrison of Canéa was even besieged by the Venetian fleets. Great slaughter was made of the Turkish armies; but new armies were soon found to supply their place, by a government which boasts such populous dominions, and which has despotic authority over its subjects.

40 Cruelty of the Turkish sultan.

Mahomet the fourth, impatient at the length of this siege, came to Negropont, that he might have more frequent opportunities of hearing from the vizir, who carried on the siege. An officer, sent with dispatches, was directed by the vizir to explain to Mahomet the manner in which he made his approaches, and to assure him that he would take all possible care to save the lives of the soldiers. The humane emperor answered, That he had sent the vizir to take the place, and not to spare the lives of the soldiers; and he was on the point of ordering the head of the officer who brought this message to be cut off, merely to quicken the vizir in his operations, and to show him how little he valued the lives of men.

41 The city capitulates.

In spite of the vizir's boasted parsimony, this war is said to have cost the lives of 200,000 Turks. Candia capitulated in the year 1668. The conditions on this occasion were honourably fulfilled. Morsini, the Venetian general, marched out of the rubbish of this well-disputed city with the honours of war.—The expence of such a tedious war greatly exhausted the resources of Venice, which could not now repair them so quickly as formerly, when she enjoyed the rich monopoly of the Asiatic trade.

42 New war with the Turks.

This republic remained in a state of tranquillity, endeavouring, by the arts of peace and cultivation of that share of commerce which she still retained, to fill her empty exchequer, till she was drawn into a new war, in the year 1683, by the insolence of the Ottoman court. The Venetians had for some time endeavoured, by negociation and many conciliatory representations, to accommodate matters with the Turks; and though the haughty conduct of their enemies afforded small hopes of success, yet such was their aversion to war on the present occasion, that they still balanced, whether to bear those insults or repel them by arms; when they were brought to decision by an event which gave the greatest joy to Venice, and astonished all Europe. This was the great victory gained over the Turkish army before the walls of Vienna by Sobieski king of Poland.

In this new war, their late General Morsini again had the command of the fleets and armies of the republic, and sustained the great reputation he had acquired in Candia. He conquered the Morea, which was ceded formally to Venice, with some other acquisition, at the peace of Carlowitz, in the last year of the last century.

During the war of the succession, the state of Venice observed a strict neutrality. They considered that dispute as unconnected with their interests, taking care, however, to keep on foot an army on their frontiers in Italy, of sufficient force to make them respected by the contending powers. But, soon after the peace of Utrecht, the Venetians were again attacked by their old enemies the Turks; who, beholding the great European powers exhausted by their late efforts, and unable to assist the republic, thought this the favourable moment for recovering the Morea, which had been so lately ravished from them. The Turks obtained their object; and at the peace of Passarowitz, which terminated this unsuccessful war, the Venetian state yielded up the Morea; the grand seignior, on his part, restoring to them the small islands of Cerigo and Cerigotto, with some places which his troops had taken during the course of the war in Dalmatia. Those, with the islands of Corfou, Santa Maura, Zante, and Cephalonia, the remains of their dominions in the Levant, they have since fortified at a great expence, as their only barriers against the Turks.

Since this period no essential alteration has taken place in the Venetian government, nor has there been any essential increase or diminution in the extent of their dominions. They have little to fear at present from the Turks, whose attention is sufficiently occupied by a more formidable enemy than the republic and the House of Austria united. Besides, if the Turks were more disengaged, as they have now stripped the republic of Cyprus, Candia, and their possessions in Greece, what remains in the Levant is hardly worth their attention.

The declension of Venice did not, like that of Rome, proceed from the increase of luxury, or the revolt of their own armies in the distant colonies, or from civil wars of any kind. Venice has dwindled in power and importance from causes which could not be foreseen, or guarded against by human prudence although they had been foreseen. In their present situation, there is little probability of their attempting new conquests; happy if they are allowed to remain in the quiet possession of what they have.

We have already mentioned the situation of Venice, the capital of this republic. Its appearance at a distance is very striking, looking like a great town half floated by a deluge. Betwixt the city and the Terra Firma are a great many shallows, on which at low water you may almost every where touch the bottom with a pole; but all possible care is taken to prevent their becoming dry land. On the south side of the city are also shallows; but on these there is a greater depth of water. The channels betwixt them are marked out by stakes or poles, which on the approach of an enemy would certainly be taken away. The city is divided by a vast number of canals, on which ply the gondoliers, or watermen, in their black gondolas or boats. The streets are very clean and neat, but narrow and crooked. There are no carriages, not so much as a chair, to be seen in them. Though the city, by its situation and the great number of steeples towering above the water, strikes one with admiration at a distance, yet when he is got into it, it does not answer his expectation; for excepting the square of St Mark and a few other places, there is nothing grand or beautiful in it, at least in comparison of many other cities of Italy. Of the canals, that called *Il Canale Maggiore*, or the "great canal," is by far the largest and longest, and consequently the most beautiful. Here races are sometimes run for prizes in the gondolas. On its banks are also several stately houses. Over these canals are a great number of handsome bridges of

of one arch, but without any fence on either ſide: they are alſo built of white ſtone, with which the ſtreets are all paved, except the Rialto over the great canal, which is all of marble, and coſt the republic 2[illegible]0,000 ducats, the arch being 90 feet wide. The canals in ſummer emit a bad ſmell, from the great quantities of filth continually running into them. The fineſt gondolas are thoſe in which the foreign miniſters make their public entries, being richly decorated with gilding, painting, and ſculpture. The number of iſlands on which the city ſtands, according to ſome, is 6[illegible]; according to others, 72. The circumference is about ſix Italian miles; and it takes up about two hours to make the circuit of it in a gondola. The inhabitants are ſuppoſed to be about 150,000 including thoſe of the iſlands Murano, La Guidecca, and thoſe who live on board the barges. There are near 200 ſprings of freſh water in the city; but the water of many of them is ſo indifferent, that the principal families preſerve rain-water in ciſterns, or are ſupplied with water from the Brenta. The moſt remarkable places in the city are the ducal palace, the ſquare and church of St Mark, who is the tutelar ſaint of Venice; the mint, public library, grand arſenal, ſeveral of the palaces of the nobles, churches, convents, and hoſpitals. In theſe laſt is a prodigious collection of the fineſt paintings; Venice, in this reſpect, even ſurpaſſing Rome itſelf. The diverſions of the Venetians are chiefly maſquerading, eſpecially during the carnival and other feſtivals; ridottos, operas, plays, which are generally wretched performances, and concerts of vocal and inſtrumental muſic. During their feſtivals, debauchery, riot, and licentiouſneſs, are carried to the greateſt height. The courtezans here, we are told, are abſolutely loſt to all ſenſe of modeſty and common decency. The grand ſcene of all, the ſhows and follies of the feſtivals, is the ſquare of St Mark, in which bulls are ſometimes baited. In the doge's palace all the high colleges hold their aſſemblies; but we are told by ſeveral travellers, which ſeems very ſtrange, that the ſtairs are no better than a privy. In this palace is a ſmall arſenal, furniſhed with arms againſt any ſudden inſurrection of the people, together with a ſtate-priſon, a great many exquiſite paintings, and ſeveral curioſities, among which are ſome *claustra caſtitatis*. One ſide of it is towards St Mark's ſquare, and the lower gallery on that ſide, with the hall under the new procuratie facing it, are called the *Broglio*, where the nobility and none elſe, at leaſt while they are preſent, are allowed to walk. The ſquare of St Mark is the greateſt ornament of the city, and hath the form of a parallelogram. In this ſquare, beſides the church and palace of St Mark, are two towers, on one ſide of which is a curious clock; and the other has ſtairs ſo contructed that one may ride up on horſeback. Oppoſite to the ducal palace is the public library of the commonwealth; containing a large collection of books and manuſcripts, with ſome fine paintings, ſtatues, and curioſities. Hard by St Mark's ſquare is the zecca, or mint: from zecca the gold coin called *zecchino* takes its name. One of the ſmalleſt pieces of money at Venice is called *gazetta;* and the firſt newſpapers publiſhed there, on a ſingle leaf, having been ſold for that a-piece, all kinds of newſpapers were from thence ſtyled *gazettes*. The grand arſenal is two and a half Italian miles in circuit, and contains vaſt quantities of naval and other warlike ſtores: ſome pretend that it could furniſh arms for 10,000 horſe and 100,000 foot: here are the trophies of Scanderbeg and others, with the helmet of Attila, &c. The rope walk is 4[illegible]14 common paces in length, and the ropes and cables are valued at 2,000,000 of ſilver ducats. In the foundery none but braſs cannon are caſt; and 100 men are generally at work in the forges. The ſalt-petre works here deſerve a traveller's notice: there is a veſſel filled with wine and water four times a-day, where the workmen, though 1000 or more, may drink as much and as often as they pleaſe. Cloſe to the Rialto is the bank. The trade of the city at preſent is far ſhort of what it was formerly. Their chief manufactures are cloth; eſpecially ſcarlet, ſilks, gold and ſilver ſtuffs, brocades, velvets, and paper, of which, and wine, oil, fruit, ſweetmeats, anchovies, and ſeveral ſorts of drugs uſed in phyſic and painting, the exports are ſtill conſiderable. Venice has neither walls, gates, nor citadel, to defend it; its ſituation ſupplying the want of all theſe. In the treaſury of relics is the protocoll, or original manuſcript, as they pretend, of St Mark's goſpel: it is rarely ſhown; and the writing, by length of time, is ſo defaced, that the greateſt connoiſſeurs in manuſcripts cannot determine whether it was wrote in Greek or Latin. Beſides what is properly called the city, there is a multitude of little iſlands lying round, which are covered with buildings, and make each of them a kind of ſeparate town; the moſt conſiderable of which is that called *Guideca*, or the "Jews Quarter," which is large and populous; with St Eroimo, St Helena, St Georgio, Chioſa, Il Lido de Paleſtrina, Il Lido de Malamocco, and Murano: theſe iſlands are a ſort of fence to the city, breaking the violence of the waves. To diſtinguiſh them from others, the Jews here muſt wear a bit of red cloth in their hats. The gardens in this city are few and inconſiderable. In the iſland of Murano are made thoſe beautiful looking-glaſſes, and other glaſs-works, for which Venice is ſo much noted: here the family of Cornaro hath a palace, with a gallery of paintings, little ſhort of an Italian mile in length. The ſalt-works in the iſland of Chioſa are of great benefit to the Venetians, and yield a very conſiderable revenue. There are ſeveral other ſmall iſlands about Venice beſides thoſe we have mentioned; but they are inconſiderable. Venice.

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Government, &c. of Venice.

As to the government of this ſtate, it was, as above related, at firſt veſted in conſuls, afterwards in tribunes. About the beginning of the 8th century, a doge or duke was elected, and veſted with unlimited power; but in 1171, the power of the doge was much abridged, and a council of 240 perſons, compoſed of commons as well as nobles, was appointed. Soon after, under duke Marino Moroſini, the preſent form of electing the doge was introduced. In 1296, the government became ariſtocratical; the privilege of ſitting in the great council being then confined to the nobility, in whom alone the ſupreme authority at preſent is veſted. The number of nobles amounts to about 2[illegible]00. All thoſe are members of the ſenate; but, according to their antiquity, ſome are accounted more honourable than others. One claſs, and that the loweſt, conſiſts of the poſterity of thoſe who, in the neceſſitous times of the commonwealth, purchaſed their nobility for 100,000 ducats. The nobles have the title of *Excellency;* and wear, at leaſt when in the city, a black furred gown reaching to their heels, with long caps and periwigs. Some of them are ſo poor, that they are fain to beg of the rich. At the head of the government is the doge, whoſe office was once hereditary and power abſolute; but the former is now elective, and the latter very much circumſcribed: indeed he is no more than a gaudy ſlave, loaded with fetters, which one would think could not be much the lighter for being gilt; yet ſo much is the human heart captivated with external pomp and pageantry, that the office, for the moſt part, is eagerly ſought after: but ſhould one otherwiſe inclined be choſen, he cannot decline it, without expoſing himſelf to baniſhment and confiſcation of his effects. Though the power of the doge is very ſmall, his ſtate and retinue are very ſplendid: his title is that of *Serenity*, and his office for life: he is ſaid to be a king with regard to his robes, a ſenator in the council-houſe, a priſoner in the city, and a private man out of it. The yearly revenue of his office is about 4[illegible]00 l.;

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4000 l.; and though he may be depofed, he cannot refign his dignity. All the nobility have a feat in the great council, unlefs they are under 25 years of age. In this council the fupreme authority and legiflative power is vefted. Next to it is the fenate or pregadi, which confifts of about 250 members, who have the power of making peace or war, and forming alliances; of appointing ambaffadors; fixing the ftandard of the coin; impofing duties and taxes; and all offices by fea and land are in their gift. The third council confifts of the doge and his fix counfellors, in which all letters and inftruments relating to the ftate are read, ambaffadors admitted to audience, and other important affairs tranfacted. The other colleges are the council of ten; which decides all criminal caufes without appeal, and to which even the doge himfelf is fubject: the procurators of St Mark, whofe office is very lucrative, and who decide with refpect to wills, guardianfhips, and the making a proper provifion for the poor; and the ftate-inquifition, whofe bufinefs it is to provide for the public tranquillity. In the wall of the ducal palace are heads of lions and leopards, with open mouths, to receive informations of any plot or treafon againft the ftate. Here is alfo a particular college for the regulation of drefs, but their jurifdiction does not extend to ftrangers. The method of electing the doge is no lefs fingular than complicated, and effectually calculated to prevent all

48 Method of choofing the doge.

kinds of bribery or corruption. All the members of the grand council who are paft 30 years of age, being affembled in the hall of the palace, as many balls are put into an urn as there are members prefent; 30 of thefe balls are gilt, and the reft white. Each counfellor draws one; and thofe who get the gilt balls go into another room, where there is an urn containing 30 balls, nine of which are gilt. The 30 members draw again; and thofe who by a fecond piece of good fortune get the gilt balls are the firft electors, and have a right to choofe 40, among whom they comprehend themfelves.

Thefe 40, by balloting in the fame manner as in the former inftances, are reduced to 12 fecond electors, who choofe 25; the firft of the 12 naming three, and the remaining 11 two a-piece. All thofe being affembled in a chamber apart, each of them draws a ball from an urn containing 25 balls, among which are 9 gilt. This reduces them to 9 third electors, each of whom chooses five, making in all 45; who, as in the preceding inftances, are reduced by ballot to 11 fourth electors, and they have the nomination of 41, who are the direct electors of the doge. Being fhut up by themfelves, they begin by choofing three chiefs and two fecretaries; each elector being then called, throws a little billet into an urn which ftands on a table before the chiefs. On this billet is infcribed the perfon's name whom the elector wifhes to be doge.

The fecretaries then, in the prefence of the chiefs and of the whole affembly, open the billets. Among all the 41 there are generally but a very few different names, as the election for the moft part balances between two or three candidates. Their names, whatever is the number, are put into another urn, and drawn out one after another. As foon as a name is extracted the fecretary reads it, and if the perfon to whom it belongs is prefent, he immediately retires. One of the chiefs then demands with a loud voice, whether any crime can be laid to this perfon's charge, or any objection made to his being raifed to the fovereign dignity? If any objection is made, the accufed is called in and heard in his own defence; after which the electors proceed to give their decifion, by throwing a ball into one of the two boxes, one of which is for the Ayes, the other for the Noes. The fecretaries then count the balls; and if there are 25 in the firft, the election is finifhed; if not, another name is read, and the fame inquifition made as before, till there are 25 appearing balls.

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49 Order of knighthood.

The principal Venetian order of knighthood is that of St Mark; the badge of which is a large gold medal dependent on the breaft. The order of Conftantine knights wear a crofs hanging from a gold chain.

50 Religion.

With refpect to religion, that of the Venetians is the Roman Catholic; but they are no bigots. The court of inquifition is here under very great reftrictions; and the pope is confidered as little more than a temporal prince, his fupremacy being rejected.

51 Military force and revenue.

The Venetians are ftill the greateft naval power in Italy. They pretend they could fit out, in cafe of neceffity, 60 men of war, 100 galleys, and 10 galeaffes; though one can hardly imagine how they could man half that number. The army is faid to confift of between 20,000 and 30,000 men; the greateft part of which are Dalmatians and Switzers. The commander in chief, ftyled *Capitano*, is always a foreigner of diftinction. General Græme, a Scotchman, lately enjoyed that honourable poft. The ordinary revenues of the ftate are computed at about 1,200,000 l. fterling; but in time of war they can raife them greatly. A confiderable part of the revenue arifes from the cuftoms, and the duty on falt made at Corfu and Chiofa.

52 Character.

The Venetians are in general tall and well made. They are a lively ingenious people, extravagantly fond of public amufements, with an uncommon relifh for humour, and yet more attached to the real enjoyments of life than to thofe which depend on oftentation and proceed from vanity. The women are of an eafy addrefs, and have no averfion to cultivating an acquaintance with thofe ftrangers who are prefented to them by their relations, or have been properly recommended.

VENIRE FACIAS, in law, is a judicial writ lying where two parties plead and come to iffue, directed to the fheriff, to caufe 12 men of the fame neighbourhood to meet and try the fame, and to fay the truth upon the iffue taken.

VENTER, fignifies the belly; but it is alfo ufed for the children by a woman of one marriage: there is in law a firft and fecond venter, &c. where a man hath children by feveral wives; and how they fhall take in defcents of lands.

VENTER Infpiciendo, is a writ to fearch a woman that faith fhe is with child, and thereby withholdeth lands from the next heir: the trial whereof is by a jury of women.

VENTILATOR, a machine by which the noxious air of any clofe place, as an hofpital, gaol, fhip, chamber, &c. may be difcharged and changed for frefh

The noxious qualities of bad air have been long known; and no one has taken greater pains to fet the mifchiefs arifing from foul air in a juft light than Dr Hales; who has alfo propofed an eafy and effectual remedy by the ufe of his ventilators; his account of which was read to the Royal Society in May 1741. In the November following M. Triewald, military architect to the king of Sweden, informed Dr Mortimer fecretary to the Royal Society, that he had in the preceding fpring invented a machine for the ufe of his majefty's men of war, in order to draw out the bad air from under their decks, the leaft of which exhaufted 36,172 cubic feet of air in an hour, or at the rate of 21,732 tons in 24 hours. In 1742 he fent one of them, formed for a 60 gun fhip to France; which was approved of by the Royal Academy of Sciences at Paris; and the king of France ordered all the men of war to be furnifhed with the like ventilators.

Plate DXLI.

The ventilators invented by Dr Hales confift of a fquare box ABCD (fig. 1.) of any fize; in the middle of one fide of this box a broad partition or midriff is fixed by hinges X, and it moves up and down from A to C, by means of an

an iron rod ZR, fixed at a proper distance from the other end of the midriff, and passing through a small hole in the cover of the box up to R. Two boxes of this kind may be employed at once, and the two iron rods may be fixed to a lever FG (fig. 2.) moving on a fixed centre O; so that by the alternate raising and pressing down of the lever FG, the midriffs are also alternately raised and depressed, whereby these double bellows are at the same time both drawing in air, and pressing it out, through apertures with valves made on the same side with, and placed both above and below, the hinges of the midriffs. In order to render the midriffs light, they are made of four bars lengthwise, and as many across them breadthwise, the vacant spaces being filled up with thin pannels of fir-board; and that they may move to and fro with the greater ease, yet without touching the sides of the boxes, there is an iron regulator fixed upright to the middle of the end of the box AC (fig. 1.) from N to L, with a notch cut into the middle of the end of the midriff at Z: so that the midriffs, in rising and falling, suffer no other friction than what is made between the regulator and the notch. Moreover, as the midriff ZX moves with its edges only one twentieth of an inch from the sides of the box ADBC, &c. very little air will escape by the edges; and, therefore, there will be no need of leathern sides as in the common bellows. The end of the box at AC is made a little circular, that it may be better adapted between A and C to the rising and falling midriff; and at the other end X of the midriff a flap of leather may be nailed over the joints if needful. The eight large valves through which the air is to pass, are placed at the hinge-end of the boxes IK (fig. 2.) as at 1, 2, 3, &c. The valve 1 opens inward to admit the air to enter, when the midriff is depressed at the other end by means of the lever FG. And at the same time the valve 3 in the lower ventilator is shut by the compressed air which passes out at the valve 4. But when that midriff is raised, the valve 1 shuts, and the air passes out at the valve 2. And it is the same with the valves 5, 6, &c. of the other box; so that the midriffs are alternately rising and falling, and two of the ventilators drawing in air, and two blowing it out: the air entering at the valves 1, 3, 6, 8, and passing out at the valves 2, 4, 5, 7. Before these last valves there is fixed to the ventilators a box OQNM (fig. 3.) as a common receptacle for all the air which comes out of the ventilators; which air passes off by the trunk P, through the wall of a building.

For a farther account of this machine we refer to the author himself, who gives a full detail of it and of its manner of working. See Description of Ventilators by Stephen Hales, D. D. Lond. 1743, 8vo.

The ventilators in large ships, since the order for ventilating the fleet issued by the lords of the admiralty in 1756, are fixed in the gunner's fore store room, and generally ahead of the fail room. The foul air is carried up through the decks and fore-castle near the fore-mast, sometimes before it, and sometimes abaft it, but more frequently on its starboard side; the lever, by which the ventilators are worked, is under the fore castle in two deck ships, and between the upper and middle decks in three-deckers; sometimes the lever is hung athwart ships; in some ships fore and aft, and in others oblique. The iron rod, which communicates the motion from the lever, passes through the partners of the fore mast, and is connected with another lever, suspended at or near the middle; in some ships over the ventilators, in others under them, when it is found necessary to fix them up to the deck. The best method to save room is to place the ventilators over one another with their circular ends together; the air-trunk should be so high above deck, that the men on deck may not be incommoded by the foul air which blows out of it: and there are the trunks come through the upper deck near and behind the foremast. For the method of freeing mines, gaols, &c. [illegible] by means of fire pipes, see [illegible].

VENTRICLE, properly denotes any little cavity; but is more particularly used by physicians and anatomists for the stomach, and for the cavities of the heart and brain.

VENTRILOQUISM, an art by which certain persons can so modify their voice, as to make it appear to the audience to proceed from any distance, and in any direction. Some faint traces of this art are to be found in the writings of the ancients; and it is the opinion of M. de la Chapelle, who in the year 1772 published an ingenious work on the subject, that the responses of many of the oracles were delivered by persons thus qualified to serve the purposes of priestcraft and delusion. As the ancient ventriloquists, when exercising their art, seemed generally to speak from their own bellies, the name by which they were designated was abundantly significant; but it is with no great propriety that modern performers are called *ventriloquists*, and their art *ventriloquism*; since they appear more frequently to speak from the pockets of their neighbours, or from the roof or distant corners of the room, than from their own mouths or their own bellies.

From Brodeau, a learned critic of the 16th century, we have the following account of one of these ventriloquist and cheat, who was valet de chambre to Francis the First. The fellow, whose name was *Louis Brabant*, had fallen desperately in love with a young, handsome, and rich heiress; but was rejected by the parents as an unsuitable match for their daughter, on account of the lowness of his circumstances. The young lady's father dying, he made a visit to the widow, who was totally ignorant of his singular talent. Suddenly, on his first appearance, in open day, in her own house, and in the presence of several persons who were with her, she heard herself accosted, in a voice perfectly resembling that of her dead husband, and which seemed to proceed from above, exclaiming, "Give my daughter in marriage to Louis Brabant: He is a man of great fortune and of an excellent character. I now endure the inexpressible torments of purgatory, for having refused her to him. If you obey this admonition, I shall soon be delivered from this place of torment. You will at the same time provide a worthy husband for your daughter, and procure everlasting repose to the soul of your poor husband."

The widow could not for a moment resist this dread summons, which had not the most distant appearance of proceeding from Louis Brabant; whose countenance exhibited no visible change, and whose lips were close and motionless, during the delivery of it. Accordingly, she consented immediately to receive him for her son-in-law. Louis's finances, however, were in a very low situation; and the formalities attending the marriage contract rendered it necessary for him to exhibit some show of riches, and not to give the ghost the lie direct. He accordingly went to work upon a fresh subject, one Cornu, an old and rich banker at Lyons; who had accumulated immense wealth by usury and extortion, and was known to be haunted by remorse of conscience on account of the manner in which he had acquired it.

Having contracted an intimate acquaintance with this man, he, one day while they were sitting together in the usurer's little back parlour, artfully turned the conversation on religious subjects, on demons and spectres, the pains of purgatory, and the torments of hell. During an interval of silence between them, a voice was heard, which to the astonished banker seemed to be that of his deceased father,

Ventrilo-quism.

complaining, as in the former cafe, of his dreadful fituation in purgatory, and calling upon him to deliver him inftantly from thence, by putting into the hands of Louis Brabant, then with him, a large fum for the redemption of Chriftians then in flavery with the Turks; threatening him at the fame time with eternal damnation if he did not take this method to expiate likewife his own fins. The reader will naturally fuppofe that Louis Brabant affected a due degree of aftonifhment on the occafion; and further promoted the deception, by acknowledging his having devoted himfelf to the profecution of the charitable defign imputed to him by the ghoft. An old ufurer is naturally fufpicious. Accordingly the wary banker made a fecond appointment with the ghoft's delegate for the next day; and, to render any defign of impofing upon him utterly abortive, took him into the open fields, where not a houfe, or a tree, or even a bufh, or a pit, were in fight, capable of fcreening any fuppofed confederate. This extraordinary caution excited the ventriloquift to exert all the powers of his art. Wherever the banker conducted him, at every ftep his ears were faluted on all fides with the complaints and groans not only of his father, but of all his deceafed relations, imploring him for the love of God, and in the name of every faint in the kalendar, to have mercy on his own foul and theirs, by effectually feconding with his purfe the intentions of his worthy companion. Cornu could no longer refift the voice of heaven, and accordingly carried his gueft home with him, and paid him down 10,000 crowns; with which the honeft ventriloquift returned to Paris, and married his miftrefs.—The cataftrophe was fatal. The fecret was afterwards blown, and reached the ufurer's ears, who was fo much affected by the lofs of his money, and the mortifying railleries of his neighbours, that he took to his bed and died.

This trick of Louis Brabant is even exceeded by an innocent piece of waggery played off not 40 years ago by another French ventriloquift on a whole community. We have the ftory from M. de la Chapelle, who informs us, that M. St Gill the ventriloquift and his intimate friend, returning home from a place whither his bufinefs had carried him, fought for fhelter from an approaching thunder ftorm in a neighbouring convent. Finding the whole community in mourning, he inquired the caufe, and was told that one of their body had died lately, who was the ornament and delight of the whole fociety. To pafs away the time, he walked into the church, attended by fome of the religious, who fhowed him the tomb of their deceafed brother, and fpoke feelingly of the fcanty honours they had beftowed on his memory. Suddenly a voice was heard, apparently proceeding from the roof of the quire, lamenting the fituation of the defunct in purgatory, and reproaching the brotherhood with their lukewarmnefs and want of zeal on his account. The friars, as foon as their aftonifhment gave them power to fpeak, confulted together, and agreed to acquaint the reft of the community with this fingular event, fo interefting to the whole fociety. M. St Gill, who wifhed to carry on the joke ftill farther, diffuaded them from taking this ftep; telling them that they would be treated by their abfent brethren as a fet of fools and vifionaries. He recommended to them, however, the immediately calling of the whole community into the church, where the ghoft of their departed brother might probably reiterate his complaints. Accordingly all the friars, novices, lay-brothers, and even the domeftics of the convent, were immediately fummoned and collected together. In a fhort time the voice from the roof renewed its lamentation and reproaches, and the whole convent fell on their faces, and vowed a folemn reparation. As a firft ftep, they chanted a *De profundis* in a full choir; during the intervals of which the ghoft occafionally expreffed the comfort he received from their pious exercifes and ejaculations on his behalf. When all was over, the prior entered into a ferious converfation with M. St Gill; and on the ftrength of what had juft paffed, fagacioufly inveighed againft the abfurd incredulity of our modern fceptics and pretended philofophers on the article of ghofts or apparitions. M. St Gill thought it now high time to difabufe the good fathers. This purpofe, however, he found it extremely difficult to effect, till he had prevailed upon them to return with him into the church, and there be witneffes of the manner in which he had conducted this ludicrous deception.

A ventriloquift, who performed feats fomewhat fimilar to thefe, made his appearance in Edinburgh, and many of the other towns of Scotland, a few months before the writing of this article. He imitated fuccefsfully the voice of a fqueaking child, and made it appear to proceed from whatever place he chofe; from the pockets of the company, from a wooden doll, with which he held many fpirited converfations; from beneath a hat or a wine-glafs, and out of any perfon's foot or hand. When the voice feemed to come from beneath a glafs or hat, it was dull and on a low key, as founds confined always are; and what evinced his dexterity was, that when the glafs was raifed from the table during the time of his fpeaking, the words or fyllables uttered afterwards were on a higher key, in confequence, one would have thought, of the air being readmitted to the fpeaker. This part of the experiment failed, however, when the management of the glafs was at a diftance committed to any of the company; but as the room was not well illuminated, we are inclined to attribute this failure to the ventriloquift's not being able to perceive at what precife inftant of time the glafs was removed from the table. The fame artift imitated the tones of a fcolding old woman, difturbed at unfeafonable hours by a perfon demanding admiffion into her houfe; but this exhibition did not to us appear mafterly. The tones of the old woman and the child were not accurately difcriminated: the child was a young fcold, and the fcold fpoke like an angry child. We have heard that, when in Edinburgh, the fame practitioner aftonifhed a number of perfons in the Fifhmarket, by making a fifh appear to fpeak, and give the lie to its vender, who affirmed that it was frefh, and caught in the morning; and whether this fact was really performed or not, we cannot doubt, from what we faw and heard him do, but that he was fully equal to its performance.

Our ventriloquift was an illiterate man; and though fufficiently communicative, could not make intelligible to us the manner in which he produced thefe acouftic deceptions. Indeed if he had, we fhould hardly have defcribed the practical rules of the art to the public; for though it is proper to make the exiftence of fuch an art univerfally known, it will readily occur to every reflecting mind, that the attainment of it fhould not be rendered eafy to thofe who, like Louis Brabant, might make it fubfervient to the purpofes of knavery and deception. The fpeculative principles on which it is founded muft be obvious to every man who has ftudied the philofophy of the human mind, and has ever witneffed the feats of mimickry.

It has been fhown elfewhere (fee METAPHYSICS, n° 47, 48.), that, previous to experience, we could not refer found to any external caufe; that it does not therefore give immediate indication of the place or diftance of the fonorous body; and that it is only by the affociation of place with found that the latter becomes an indication of the former. This being admitted, nothing feems requifite to fit a man for becoming an expert ventriloquift but a delicate ear, flexibility of the organs of fpeech, and long practice of thofe rules

rules which repeated trials would enable him to discover. A delicate ear perceives every difference which change of place produces in the same sound; and if a person possessed of such an ear have sufficient command over his organs of speech, to produce by them a sound in all respects similar to another proceeding from any distant object, it is evident that to the audience the sound which he utters must appear to proceed from that object. If this be the true theory of ventriloquism, it does not seem to be possible for the most expert ventriloquist to speak in his usual tones of conversation, and at the same time make the voice appear to come from a distance; for these tones must be supposed familiar to his audience, and to be in their minds associated with the ideas of his figure, place, and distance. Hence the ventriloquist whom we saw appeared to speak from various places only in the tones of the squeaking child, while Louis Brabant and M. St Gille, in their great feats, imitated the voices of ghosts, to which no man could be familiar, and where terror would greatly contribute to the deception. There can, however, be no doubt, but that if, by a peculiar modification of the organs of speech, a sound of any kind can be produced, which in faintness, tone, body, and in short every other sensible quality, perfectly resembles a sound delivered from the roof of an opposite house; the ear will naturally, without examination, refer it to that situation and distance, the sound which the person hears being only a sign, which he has from his infancy been constantly accustomed, by experience, to associate with the idea of a person speaking from a house-top. It is evident too, that when there is no particular ground of suspicion, any small disparity between the two sounds will not be perceptible. But if our theory be just, that experience or habit which misleads a person who has seldom heard the ventriloquist, and is a stranger to his powers, at length sets another person right who is acquainted with them, and has been a frequent witness of their effects. This was actually the case of M. de la Chapelle, with whom the illusion at length ceased, in consequence of repeated visits to M. St Gille: so that while others, ignorant of his talent, and possessed only of their old or habitual experience with regard to articulate sounds, considered his voice as coming from the top of a tree, or from a deep cellar under ground; our author, well acquainted with the powers of the ventriloquist, and having acquired a new kind of experience, at once referred it directly to the mouth of the speaker.

VENUS, in Pagan worship, the goddess of love and beauty. Cicero mentions two other deities of this name. Venus, styled *Urania* and *Coelestis*; and the *Venus Pandemos* or *Popularis*, the wife of Vulcan, and the goddess of wanton and effeminate love. To the first the Pagans ascribed no attributes but such as were agreeable to the strictest chastity and virtue; and of this deity they admitted no corporeal resemblance, she being only represented by the form of a globe, ending conically. Her sacrifices were termed *nephalia*, on account of their sobriety. To her honey and wine were offered, and no animal except the heifer; and on her altars the wood of figs, vines, or mulberries, were not suffered to be burnt. The Romans dedicated a temple to this goddess, to whom they gave the name of *Verticordia*; because she turned the hearts of lewd women, and inspired modesty and virtue.

But the most famous of these goddesses is the wife of Vulcan; who is represented as springing from the froth raised by the genitals of Saturn, when cut off by Jupiter and thrown into the sea. As soon as she was formed, she was laid in a beautiful shell embellished with pearl, and wafted by gentle zephyrs to the isle of Cytherea, whence she sailed to Cyprus. At her landing, flowers rose beneath her feet; she was received by the Hours, who braided her hair with golden fillets; and then wafted her to heaven, where her charms appeared so attractive, that most of the gods desired her in marriage; but Vulcan, by the advice of Jupiter, gained possession by putting poppies into her nectar. As Venus was the goddess of love and pleasure, the poets have been lavish in the description of her beauties; and the painters and statuaries have endeavoured to give her the most lovely form. Sometimes she is represented clothed in purple, glittering with gems, her head crowned with roses, and drawn in an ivory car by swans, doves, or sparrows; at others she stands attended by the Graces; but in all positions, her son Cupid is her inseparable companion. She was honoured as the mother of Hymeneus, Cupid, Æneas, and the Graces, and was passionately fond of Adonis and Anchises.

This goddess was principally worshipped at Paphos and Cyprus; and the sacrifices offered to her were white goats and swine, with libations of wine, milk, and honey. Her victims were crowned with flowers, or wreaths of myrtle.

VENUS, in astronomy. See ASTRONOMY-*Index*, and PNEUMATICS, n° 237.

VENUS's Fly-trap. See *DIONÆA Muscipula.*

VENUS, in zoology, a genus of insects belonging to the order of vermes testacea. The animal is a tethys: the shell is bivalve; the hinge with three teeth near each other, one placed longitudinally and bent inwards. There are a great many species; of which the most remarkable is the *mercenaria*, or commercial, with a strong, thick, weighty shell, covered with a brown epidermis; pure white within; slightly striated transversely. Circumference above 11 inches.—These are called in North America *clams*; they differ from other species only in having a purple tinge within. Wampum, or Indian money, is made of them.

VEPRECULÆ, diminutive from *vepres*, "a briar or bramble; the name of the 31st order in Linnæus's Fragments of a Natural Method. See BOTANY, Sect. 6.

VERA-CRUZ, a sea-port town of North America, in New Spain, with a very secure and commodious harbour, defended by a fort. Here the Flotilla annually arrives from Spain to receive the produce of the gold and silver mines of Mexico; and at the same time a fair is held here for all manner of rich merchandise brought from China and the East Indies by way of the South Sea, and for the merchandise of Europe by the way of the Atlantic Ocean. This town is not two miles in circumference; and about it there is a wall of no great strength on the land-side. The air is unwholesome; and there are very few Spaniards here unless when the Flotilla arrives, and then it is crowded with people from all parts of Spanish America. It is 200 miles south-east of Mexico. W. Long. 37. 25. N. Lat. 19. 12.

VERAGUA, a province of New Spain, bounded on the east by that of Costa Rica, on the west by Panama, on the north by Darien and the Gulf of Mexico, and on the south by the South Sea. It is about 125 miles in length from east to west, and 60 in breadth from north to south. It is a mountainous barren country; but has plenty of gold and silver. Conception is the capital town.

VERATRUM, in botany: A genus of plants of the class of *polygamia*, and order of *monoecia*; and in the natural system arranged under the 10th order, *Coronariæ*. There is no calyx; the corolla has six petals; there are six stamina: the hermaphrodite flowers have three pistils and three capsules. There are three species, none of which are natives of Britain.

The most important is the *album*, or hellebore, the root of which is perennial, about an inch thick, externally brown, internally white, and beset with many strong fibres: the

Veratrum || Verbascum.

stalk is thick, strong, round, upright, hairy, and usually rises four feet in height: the leaves are numerous, very large, oval, entire, ribbed, plaited, without footstalks, of a yellowish green colour, and surround the stem at its base: the flowers are of a greenish colour, and appear from June to August in very long, branched, terminal spikes.

It appears from various instances, that every part of the plant is extremely acrid and poisonous, as its leaves and even seeds prove deleterious to different animals.

Woodville's Medical Botany.

The ancients, though sufficiently acquainted with the virulency of their white hellebore, were not deterred from employing it internally in several diseases, especially those of a chronic and obstinate kind, as mania, melancholia, hydrops, elephantiasis, epilepsia, vitiligo, lepra, rabies canina, &c. They considered it the safer when it excited vomiting, and Hippocrates wished this to be its first effect. To those of weak constitutions, as women, children, old men, and those labouring under pulmonary complaints, its exhibition was deemed unsafe: and even when given to the robust, it was thought necessary to moderate its violence by different combinations and preparations; for it was frequently observed to effect a cure, not only by its immediate action upon the primæ viæ, but when no sensible evacuations was promoted by its use.

Greding employed it in a great number of cases of the maniacal and melancholic kind; the majority of these, as might be expected, derived no permanent benefit; several, however, were relieved, and five completely cured by this medicine. It was the bark of the root, collected in the spring, which he gave in powder, beginning with one grain: this dose was gradually increased according to its effects. With some patients one or two grains excited nausea and vomiting, but generally eight grains were required to produce this effect, though in a few instances a scruple and even more was given.

Veratrum has likewise been found useful in epilepsy, and other convulsive complaints; but the diseases in which its efficacy seems least equivocal, are those of the skin; as scabies and different prurient eruptions, herpes, morbus pediculosus, lepra, scrophula, &c. and in many of these it has been successfully employed both internally and externally.

As a powerful stimulant, and irritating medicine, its use has been resorted to only in desperate cases, and then it is first to be tried in very small doses in a diluted state, and to be gradually increased according to the effects.

VERB, in grammar. See GRAMMAR, Chap. IV.

VERBASCUM, in botany: A genus of plants of the class of *pentandria*, and order of *monogynia*; and in the natural system arranged under the 28th order, *Luridæ*. The corolla is rotated, and rather unequal: the capsule is monolocular and bivalved. There are 12 species, five of which are natives of Britain; 1. The *thapsus*, or great mullein, which has a stem single, simple, erect, covered with leaves, about six feet high. Leaves large, broad, white, woolly on both sides, sessile, decurrent. Flowers terminal, in a long spike, sessile, yellow.

Catarrhal coughs and diarrhœas are the complaints for which it has been internally prescribed. Dr Home tried it in both, but it was only in the latter disease that this plant succeeded. He relates four cases in which a decoction of verbascum was given; and from which he concludes, that it "is useful in diminishing or stopping diarrhœas of an old standing, and often in easing the pains of the intestines. These acquire a great degree of irritability; and the ordinary irritating causes, aliment, bile, distension from air, keep up a quicker peristaltic motion. This is obviated by the emollient and perhaps gentle astringent qualities of this plant."

2. The *nigrum*, or black mullein, having a stem beset with hairs that are beautifully branched; the blossoms yellow, with purple tips. It is a beautiful plant, and the flowers are grateful to bees. Swine eat it; sheep are not fond of it; cows, horses, and goats, refuse it. The other British species are the lychnitis, nigrum, blattaria, and virgatum.

Verbascum || Verbena.

VERBENA, in botany: A genus of plants of the class of *diandria*, and order of *monogynia*; and in the natural system arranged under the 40th order, *Personatæ*. There are 17 species, only one of which is a native of Britain; the *officinalis*, or common vervain, which grows on the road-sides near towns and villages. The leaves have many jagged clefts, the blossoms are pale blue. It manifests a slight degree of astringency, and was formerly much in vogue as a deobstruent; but is now disregarded. Mr Millar says that it is never found above a quarter of a mile from a house; whence the common people in England call it *Simpler's joy*, because, wherever it is found, it is a certain sign of a house being near. Sheep eat it; cows, horses, and goats refuse it.

VERD (Cape), a promontory on the west coast of Africa, 40 miles north-west of the mouth of the river Gambia. W. Long. 17. 38. N. Lat. 14. 25.

The islands of Cape de Verd are seated in the Atlantic Ocean, about 400 miles west of the Cape. They are between the 13th and 19th degree of latitude; and the principal are 10 in number, lying in a semicircle. Their names are, *St Antony*, *St Vincent*, *St Lucia*, *St Nicholas*, the *Isle of Sal*, *Bona Vista*, *Mayo*, *St Jago*, *Fuego*, and *Brava*.

VERDICT (*Vere dictum*), is the answer of the jury given to the court concerning the matter of fact, in any case civil or criminal, committed by the court to their trial and examination. See LAW, N° clxxxvi. 51. and TRIAL.

VERDIGRISE, the acetite of copper, much used by painters as a green colour. It is chiefly manufactured at Montpelier; the vines of Languedoc being very convenient for this purpose. See CHEMISTRY, n° 872.

The following process for making verdigrise is described by Mr Monet of the Royal Society of Montpelier, and is published among the memoirs of the academy for the years 1750 and 1753.

Vine-stalks well dried in the sun are steeped during eight days in strong wine, and afterwards drained. They are then put into earthen pots, and upon them wine is poured. The pots are carefully covered. The wine undergoes the acetous fermentation, which in summer is finished in seven or eight days; but requires a longer time in winter, although this operation is always performed in cellars. When the fermentation is sufficiently advanced, which may be known by observing the inner surface of the lids of the pots, which during the progress of the fermentation is continually wetted by the moisture of the rising vapours, the stalks are then to be taken out of the pots. These stalks are by this method impregnated with all the acid of the wine, and the remaining liquor is but a very weak vinegar. The stalks are to be drained during some time in baskets, and layers of them are to be put into earthen pots with plates of Swedish copper, so disposed that each plate shall rest upon and be covered with layers of stalks. The pots are to be covered with lids; and the copper is thus left exposed to the action of the vinegar, during three or four days, or more, in which time the plates become covered with verdigrise. The plates are then to be taken out of the pots, and left in the cellar three or four days; at the end of which time they are to be moistened with water, or with the weak vinegar above mentioned, and left to dry. When this moistening and drying

of the plates has been thrice repeated, the verdigrise will be found to have considerably increased in quantity; and it may then be scraped off for sale.

A solution or erosion of copper, and consequently of verdigrise, may be prepared by employing ordinary vinegar instead of wine, as is directed in the above process. But it would not have the unctuosity of ordinary verdigrise, which quality is necessary in painting. Good verdigrise must be prepared by means of a vinous acid, or solvent half acid and half spirituous. Accordingly, the success of the operation depends chiefly on the degree of fermentation to which the wine employed has been carried: for this fermentation must not have been so far advanced that no sensibly vinous or spirituous parts remained in the liquor.

Verdigrise is employed externally for deterging foul ulcers, and as an escharotic. It is rarely or never given internally. Some recommend it indeed in the dose of a grain or two as an emetic, which operates almost as soon as received into the stomach, and which may therefore be of use where poisonous substances have been taken, to procure their immediate rejection. It appears, however, highly imprudent to have recourse on such occasions to a remedy in itself so dangerous and so virulent; and more especially as a speedy evacuation may generally be obtained by means of substances which are not only innocent, but at the same time weaken the force of the poison by diluting and obtunding it; as warm water, milk, oils. It is accordingly excluded from the present pharmacopœiæ.

VERDITER, or VERDATER, a preparation of copper, sometimes used by the painters, &c. for a blue; but more usually mixed with a yellow for a green colour. See CHEMISTRY, n° 758, and COLOUR-Making, n° 28.

VERE (Sir Francis), a renowned English general, was the second son of Geffrey de Vere, a branch of the ancient family of that name, earls of Oxford, and was born in the year 1554. Concerning his education we are uninformed. About the age of 31 he embarked with the troops sent by Queen Elizabeth, under the command of the earl of Leicester, to the assistance of the states of Holland; in which service his courage and military genius became immediately conspicuous: but his gallant behaviour in the defence of Bergen-op-Zoom, in the year 1588, when besieged by the prince of Parma, established his reputation. After the siege was raised, he received the honour of knighthood from lord Willoughby, who succeeded the earl of Leicester in the command. He continued in the service of the states till about the year 1595; during which time, namely, in 1593, he was elected member of parliament for Leominster in Herefordshire. The famous expedition against Cadiz being resolved upon, Sir Francis Vere was called home, and appointed to a principal command under the earl of Essex. The success of this enterprise is universally known. In 1597 we find him again in Holland, present at the battle of Turnhout, of which he has given a particular description in his Commentaries. In the same year he embarked, with the earl of Essex, in the expedition to the Azores; and at his return was appointed governor of the Briel in Holland, with the command of the English troops in the service of the states. In 1600 he was one of the three generals at the battle of Newport, and had the honour of having the victory universally ascribed to his conduct and resolution. The states of Holland, then at war with Spain, marched their army with an intention to besiege Newport in Flanders. The commanders were, count Ernest of Nassau, count Somes, and Sir Francis Vere. The Spaniards marched to intercept them, and this battle ensued. Sir Francis was shot first through the leg, and then through the same thigh; notwithstanding which, he rallied the flying army, and led them on to victory. The Spaniards lost 120 ensigns, and most of their foot were slain. Queen Elizabeth on this occasion declared him the *worthiest captain of her time*. (See *Letters of the Sidney Family*, vol. ii. p. [illegible].) But the last and most glorious achievement of his life was his gallant defence of Ostend, with about 1600 men, against an army of 12,000, from July 1601 until March 1602, when he resigned the government, and returned to Holland. An account of this memorable siege, which lasted above three years, to the destruction of the best troops of Holland, Spain, France, England, Scotland, and Italy, the reader may see in *Vere's Commentaries*, with the Continuation at the end. Queen Elizabeth died in the year 1603: the peaceful James succeeded to the throne; and Sir Francis Vere, with all the heroes of his time, sheathed his sword. He died in 1608, in the 54th year of his age; and was buried in St John's Chapel in Westminster abbey, where a splendid monument was erected to his memory. He married the daughter of ——— Dent, a citizen of London, by whom he had three sons and two daughters, none of whom survived him. He will ever be remembered by posterity as one of the greatest heroes of our most heroic age. —The work above mentioned is intitled, "The Commentaries of Sir Francis Vere, being diverse pieces of service wherein he had command; written by himself by way of commentary." Cambridge, 1657, folio. It is elegantly printed, and adorned with prints of Sir Francis, Sir Horace Vere, Sir John Ogle, maps, and plans of battles, &c.

VERGE (*Virgata*), in law, signifies the compass of the king's court, which bounds the jurisdiction of the lord steward of the household; and which is thought to have been 12 miles round.

The term *verge* is also used for a stick or rod, whereby one is admitted tenant to a copyhold estate, by holding it in his hand, and swearing fealty to the lord of the manor.

VERGERS, certain officers of the courts of king's bench and common pleas, whose business it is to carry white wands before the judges. There are also vergers of cathedrals, who carry a rod tipped with silver before the bishop, dean, &c.

VERGIL (Polydore). See VIRGIL.

VERJUICE, a liquor obtained from grapes or apples, unfit for wine or cyder; or from sweet ones, whilst yet acid and unripe. Its chief use is in sauces, ragouts, &c. though it is also an ingredient in some medicinal compositions, and is used by the wax-chandlers to purify their wax.

VERMES, the sixth class of animals in the Linnean system, comprehending five orders. See NATURAL HISTORY, and ZOOLOGY.

VERMICELLI, or VERMICHELLY, a composition of flour, cheese, yolks of eggs, sugar, and saffron, reduced to a paste, and formed into long slender pieces like worms, by forcing it with a piston through a number of little holes. It was first brought from Italy, where it is in great vogue: it is chiefly used in soups and pottages, to provoke venery, &c.

VERMICULAR, an epithet given to any thing that bears a relation or resemblance to worms.

VERMIFORMIS, in anatomy, a term applied to various parts in the human body, bearing some resemblance to worms.

VERMILION, a very bright and beautiful red colour, composed of quicksilver and sulphur, in great esteem among the ancients under the name of *minium*; but what goes by the name of minium among us, is a preparation of lead, known also by the name of *red-lead*. See CHEMISTRY, n° 1404.

VERMIN, a collective name, including all kinds of little

animals and insects, which are hurtful or troublesome to mankind, beasts, or fruits, &c. as worms, lice, fleas, caterpillars, ants, flies, &c.

VERNACULAR, a word applied to something that is peculiar to any one country.

VERNAL, something belonging to the spring-season.

VERNIER SCALE, a scale excellently adapted for the graduation of mathematical instruments, thus called from its inventor Peter Vernier, a person of distinction in the Franche Comté. See NONIUS.

Vernier's method is derived from the following principle. If two equal right lines, or circular arcs, A, B, are so divided, that the number of equal divisions in B is one less than the number of equal divisions of A, then will the excess of one division of B above one division of A be compounded of the ratios of one of A to A, and of one of B to B.

For let A contain 11 parts, then one of A to A is as 1 to 11, or $\frac{1}{11}$. Let B contain 10 parts, then one of B to B is as 1 to 10, or $\frac{1}{10}$. Now $\frac{1}{10}-\frac{1}{11}=\frac{11-10}{10\times 11}=\frac{1}{10\times 11}=\frac{1}{10}\times\frac{1}{11}$.

Or if B contains n parts, and A contains $n+1$ parts; then $\frac{1}{n}$ is one part of B, and $\frac{1}{n+1}$ is one part of A. And $\frac{1}{n}-\frac{1}{n+1}=\frac{\overline{n+1}-n}{n\times\overline{n+1}}=\frac{1}{n}\times\frac{1}{n+1}$.

The most commodious divisions, and their aliquot parts, into which the degrees on the circular limb of an instrument may be supposed to be divided, depend on the radius of that instrument.

Let R be the radius of a circle in inches; and a degree to be divided into n parts, each being $\frac{1}{p}$th part of an inch.

Now the circumference of a circle, in parts of its diameter 2 R inches, is 3,1415926 × 2 R inches.

Then $360^\circ : 3{,}1415926\times 2\,R :: 1^\circ : \frac{3{,}1415926}{360}\times 2\,R$ inches.

Or, $0{,}01745329\times R$ is the length of one degree in inches.

Or, $0{,}01745329\times R\times p$ is the length of 1°, in pth parts of an inch.

But as every degree contains n times such parts, therefore $n=0{,}01745329\times R\times p$.

The most commodious perceptible division is $\frac{1}{8}$ or $\frac{1}{10}$ of an inch.

Example. Suppose an instrument of 30 inches radius, into how many convenient parts may each degree be divided? how many of these parts are to go to the breadth of the vernier, and to what parts of a degree may an observation be made by that instrument?

Now $0{,}01745\times R=0{,}5236$ inches, the length of each degree: and if p be supposed about $\frac{1}{8}$ of an inch for one division; then $0{,}5236\times p=4{,}188$ shows the number of such parts in a degree. But as this number must be an integer, let it be 4, each being 15′: and let the breadth of the vernier contain 31 of those parts, or $7\frac{3}{4}^\circ$, and be divided into 30 parts.

Here $n=\frac{1}{4}$; $m=\frac{1}{30}$; then $\frac{1}{4}\times\frac{1}{30}=\frac{1}{120}$ of a degree, or 30′, which is the least part of a degree that instrument can show.

If $n=\frac{1}{5}$, and $m=\frac{1}{36}$; then $\frac{1}{5}\times\frac{1}{36}=\frac{60}{5\times 36}$ of a minute, or 20″.

The following table, taken as examples in the instruments commonly made from 3 inches to 8 feet radius, shows the divisions of the limb to nearest tenths of inches, so as to be an aliquot of 60's, and what parts of a degree may be estimated by the vernier, it being divided into such equal parts, and containing such degrees as their columns show.

Rad. inches	Parts in a deg.	Parts in vernier.	Breadth of vernier.	Parts observed.	
3	1	15	$15\frac{1}{3}$	4′	0″
6	1	20	$20\frac{1}{3}$	3	0
9	2	20	$10\frac{1}{2}$	1	30
12	2	24	$12\frac{1}{2}$	1	15
15	3	20	$6\frac{2}{3}$	1	0
18	3	30	$10\frac{1}{3}$	0	40
21	4	30	$7\frac{3}{4}$	0	30
24	4	36	$9\frac{1}{4}$	0	25
30	5	30	$7\frac{1}{5}$	0	20
36	6	30	$5\frac{1}{6}$	0	20
42	8	30	$3\frac{7}{8}$	0	15
48	9	40	$4\frac{5}{9}$	0	10
60	10	36	$3\frac{7}{10}$	0	10
72	12	30	$2\frac{7}{12}$	0	10
84	15	40	$2\frac{2}{3}$	0	6
96	15	60	4	0	4

By altering the number of divisions, either in the degrees or in the vernier, or in both, an angle can be observed to a different degree of accuracy. Thus, to a radius of 30 inches, if a degree be divided into 12 parts, each being five minutes, and the breadth of the vernier be 21 such parts, or $1\frac{3}{4}^\circ$, and divided into 20 parts, then $\frac{1}{12}\times\frac{1}{20}=\frac{1^\circ}{240}=15''$: or taking the breadth of the vernier $2\frac{7}{12}^\circ$, and divided into 30 parts; then $\frac{1}{12}\times\frac{1}{30}=\frac{1^\circ}{360}$, or 10″: Or $\frac{1}{12}\times\frac{1}{50}=\frac{1^\circ}{600}=6''$; where the breadth of the vernier is $4\frac{1}{3}^\circ$.

VERONA, a city of Italy, capital of the Veronese, in the territory of Venice, situated near the mountains, on the river Adige, in E. Long. 11. 24. N. Lat. 45. 26. It is seven miles in compass; and has been so fortified by the Venetians, that it is now looked upon as impregnable. It contains 57,400 inhabitants.

VERONESE, a territory of Italy, in the republic of Venice, bounded on the north by the Trentino, on the east by the Vicentino and Paduano, on the south by the Mantuano, and on the west by the Bresciano. It is about 35 miles in length, and 27 in breadth; and is one of the most fertile countries in Italy, abounding in corn, wine, fruits, and cattle.

VERONESE. See CAGLIARI.

VERONICA, in botany: A genus of plants of the class of *diandria*, and order of *monogynia*; and in the natural system arranged under the 40th order, *Personatæ*. There are 40 species;

species; 15 are natives of Britain, only two of which have been applied to any use. 1. The *officinalis*, common male speedwell, or fluellin; a native of Britain, growing on heaths and barren grounds. The blossoms are blue, the leaves elliptical, serrated, and hairy. The leaves have a small degree of astringency, and are somewhat bitter. An infusion of them is recommended by Hoffman as a substitute for tea; but is more astringent and less grateful. The herb was formerly esteemed in medicine for various disorders, but is now almost totally disused. Cows, sheep, goats, and horses, eat it; swine refuse it. 2. The *beccabunga*, or common brook-lime, the flowers of which are blue, in loose lateral spikes; leaves sessile, oval, opposite, thick, notched.

This plant was formerly considered as of much use in several diseases, and was applied externally to wounds and ulcers; but if it have any peculiar efficacy, it is to be derived from its antiscorbutic virtue. As a mild refrigerant juice it is preferred where an acrimonious state of the fluids prevails, indicated by prurient eruptions upon the skin, or in what has been called the *hot scurvy*. We must, however, acknowledge, that we should expect equal benefit from the same quantity of any other bland fresh vegetable matter taken into the system. To derive much advantage from it, the juice ought to be used in large quantities, or the fresh plant eaten as food.

VERSAILLES, a town of France, in the late province of the Isle of France, 10 miles west-south-west of Paris. It contains 60,000 inhabitants, and since the Revolution has been created a bishop's see. In the reign of Louis XIII. it was only a small village. This prince built here a hunting-hut in 1630, which Bassompierre calls "the paltry chateau of Versailles." Although the situation was low and very unfavourable, Louis XIV. built a magnificent palace here, which was the usual residence of the kings of France till the 6th of October 1789, when the late unfortunate Louis XVI. and his family were removed from it to the Thuilleries. The buildings and the gardens are adorned with a vast number of statues, done by the greatest masters, and the water-works are all worthy of admiration. The great gallery is thought to be as curious a piece of workmanship of that kind as any in the world: nor is the chapel less to be admired for its fine architecture and ornaments. The gardens, with the park, are five miles in circumference, and surrounded by walls. There are three fine avenues to Versailles, one of which is the common road to Paris, the other comes from Seaux, and the third from St Cloud. E. Long. 2. 12. N. Lat. 48. 48.

VERSE, in poetry, a line consisting of a number of long and short syllables, which run with an agreeable cadence.

VERSE is also used for a part of a chapter, section, &c.

VERSIFICATION, the art or manner of making verse; also the tune and cadence of verse. See POETRY, Part III.

VERSION, a translation of some book or writing out of one language into another. See TRANSLATION.

VERT, in heraldry, the term for a green colour. It is called *vert* in the blazon of the coats of all under the degree of nobles: but in coats of nobility it is called *emerald*; and in those of kings *venus*. In engraving it is expressed by diagonals, or lines drawn athwart from right to left, from the dexter chief corner to the sinister base.

VERTEBRÆ, in anatomy. See there, n° 30.

VERTEX, in anatomy, denotes the crown of the head. Hence vertex is also used figuratively for the top of other things: thus we say, the vertex of a cone, pyramid, &c.

VERTEX, is also used in astronomy for the point of the heaven directly over our heads, properly called the *zenith*.

VERTICILLATÆ, the name of a class in Ray's and Boerhaave's Methods, consisting of herbaceous vegetables, having four naked seeds, and the flowers placed in whorls round the stalk. The term is synonymous to the *labiati*, or lip-flowers of Tournefort; and is exemplified in mint, thyme, and savory. Verticillatæ is also the name of the 42d order in Linnæus's Fragments of a Natural Method, consisting of plants which answer the above description.

VERTICILLUS, a mode of flowering, in which the flowers are produced in rings at each joint of the stem, with very short foot-stalks. The term is exemplified in mint, hore-hound, and the other plants of the natural order described above.

VERTICITY, is that property of the loadstone whereby it turns or directs itself to one particular point.

VERTIGO, in medicine. See there, n° 82.

VERTUMNUS, in mythology, a god who presided over gardens and orchards, honoured among the Etruscans, from whom the worship of this deity was transmitted to the Romans.

Ovid has described the various forms assumed by this deity, in order to obtain the love of Pomona. Some have supposed that Vertumnus, whose name they derive *a vertendo*, because he had power to change his form at pleasure, marked the year and its variations; and thus they say he pleased Pomona, by bringing the fruits to maturity. Accordingly, Ovid says, that he assumed the form of a labourer, reaper, vine-dresser, and old woman, to represent the four seasons, spring, summer, autumn, and winter. Vertumnus had a temple near the market-place at Rome, being represented as one of the tutelary deities of the merchants. The commentators on Ovid say, that he was an ancient king of Hetruria, who, by his diligent and successful cultivation of fruits and gardens, obtained the honour of being ranked among the gods.

VERUMONTANUM, in anatomy, a small eminence near the passages where the semen is discharged into the urethra.

VERVAIN, in botany. See VERBENA.

VERTOT d'AUBOEF (Rene Aubert de), a celebrated historian, was descended from a noble and ancient family in Normandy, and born in 1655. At 16 years of age he became a Franciscan friar; afterwards he entered into the order of the Premonstratenses, in which he had several benefices; and at length was a secular ecclesiastic. He became secretary to the duchess of Orleans, member of the Academy of Inscriptions, and historiographer of Malta. He died at Paris in 1735. His principal works are, 1. The History of the Revolutions of Sweden. 2. The Revolutions of Portugal. 3. The Revolutions of the Roman [illegible]. 4. The History of Malta. These works are written in elegant French, and translated into most of the languages of Europe.

VERULAM. See BACON.

VESALIUS (Andreas), a celebrated physician and anatomist, was born at Brussels about the year 1512. He studied physic at Paris under James Sylvius; but applied himself chiefly to anatomy, which was then very little known, dissections being [illegible] unlawful and [illegible]; and it appears from his work *De humani corporis fabrica*, that he perfected himself in this useful knowledge very early. About the year 1540, the republic of Venice made him professor in the university of Padua, where he taught anatomy for seven years: Charles V. called him to be his physician, as he was also to Philip II. king of Spain. Vesalius was now at the height of his glory, when all of a sudden he formed the design of taking a journey to Palestine: concerning which journey we are told the following story. A young Spanish nobleman he attended, being believed to

be

be dead, Vesalius obtained leave to open him to explore the true cause of his illness; but when he opened the breast, he perceived symptoms of life, and saw the heart beat. The parents, not satisfied with prosecuting him for murder, accused him of impiety to the inquisition, in hopes that tribunal would punish him with greater rigour: but the king interposing, saved him on condition of his making a pilgrimage to the Holy Land. He was shipwrecked on his return, and thrown upon the island of Zante, where he perished, in 1564. He was the author of several works, the principal of which is *De humani corporis fabrica*.

VESICATORIUM, a Blister; an application of an acrid nature made to any part of the body, in order to draw a flux of humours to that part, and thus elevate the scarf-skin into a blister.

VESPA, the wasp; a genus of insects belonging to the order of hymenoptera. The mouth consists of two jaws without any proboscis; the superior wings are plaited; the eyes are lunar; and there is a sharp sting in the tail. There are 159 species; only 3 of which are natives of Britain, the *crabro*, the *vulgaris*, and the *coarctata*.

1. *Crabro*, the hornet. It has tawny antennæ; the segments of the abdomen are black on the anterior part and yellow on the posterior, with two black spots on each. Its length is an inch; it builds in hollow trees. Its cakes or combs are composed of a substance like coarse paper, or rusty parchment. It is very voracious, devouring other insects, and even bees.

2. *Vulgaris*, the common wasp. The male has seven yellow segments of the abdomen, with a black triangle on each: The head is yellow, and the antennæ long. The upper lip of the female is yellow, the antennæ short; there are six segments of the abdomen with two lateral black spots on each. M. Reaumur and Dr Derham agree in distinguishing three sorts of wasps; *viz.* the queens or females, the males, and the common labouring wasps, called *mules*, which, according to Reaumur, are neither males nor females, and consequently barren. The queens, of which there is a great number, are much longer in the body, and larger than any other wasp: they have a large heavy belly, corresponding in size to the prodigious quantity of eggs with which they are charged. The males are less than the queens, but longer and larger than the common wasps, which are the smallest of the species: they have no stings, with which both the queens and common wasps are furnished. There are in one nest two or three hundred males, and as many females: but their number depends on the size of the nest; and Dr Derham observed, that the males were bred, or at least mostly resided, in the two cells or partings, between the combs, next to the uppermost cell. The antennæ or horns of the male wasps are longer and larger than those of either of the other sorts: but the chief difference, says Dr Derham, consists in their parts of generation, which are altogether different from those of other wasps.

The mules are the labourers belonging to a nest, and are employed in procuring materials for the nests and in constructing them, and also in furnishing the other wasps, and the young, with provisions.

At the beginning of winter, the wasps destroy all the eggs, and all the young ones without exception: all the mules and males, which have been employed in this work, being unfurnished with provisions, perish; and none survive except some few females, which, according to Reaumur, were fecundated in October, and raise a new colony in the beginning of spring.

In spring a new commonwealth is founded by a single female impregnated during the autumn, and that has weathered out the severity of the winter. It digs a hole in a dry soil, contrives itself a sinuous inlet, or else it takes up with the dwelling place of a mole, where it hastily builds a few cells and deposits its eggs. Within the space of 20 days, they have gone through the different states of larvæ, chrysalids, and turned to wasps. Nature all-wise provides for every thing. The mule-wasps are the only ones that labour at laying the foundation of the republic. The first eggs that are hatched prove to be neuter-wasps. No sooner are they come into existence, but they fall to work, enlarge the hole, and go about upon wood, lattice-work, and window sashes, in search of materials for building. With their teeth they cut, hack, and tear off small fibres of wood, which they moisten with a liquor they disgorge, and then convey them to the work-shop. Other labourers are in waiting for them, who with those materials set about the construction of the wasp-nest, which is commonly round, and made of materials resembling fine paper. The common covering of it, which is formed of several leaves or layers, with intermediate spaces, is pierced by two holes at a distance from one another, one of which is used for the entrance of the wasps, and the other only for their exit. The space within this covering is cut by a number of horizontal planes, with intervals between them of the size of about half an inch; they are suspended from one another by ligaments, and attached to the covering by their edges: they all have hexagonal cells in their lower surface.

The eggs of the wasp are of an oblong form, and resemble those of a common fly, but they are larger; they are always fastened to the angles of a cell, never to the sides of it. They are usually placed single; it is very rare to find two in one cell; and, if they are laid so, it seems that only one succeeds; for there is never found more than one worm in a cell.

The heads of all the nymphs are turned toward the centre of the comb, and their tails go obliquely downward toward the base of the cell. They are continually seen opening their mouths, and moving their forcipes, seeming ever hungry, and impatiently waiting for food from their parents. The cells are left open till the nymph is at its full growth; then the wasps cover it over with a thin lid, under which the worm undergoes its transformation; and as soon as it is arrived at the wasp-state, it eats its way through this thin cover, and comes to work with the rest. The elder brothers, or first-hatched insects, take amazing care of those born after them, by proportioning their food to the delicacy of their stomach. First, it consists of the juice of fruits and meats; afterwards it is the carcases of insects. The caterers provide for the labourers. Each one takes his own portion; there is no dispute, no fighting. The republic grows daily more numerous, living in profound peace. Every individual, as soon as he has acquired sufficient strength, flies away to the fields. They then become a gang of banditti; they pillage our wall-trees, break into our fruit before its maturity, dart with the fierceness of hawks upon our bees, cut their throats to possess themselves of their honey, plunder and lay waste their commonwealth, riot on the fruits of their labour, and oblige them to remove. During the period of plenty, the wasps bring all the booty to the nest, and share it amongst them. There is nothing then goes forwards but feasting, rioting, and good fellowship; but concord cannot be lasting among robbers. Towards the month of October provisions begin to run short: The neuters and males tear from their cradles the eggs, the larvæ, the chrysalids, and the new-born insects, without showing mercy to any. They next fight against one another. Frosts and rains throw the citizens into a state of languor,

languor, and they almost all perish, luckily for us and our bees, some few females alone excepted, which in the ensuing spring become founders of new republics.

3. *Coarctata*, the small wasp; has black antennæ, yellowish at the base; the head is black with a yellow spot between the antennæ, and another at the base of the upper lip. Each segment of the abdomen is bordered with yellow. It is about half an inch long. The history, as well as the manners of this species, are the same as those of the common wasp: but their buildings are on a different construction. Their nest is fastened to the branch of a tree with a kind of band: and is in bigness from the size of an orange down to that of an egg. Wood reduced to paper is the material part of it; which if it were of a ruddy colour, might be taken for a large opening rose. It is covered over with a varnish impenetrable by water. One of these nests was neither mollified nor impaired by that element.

VESPASIAN, the 10th emperor of Rome; remarkable for his clemency and other virtues. See ROME, n° 322—330.

VESPERS, in the church of Rome, denote the afternoon service; answering in some measure to the evening prayers of the church of England.

VESPERTILIO, the BAT; a genus of quadrupeds, belonging to the order of *primates*. All the teeth are erect, pointed, near each other; and the first four are equal. The fore-feet have the toes connected by a membrane expanded into a kind of wings by which the creature is enabled to fly. There are 28 species, of which 4 are natives of Britain. The most remarkable are,

1. The *vampyrus*, vampire, or Ternate bat, with large canine teeth; four cutting teeth above, the same below; sharp black nose; large naked ears; the tongue is pointed, terminated by sharp aculeated papillæ; talons very crooked, strong, and compressed sidewise; no tail: the membrane divided behind quite to the rump: head of a dark ferruginous colour; on the neck, shoulder, and under side, of a much lighter and brighter red; on the back the hair shorter, dusky, and smooth: the membranes of the wings dusky. They vary in colour; some being entirely of a reddish brown, others dusky.

These monsters inhabit Guinea, Madagascar, and all the islands from thence to the remotest in the Indian Ocean. They fly in flocks, and perfectly obscure the air with their numbers; they begin their flight from one neighbouring island to another immediately on sunset, and return in clouds from the time it is light till sun-rise. They live on fruits: and are so fond of the juice of the palm tree, that they will intoxicate themselves with it till they drop on the ground. It is most likely, from the size of their teeth, they are carnivorous. Mr Edwards relates, that they will dip into the sea for fish. They swarm like bees; hanging by one another from the trees in great clusters. The Indians eat them, and declare the flesh to be very good: they grow exceffively fat at certain times of the year. The French who live in the Isle de Bourbon boil them in their bouillon, to give it a relish. The negroes have them in abhorrence. Many are of an enormous size: Beckman measured one, whose extent from tip to tip of the wings was five feet four inches; and Dampier another, which extended farther than he could reach with out-stretched arms. Their bodies are from the size of a pullet to that of a dove: their cry is dreadful, their smell rank, their bite, resistance, and fierceness great, when taken.

The ancients had some knowledge of these animals. Herodotus mentions certain winged wild beasts like bats, that molested the Arabs who collected the cassia, to such a degree, that they were obliged to cover their bodies all but their eyes, with skins. It is very probable, as M. de Buffon remarks, it was from such relations that poets formed their fictions of Harpies.

Linnæus gives this species the title of *vampyre*; conjecturing it to be the kind which draws blood from people in their sleep. M. de Buffon denies it; attributing that faculty only to a species found in South America. But there is reason to imagine that this thirst after blood is not confined to the bats of one continent nor to one species: for Bontius and Nieuhoff inform us, that the bats of Java seldom fail attacking persons who lie with their feet uncovered, whenever they can get access; and Gumilla, after mentioning a greater and less species found on the banks of the Oronoque, declares them to be equally greedy after human blood. Persons thus attacked have been known to be near passing from a sound sleep into eternity. The bat is so dexterous a bleeder, as to insinuate its aculeated tongue into a vein without being perceived, and then suck the blood till it is satiated; all the while fanning with its wings, and agitating the air in that hot climate in so pleasing a manner, as to fling the sufferer into a still sounder sleep. It is therefore very unsafe to rest either in the open air, or to leave open any entrance to these dangerous animals: but they do not confine themselves to human blood; for M. Condamine says, that in certain parts of America they have destroyed all the great cattle introduced there by the missionaries. See Plate DX. fig. 3.

2. The *spectrum*, or spectre, with a long nose; large teeth; long, broad, and upright ears: at the end of the nose a long conic erect membrane, bending at the end, and flexible: hair on the body cinereous, and pretty long: wings full of ramified fibres: the membrane extends from hind leg to hind leg; no tail; but from the rump extend three tendons, terminating at the edge of the membrane. By Seba's figure the extent of the wings are two feet two inches; from the end of the nose to the rump, seven inches and an half.

Inhabits South America; lives in the palm trees; grows very fat; called *vampyre* by M. de Buffon, who supposes it to be the species that sucks human blood: but neither Piso, nor any other writer who mentions the fact, gives the least description of the kind.

3. The *Peruvian* bat hath a head like a pug-dog; large straight-pointed ears; two canine teeth, and two small cutting teeth between each, in each jaw: the tail is inclosed in the membrane which joins to each hind-leg, and is also supported by two long cartilaginous ligaments involved in the membrane: colour of the fur, iron grey: body equal to that of a middle-sized rat: extent of the wings two feet five inches.

4. The *noctule* hath the nose slightly bilobated; ears small and rounded; on the chin a minute verruca; hair reddish ash-colour: length of the rump two inches eight-tenths; tail one inch seven tenths; extent of wings 13 inches. Inhabits Great Britain and France; flies high in search of food, not skimming near the ground. A gentleman informed Mr Pennant of the following fact relating to those animals, which he was witness to: That he saw taken under the eaves of Queen's College, Cambridge, in one night, 185; the second night, 63; the third night, 2; and that each that was measured had 15 inches extent of wings.

5. The *murinus*, common bat; has a tail: the lips and nose are simple; and the ears are smaller than the head.

It inhabits Europe, and is found in Britain. This animal flies only during the night, living chiefly on moths: when it lights on the ground it is unable to rise again till it has crawled to some height. It remains torpid during win-

ter, revives in the beginning of the spring, and comes abroad in the dusk of the evening. This species is two inches and a half long, when full grown, and about nine inches in extent; the fur is of a mouse-colour, tinged with reddish; it generally skims near the ground, with an uneven jerking flight; and often seeking for gnats and other aquatic insects, flies close by the surface of water. It breeds in the summer season, and is preyed on by owls.

Bats are very voracious, if proper food is to be had; and though moths and other insects be their natural and common food, yet if flesh, whether raw or roasted, fresh or corrupted, comes in their way, they devour it with greediness. In this country they appear abroad early in spring, flying about only in the evenings; but are sometimes routed from their torpidity by a warm day or two during winter, and will then venture out in quest of food, but recommence their state of hybernation whenever the cold returns: They retire at the end of summer into caves, ruined houses, or the roofs and eaves of houses, where they remain suspended by the hind legs, and enveloped in their wings, generally in large numbers. Bats may be caught by means of the flower cups of bur-dock, whitened and thrown up in the way of their flight; they are attracted by the whiteness, and the hooks of the bur, sticking to their membranous wings, make them fall to the ground.

VESSEL, a general name given to the different sorts of ships which are navigated on the ocean, or in canals and rivers. It is, however, more particularly applied to those of the smaller kind, furnished with one or two masts. See SHIP.

VESTA, in pagan worship, the same with Cybele. See CYBELE.

VESTA the *Younger*, in pagan worship, the goddess of Fire, was the daughter of Saturn and Cybele, and the sister of Ceres. She was so much in love with chastity, that on Jupiter's ascending the throne and offering to grant whatever she asked, she only desired the preservation of her virginity, which she obtained.—Vesta was not represented in her temple by any image.

VESTALIA, in Roman antiquity, a festival celebrated in honour of the goddess Vesta, on the 5th of the ides of June: that is, on the ninth of the month.

VESTALS, among the ancient Romans, were priestesses of the goddess Vesta, and had the perpetual fire committed to their charge: they were at first only four in number, but afterwards increased to six; and it does not appear that their number ever exceeded six, among whom was one superior to the rest, and called *vestalis maxima*.

The vestals were chosen from six to ten years of age, and obliged to strict continency for 30 years; the first 10 of which were employed in learning the ceremonies of religion, the next 10 in the performance of them, and the 10 last in teaching them to the younger vestals.

The habit of the vestals consisted of an head-dress, called *infula*, which sat close to the head, and from whence hung certain laces called *vittæ*; a kind of surplice made of white linen, and over it a purple mantle with a long train to it.

VESTIBLE, in architecture, a kind of entrance into a large building; being an open place before the hall, or at the bottom of the staircase.

VESTRY, a place adjoining to a church, where the vestments of the minister are kept; and also a meeting at such place, consisting of the minister, church-wardens, and chief men of most parishes, who make a parish vestry or meeting. By custom there are select vestries, being a certain number of persons chosen to have the government of the parish, make rates, and take the accounts of church-wardens, &c.

VESUVIUS, a celebrated volcano of Italy, six miles east from the city of Naples. This mountain has two tops; one of which only goes by the name of *Vesuvius*, the other being now called *Somma*; but Sir William Hamilton is of opinion, that the latter is what the ancients called *Vesuvius*.

The perpendicular height of Vesuvius is only 3700 feet, though the ascent from the foot to the top is three Italian miles. One side of the mountain is well cultivated and fertile, producing great plenty of vines; but the south and west sides are entirely covered with cinders and ashes; while a sulphureous smoke constantly issues from the top, sometimes attended with the most violent explosions of stones, the emission of great streams of lava, and all the other attendants of a most formidable volcano. The first of these eruptions recorded in history took place in the year 79; at which time the two cities of Pompeii and Herculaneum were entirely buried under the stones and ashes thrown out. Incredible mischief was also done to the neighbouring country, and numbers of people lost their lives, among whom was Pliny the Elder.

It is the opinion of the best judges, however, that this eruption was by no means the first that had ever happened. The very streets of those cities which were at that time overwhelmed are said to be partly paved with lava. Since that time 30 different eruptions have been recorded, some of which have been extremely violent. In the year 1538, a mountain, three miles in circumference and a quarter of a mile in perpendicular height, was thrown up in the course of one night. In the year 1766, Sir William Hamilton, ambassador to his Sicilian Majesty, began to observe the phenomena of this mountain; and since that time the public has been favoured with much more exact and authentic accounts of the various changes which have taken place in Vesuvius than what were to be had before.

The first great eruption taken notice of by this gentleman was that of 1767, which, though very violent, was mild in comparison with that of 1538.

From this time (1767) Vesuvius never ceased for ten years to send forth smoke, nor were there many months in which it did not throw out stones, scoriæ, and cinders; which, increasing to a certain degree, were usually followed by lava; so that from the year 1767 to 1779 there were nine eruptions, some of them very considerable. In the month of August that year, however, an eruption took place, which, for its extraordinary and terrible appearance, may be reckoned among the most remarkable of any recorded concerning this or any other volcano.

During the whole month of July the mountain continued in a state of fermentation. Subterraneous explosions and rumbling noises were heard; quantities of smoke were thrown up with great violence, sometimes with red-hot stones, scoriæ, and ashes; and towards the end of the month these symptoms increased to such a degree as to exhibit, in the night time, the most beautiful fire-works that can be imagined.

On Thursday 5th August the volcano appeared most violently agitated; a white and sulphureous smoke issued continually and impetuously from its crater, one puff seeming to impel another; so that a mass of them was soon accumulated, to appearance, four times the height and size of the volcano itself. These clouds of smoke were exceedingly white, so that the whole resembled an immense accumulation of bales of the whitest cotton. In the midst of this very white smoke, vast quantities of stones, scoriæ, and ashes, were thrown up to the height of 2000 feet; and a quantity of

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of liquid lava, seemingly very heavy, was lifted up just high enough to clear the rim of the crater, and take its way down the sides of the mountain. This lava, having run violently for some hours, suddenly ceased, just before it had reached the cultivated parts of the mountain, near four miles from the spot whence it issued. The heat, all this day, was intolerable at the towns of Somma and Ottaiano; and was sensibly felt at Palma and Lauri, which are much farther off. Reddish ashes fell so thick on the two former, that the air was darkened, so that objects could not be distinguished at the distance of ten feet. Long filaments of a vitrified matter, like spun glass, were mixed, and fell with these ashes; several birds in cages were suffocated, and the leaves of the trees in the neighbourhood of Somma were covered with white and very corrosive salt.

About 12 at night, on the *7th*, the fermentation of the mountain seemed greatly to increase. Our author was watching the motions of the volcano from the mole at Naples, which has a full view of it. Several glorious picturesque effects had been observed from the reflection of the deep red fire within the crater of Vesuvius, and which mounted high amongst those huge clouds on the top of it: when a summer storm, called in that country a *tropea*, came on suddenly, and blended its heavy watery clouds with the sulphureous and mineral ones, which were already like so many other mountains piled up on the top of the volcano. At this moment a fountain of fire was shot up to an incredible height, casting so bright a light, that the smallest objects were clearly distinguishable at any place within six miles or more of Vesuvius. The black stormy clouds, passing swiftly over, and at times covering the whole or a part of the bright column of fire, at other times clearing away and giving a full view of it, with the various tints produced by its reverberated light on the white clouds above in contrast with the pale flashes of forked lightning that attended the tropea, formed such a scene as no power of art can express. One of his Sicilian majesty's gamekeepers, who was out in the fields near Ottaiano whilst this storm was at its height, was surprised to find the drops of rain scald his face and hands; a phenomenon probably occasioned by the clouds having acquired a great degree of heat in passing through the above mentioned column of fire.

On the *8th* the mountain was quiet till towards six o'clock in the evening, when a great smoke began to gather over its crater; and about an hour after a rumbling subterraneous noise was heard in the neighbourhood of the volcano; the usual throws of red-hot stones and scoriæ began and increased every instant. The crater, viewed through a telescope, seemed much enlarged by the violence of last night's explosions, and the little mountain on the top was entirely gone. About nine o'clock a most violent report was heard at Portici and its neighbourhood, which shook the houses to such a degree as made the inhabitants run out into the streets. Many windows were broken, and walls cracked by the concussion of the air on this occasion, though the noise was but faintly heard at Naples. In an instant a fountain of liquid transparent fire began to rise, and gradually increasing, arrived at last at the amazing height of ten thousand feet and upwards. Puffs of smoke, as black as can possibly be imagined, succeeded one another hastily, and accompanied the red-hot, transparent, and liquid lava, interrupting its splendid brightness here and there by patches of the darkest hue. Within these puffs of smoke, at the very moment of emission, a bright but pale electrical fire was observed playing briskly about in zig-zag lines. The wind was south-west, and, though gentle, was sufficient to carry these puffs of smoke out of the column of fire; and a collection of them by degrees formed a black and extensive curtain behind it; in other parts of the sky it was perfectly clear, and the stars bright. The fiery fountain, of such immense magnitude, on the dark ground just mentioned, made the finest contrast imaginable; and the blaze of it reflected from the surface of the sea, which was at that time perfectly smooth, added greatly to this sublime view.

The lava, mixed with stones and scoria, having risen to the amazing height already mentioned, was partly directed by the wind towards Ottaiano, and partly falling, still red-hot and liquid, upon the top of Vesuvius, covered its whole cone, part of that of the summit of Somma, and the valley between them. The falling matter, being nearly as inflamed and vivid as that which was continually issuing fresh from the crater, formed with it one complete body of fire, which could not be less than two miles and a half in breadth, and of the extraordinary height above mentioned, cast a heat to the distance of at least six miles round. The brushwood on the mountain of Somma was soon in a blaze, and the flame of it being of a different colour from the deep red of the matter thrown out by the volcano, and from the silvery blue of the electrical fire, still added to the contrast of this most extraordinary scene.

The black cloud, increasing greatly, once bent towards Naples, and threatened the city with speedy destruction; for it was charged with electrical fire, which kept constantly darting about in bright zig-zag lines. This fire, however, rarely quitted the cloud, but usually returned to the great column of fire whence it proceeded; though once or twice it was seen to fall on the top of Somma, and set fire to some dry grass and bushes. Fortunately the wind carried back the cloud just as it reached the city, and had begun to occasion great alarm. The column of fire, however, still continued, and diffused such a strong light, that the most minute objects could be discerned at the distance of ten miles or more from the mountain. Mr Morris informed our author, that at Sorrento, which is twelve miles distant from Vesuvius, he read the title-page of a book by that volcanic light.

All this time the miserable inhabitants of Ottaiano were involved in the utmost distress and danger by the showers of stones which fell upon them, and which, had the eruption continued for a longer time, would most certainly have reduced their town to the same situation with Herculaneum and Pompeii. The mountain of Somma, at the foot of which the town of Ottaiano is situated, hides Vesuvius from the view of its inhabitants; so that till the eruption became considerable it was not visible to them. On Sunday night, when the noise increased, and the fire began to appear above the mountain of Somma, many of the inhabitants flew to the churches, and others were preparing to quit the town, when a sudden and violent report was heard; soon after which they found themselves involved in a thick cloud of smoke and ashes: a horrid clashing noise was heard in the air, and presently fell a vast shower of stones and large pieces of scoriæ, some of which were of the diameter of seven or eight feet, which must have weighed more than a hundred pounds before they were broken, as some of the fragments which Sir William Hamilton found in the streets still weighed upwards of 100 pounds. When these large vitrified masses either struck against one another in the air, or fell on the ground, they broke in many pieces, and covered a large space of ground with vivid sparks of fire, which communicated their heat to every thing that was combustible. These masses were formed of the liquid lava; the exterior parts of which were become black and porous by cooling in their fall through such a vast space; whilst the interior parts, less exposed, retained an extreme heat, and were perfectly red.

8 Distress of the inhabitants of Ottaiano.

In an instant the town and country about it was on fire in many

many parts, for there were several straw huts in the vineyards, which had been erected for the watchmen of the grapes; all of which were burnt. A great magazine of wood in the heart of the town was all in a blaze; and had there been much wind, the flames would have spread universally, and all the inhabitants would have been burnt in their houses; for it was impossible for them to stir out. Some, who attempted it with pillows, tables, chairs, the tops of wine casks, &c. on their heads, were either knocked down or soon driven back to their close quarters under arches and in the cellars of their houses. Many were wounded, but only two persons died of their wounds.

To add to the horror of the scene, incessant volcanic lightning was whisking about the black cloud that surrounded them, and the sulphureous smell and heat would scarcely allow them to draw their breath. In this dreadful situation they remained about 25 minutes, when the volcanic storm ceased all at once, and Vesuvius remained sullen and silent.

9 Vast quantity of electric matter in the air.

Some time after the eruption had ceased, the air continued greatly impregnated with electrical matter. The duke of Cottoñano told our author, that having, about half an hour after the great eruption had ceased, held a Leyden bottle, armed with a pointed wire, out at his window at Naples, it soon became considerably charged. But whilst the eruption was in force, its appearance was too alarming to allow one to think of such experiments.—He was informed also by the prince of Monte Mileto, that his son, the duke of Popoli, who was at Monte Mileto the 8th of August, had been alarmed by the shower of cinders that fell there; some of which he had sent to Naples, weighing two ounces; and that stones of an ounce weight had fallen upon an estate of his ten miles farther off. Monte Mileto is about 30 miles from the volcano. The Abbé Cagliari also related, that his uncle, a canon in a convent at Manfredonia, had written to inquire after him, imagining that Naples must have been destroyed, when they, at so great a distance, had been alarmed by a shower of ashes which fell on the city at eleven o'clock at night, so much as to open all the churches, and go to prayers. As the great eruption happened at nine o'clock, these ashes must have travelled an hundred miles in the space of two hours.

10 Deplorable state of the town of Ottaiano.

Nothing could be more dismal than the appearance of Ottaiano after this eruption. The houses were unroofed, half buried under the black stones and ashes; all the windows towards the mountain were broken, and some of the houses themselves burnt; the streets choked up with ashes, in some narrow places not less than four feet thick; and a few of the inhabitants who had just returned, were employed in clearing them away, and piling them up in hillocks, to get at their ruined houses. The palace of the prince of Ottaiano is situated on an eminence above the town, and nearer the mountain. The steps leading up to it were deeply covered with volcanic matter; the roof was totally destroyed, and the windows broken, but the house itself, being strongly built, had not suffered much.

11 Vast fragments of lava thrown out.

An incredible number of fragments of lava were thrown out during the eruption, some of which were of immense magnitude. The largest measured by Sir William Hamilton [illegible] in circumference and 17 in height. This was thrown at least a quarter of a mile clear of the mouth of the volcano. [illegible] Our author [illegible] described by M. de St Fond, in his Treatise of Extinguished Volcanoes. A third of 16 feet in height and 92 in circumference was thrown much farther, and lay in the valley between Vesuvius and the Hermitage. It appeared also, from the large fragments that surrounded this mass, that it had been much larger while in the air.

Vesuvius continued to emit smoke for a considerable time after this great eruption, so that our author was apprehensive that another would soon ensue; but from that time nothing comparable to the above has taken place. From the time of this great eruption to the year 1786 our author kept an exact diary of the operations of Vesuvius, with drawings, showing, by the quantity of smoke, the degree of fermentation within the volcano. The operations of the subterraneous fire, however, appear to be very capricious and uncertain. One day there will be the appearance of a violent fermentation, and the next every thing will be calmed; but whenever there has been a considerable ejection of scoriæ and cinders, it has been a constant observation, that the lava soon made its appearance, either by boiling over the crater, or forcing its way through the crevices in the conical part of the mountain. An eruption took place in the month of November 1784, and continued for some time, but without being accompanied with any extraordinary circumstance. 12 Eruption in 1784.

13 State of Vesuvius to the present time.

Since that time there have been no remarkable eruptions of this volcano, at least none that have been properly authenticated; though, indeed, Sir William Hamilton observes, that the inhabitants of Naples in general pay so little attention to the operations of this volcano, that many of its eruptions pass unnoticed by at least two-thirds of them.

VETCH, in botany. See VICIA.

VETERAN, among the ancient Romans, an appellation given to a *soldier* grown old in the service, or who had made a certain number of campaigns.

VETERINARY ART. See FARRIERY.

VEXILLUM, in botany; the upper petal of a pea-bloom, or butterfly-shaped flower, which is generally larger than any of the others.

VIALES, in mythology, a name given among the Romans to the gods who had the care and guard of the roads and highways.

VIATICUM, in Roman antiquity, an appellation given in common to all officers of any of the magistrates; as *lictors, accensi, scribes, criers*.

VIBEX, is sometimes used, by physicians, for a black and blue spot in the skin occasioned by an afflux or extravasation of blood.

VIBRATION, in mechanics, a regular, reciprocal motion of a body, as a pendulum.

VIBURNUM, in botany; a genus of plants of the class *pentandria*, order *trigynia*, and in the natural system arranged under the 43d order, *dumosæ*. The calyx is quinquepartite and above; the corolla divided into five laciniæ; the fruit a monospermous berry. There are 19 species; two of which, the *lantana* and *opulus*, are natives of Britain. 1. The *lantana*, common viburnum, wayfaring, or pliant meally tree, rises with a woody stem, branching twenty feet high, having very pliant shoots covered with a lightish brown bark; large heart-shaped, veined, serrated leaves, white and hoary underneath; and the branches terminated by umbels of white flowers, succeeded by bunches of red berries, &c. 2. The *opulus*, or *guelder rose*; consisting of two varieties, one with flat flowers, the other globular. The former grows eighteen or twenty feet high, branching opposite, of an irregular growth, and covered with a whitish bark; large lobated or three-lobed leaves on glandulose foot-stalks, and large flat umbels of white flowers at the ends of the branches, succeeded by red berries. The latter grows fifteen or

or eighteen feet high, branching like the other, garnished with large lobated or three-lobed leaves, on glandular footstalks; and large globular umbels of white flowers at the ends of the branches, in great abundance. This tree when in bloom exhibits a singularly fine appearance: the flowers, though small, are collected numerously into large globular umbels round like a ball; hence it is sometimes called *snow-ball-trees*. 3. The *tinus*, common laurustinus, or evergreen viburnum; grows eight or ten feet high or more, branching numerously from the bottom upwards, assuming a close bushy growth, with the branches somewhat hairy and glandulous; very closely garnished with oval, wholly entire leaves, of a strong green colour, placed in pairs opposite; and whitish and red flowers, collected numerously in large umbellate clusters all over the plant, at the sides and ends of the branches, from January until March or April, exhibiting a most beautiful appearance. There are a great many varieties. All the different species of viburnum, both deciduous and evergreen kinds, being of the tree kind, are woody and durable in root, stem, and branches. They may all be propagated by layers; and are of such hardy temperature, as to grow freely in the open ground all the year, in shrubberies, and other hardy plantations.

VICAR, a person appointed as deputy to another, to perform his functions in his absence, and under his authority.

VICAR, in the canon-law, denotes a priest of a parish, the predial tithes whereof are impropriated or appropriated; that is, belong either to a chapter, religious house, &c. or to a layman who receives them, and only allows the vicar the small tithes, or a convenient salary. See the article *Parson and Vicar*.

VICE, in ethics, is ordinarily defined an elective habit, denoting either an excess or defect from the just medium wherein virtue is placed.

VICE, in smithery and other arts conversant in metals, a machine or instrument serving to hold fast any thing they are at work upon, whether it is to be beat, filed, or rivetted.

VICE is also used in the composition of divers words to denote the relation of something that comes instead or in the place of another; as vice-admiral, vice-chancellor, &c. are officers who take place in the absence of admirals, &c.

VICEROY, a governor of a kingdom, who commands in the name and instead of a king, with full and sovereign authority.

VICIA, in botany: A genus of plants of the class *diadelphia*, and order of *decandria*; and in the natural system arranged under the 32d order, *Papilionaceæ*. The stigma is bearded transversely on the lower side. There are 20 species, 7 of which are natives of Britain. The most important of these are, 1. The *sativa*, common vetch, or tare. The stalks are round, weak, branched, about two feet long. Pinnæ five or seven pair, a little hairy, notched at the end. Stipulæ dentated. Flowers light and dark purple, on short pedicles, generally two together; pods erect; seeds black. It is known to be an excellent fodder for horses. 2. The *cracca*, tufted vetch. It has a stem branched, three or four feet long. Leaves pinnated; pinnæ generally ten or twelve pair, lance shaped, downy. Stipulæ entire. Flowers purple, numerous, pendulous, in imbricated spikes. It is also reckoned an excellent fodder for cattle. 3. The *faba*, or common garden bean. It is a native of Egypt. It is too well known to require description.

VICISSITUDE, the regular succession of one thing after another; as the vicissitude of day and night, of the seasons, &c.

VICTIM, denotes a sacrifice offered to some deity, of a living creature, as a man or beast, which is slain to appease his wrath, or to obtain some favour.

VICTOR (Sextus Aurelius), a Roman [illegible] who flourished under the emperors [illegible] and [illegible], as we learn from many passages in his own writings [illegible] Ammianus Marcellinus. This historian [illegible] that Constantius made him consul, and [illegible] them, or [illegible]; [illegible] as he owns [illegible], he was [illegible] of poor and illiterate parents. It is [illegible] that he was an African: it is certain, that he dwells much upon the praises of that country, [illegible] of the earth; *decus terrarum*. Two [illegible] in the historical way: one *De viris illustribus urbis Romæ*; the other, *De Cæsaribus*, to which is [illegible] *De origine gentis Romanæ*. The whole makes an abridged history of Rome, from its foundation down to the emperor Julian inclusive.

VICTORY, the overthrow or defeat of an enemy in war or combat.

VICTORY, in pagan worship, is represented by Hesiod as the daughter of Styx and Pallas, and Varro calls her the *daughter of Heaven and Earth*. The Romans erected a temple to her, where they prayed to the gods to give success to their arms. They painted her in the form of a woman, clad in cloth of gold. In some medals, she is represented with wings flying through the air, holding a laurel crown in one hand and a palm in the other. In [illegible] medals, she is seen standing upon a globe, with the same crown and branch of palm.

VIDA (Marcus Hieronymus), bishop of Alva, in Mountferrat, and one of the most excellent Latin poets that have appeared since the Augustan age, was born at Cremona in 1470. Having distinguished himself by his learning and taste for literature, he was made bishop of Alva in 1552. After continuing two years with pope Clement VII. at Rome, he went to reside upon his see; where, for 30 years, he performed all the offices of a good bishop and a good man; and though he was mild, gentle, and full of goodness, he was so far from wanting spirit, that when the city of Alva was besieged by the French, he used all possible means to prevent its being given up, by strenuously exhorting the people, and, when provisions were scarce, by supplying them at his own expence. His poetics, and poem on the silk-worm, pass for his masterpiece; his poem on the game of chess is also greatly admired. He also wrote hymns, eclogues, and a poem entitled *Christiados* in six books; all which are in Latin, and have gained him a great reputation. His works in prose consist of dialogues, synodical constitutions, letters, and other pieces. He died in 1566, soon after his being made bishop of Cremona.

VIENNA, the capital of the circle of Austria, in Germany, and of the whole German empire, is the place where the emperor resides. The city itself is not of very great extent; nor can it be [illegible], it being [illegible] by a very strong fortification; but it is very populous. The streets, in general, are narrow, and the houses built high. Some of the public buildings are magnificent; but they appear [illegible] to no great advantage, on account of the narrowness of the streets. The chief of them are the imperial palace, the library, and the museum; the palaces of the princes Lichtenstein, Eugene, &c. Vienna was twice ineffectually besieged by the Turks; namely, in 1529, and [illegible]. At the latter period, the siege was raised by John Sobieski, king of Poland, who totally defeated the Turkish army before the walls of that place. There is no great danger that Vienna will ever again be besieged

jected to the inconveniences of a fiege. Yet, in cafe this fhould happen, a meafure has been taken, which will prevent the neceffity of deftroying the fuburbs; namely, no houfes without the walls are allowed to be built nearer to the glacis than 600 yards; fo that there is a circular field of that breadth all round the town, which, exclufive of the advantage above-mentioned, has a very beautiful and falutary effect. Thefe magnificent fuburbs, and the town together, are faid to contain above 300,000 inhabitants; yet the former are not near fo populous, in proportion to their fize, as the town; becaufe many houfes in the fuburbs have extenfive gardens belonging to them, and many families, who live during the winter within the fortifications, fpend the fummer in the fuburbs. The cathedral is built of free ftone, is 114 yards long, and 48 broad, and the fteeple is 447 feet high. Inftead of a weather-cock there was a Turkifh crefcent, in memory of the fiege in 1589; but, after the fecond fiege in 1683, they changed it for a golden crofs, which three months after was thrown down by a ftorm. At prefent there is a black fpread eagle, over which is a gilded crofs. Joining to the church is the archbifhop's palace, the front of which is very fine. The univerfity had feveral thoufand ftudents, who, when this city was befieged, mounted guard, as they did alfo in 1741. Befide this, there is the academy of Lower Auftria; and the archducal library is much frequented by foreigners, as it contains above 100,000 printed books, and 10,000 manufcripts. The academy of painting is remarkable for the fine pictures it produces. The archducal treafury, and a cabinet of curiofities of the houfe of Auftria, are great rarities. The inhabitants, in general, live in a fplendid manner; and people of diftinction have all forts of wines at their tables, which they are very free with to foreigners. There is a fort of harbour on the Danube, where there are magazines of naval ftores, and fhips have been fitted out to ferve on that river againft the Turks. Vienna is an archbifhop's fee. It is feated at the place where the river Vienna, or Wien, falls into the Danube, 30 miles weft of Prefburgh, 350 north-north-eaft of Rome, 520 fouth-eaft by fouth of Amfterdam, 565 eaft of Paris, and 680 eaft-fouth-eaft of London. E. Long. 16. 28. N. Lat. 48. 13.

VIGIL, in church-hiftory, is the eve or next day before any folemn feaft; becaufe then Chriftians were wont to watch, faft, and pray, in their churches.

Vigils of Plants, a term under which botanifts comprehend the precife time of the day in which the flowers of different plants open, expand, and fhut.

As all plants do not flower in the fame feafon, or month; in like manner, thofe which flower the fame day, in the fame place, do not open and fhut precifely at the fame hour. Some open in the morning, as the lip flowers, and compound flowers with flat fpreading petals; others at noon, as the mallows; and a third fet in the evening, or after funfet, as fome geraniums and opuntias: the hour of fhutting is equally determined. Of thofe which open in the morning, fome fhut foon after, while others remain expanded till night.

The hours of opening, like the time of flowering, feem to vary, according to the fpecies of the plant, the temperature of the climate, and that of the feafon. Flowers, whofe extreme delicacy would be hurt by the ftrong impreffions of an ardent fun, do not open till night; thofe which require a moderate degree of heat to elevate their juices; in other words, whofe juices do not rife but in the morning or evening, do not expand till then; whilft thofe which need a more lively heat for the fame purpofe, expand at noon, when the fun is in his meridian ftrength. Hence it is, that the heat of the air being greater betwixt the tropics than elfewhere, plants which are tranfported from thofe climates into the cold or temperate climates of Europe, expand their flowers much later than in their native foil. Thus, a flower which opens in fummer at fix o'clock in the morning at Senegal, will not open at the fame feafon in France and England till eight or nine, nor in Sweden till ten.

Linnæus diftinguifhes by the general name of *folar (flores folares)* all thofe flowers which obferve a determinate time in opening and fhutting. Thefe flowers are again divided, from certain circumftances, into three fpecies, or kinds:

Equinoctial flowers *(flores æquinoctiales)* are fuch as open and fhut at all feafons, at a certain fixed or determinate hour.

Tropical flowers *(flores tropici)* are fuch whofe hour of opening is not fixed at all feafons, but accelerated or retarded according as the length of the day is increafed or diminifhed.

Meteorous flowers *(flores meteorici)* are fuch whofe hour of expanfion depends upon the dry or humid ftate of the air, and the greater or lefs preffure of the atmofphere. Of this kind is the Siberian fow-thiftle, which fhuts at night if the enfuing day is to be clear and ferene, and opens if it is to be cloudy and rainy. In like manner the African marigold, which in dry ferene weather opens at fix or feven in the morning, and fhuts at four o'clock in the afternoon, is a fure indication that rain will fall during the courfe of the day, when it continues fhut after feven.

VIGO, a fea-port town of Spain, in Galicia, with an old caftle and a fort. It is feated in a fertile country by the fea-fide. It was rendered famous by a fea-fight between the confederate fleet commanded by Sir George Rook, and a fquadron of French men of war, while the duke of Ormond with a body of land-forces drove the Spaniards from the caftles which defended the harbour. Admiral Hopfon having with infinite danger broke through the boom made acrofs the mouth of the harbour, the Englifh took four galleons and five large men of war, and the Dutch five galleons and one man of war. Four galleons, with 14 men of war, were deftroyed, with abundance of plate and other rich effects. W. Long. 8. 21. N. Lat. 42. 3.

VILLA FRANCA, the name of feveral towns; one in Piedmont, three miles eaft of Nice; another of Catalonia, 18 miles weft of Barcelona; a third, the capital of St Michael, one of the Azores; and a fourth, a town of Eftremadura in Spain, 57 miles fouth-eaft of Salamanca.

VILLAGE, an affemblage of houfes inhabited chiefly by peafants and farmers, and having no market, whereby it is diftinguifhed from a town. The word is French, formed of *vil*, or *vilis*, "low, mean, contemptible:" or rather, from the Latin *villa*, a country-houfe or farm.

VILLAIN, or VILLEIN, in our ancient cuftoms, denotes a man of fervile or bafe condition, *viz.* a bond-man or fervant.

VILLARS (Lewis Hector, duke de), marfhal of France, grandee of Spain, &c. and a very brave general, was the fon of Peter marquis de Villars, of a noble and ancient family. He was at firft aid-de-camp to marfhal de Bellefons, his coufin; and diftinguifhed himfelf in feveral fieges and battles till the year 1702, when having obtained the victory at Fredlinghem from the prince of Baden, he was made marfhal of France. The marfhal de Villars took the fort of Kell the year following, and gained a battle at Hochftet in concert with the elector of Bavaria. In 1707 he forced the lines of Stolhoffen, and raifed large contributions from the enemy: but in 1709, he, in conjunction with marfhal Bouflers, was entirely defeated by the duke of Marlborough, at the battle of Malplaquet, when marfhal Villars was wounded at the beginning of the action. In 1712 he gained much glory by forcing the intrenchments at Denain on the Scheld; which was followed by the taking of Marchiennes, Douay, Bouchain, Landau, Friburg, &c. and by the peace concluded at Raftat between the emperor and France

France in 1714. The marshal de Villars, who had been plenipotentiary at the treaty of Rastat, was made president of the council of war in 1715, then counsellor of the regency, and minister of state. In 1733, he was nominated to command in Italy under the king of Sardinia, and the French king declared him marshal-general of his camps and armies; a title which had not been granted to any one since the marshal Turenne, who appears to have been the first who was ever honoured with it. The marshal de Villars made himself master of Pisighitona, Milan, Novara, and Tortona. But having opened the following campaign, he fell sick, and died at Turin, in 1734, aged 82. The Memoirs of M. de Villars have been published in Holland, the first volume of which was written by himself.

VILLENAGE, in law. The folk-land or estates held in villenage, was a species of tenure neither strictly feodal, Norman, or Saxon; but mixed and compounded of them all; and which also, on account of the heriots that usually attend it, may seem to have somewhat Danish in its composition. Under the Saxon Government there were, as Sir William Temple speaks, a sort of people in a condition of downright servitude, used and employed in the most servile works, and belonging, both they, their children, and effects, to the lord of the soil, like the rest of the cattle or stock upon it. These seem to have been those who held what was called the *folkland*, from which they were removeable at the lord's pleasure. On the arrival of the Normans here, it seems not improbable, that they, who were strangers to any other than a feodal state, might give some sparks of enfranchisement to such wretched persons as fell to their share, by admitting them, as well as others, to the oath of fealty; which conferred a right of protection, and raised the tenant to a kind of estate superior to downright slavery, but inferior to every other condition. This they called *villenage*, and the tenants *villeins*.

These villeins, belonging principally to lords of manors, were either villeins *regardant*, that is, annexed to the manor or land; or else they were *in gross*, or at large, that is, annexed to the person of the lord, and transferable by deed from one owner to another. They could not leave their lord without his permission; but, if they ran away, or were purloined from him, might be claimed and recovered by action, like beasts or other chattels. They held indeed small portions of land by way of sustaining themselves and families: but it was at the mere will of the lord, who might dispossess them whenever he pleased; and it was upon villein services, that is, to carry out dung, to hedge and ditch the lord's demesnes, and any other the meanest offices: and their services were not only base, but uncertain both as to their time and quantity.

A villein could acquire no property either in lands or goods: if he purchased either, the lord might seize them to his own use; unless he contrived to dispose of them again before the lord had seized them, for the lord had then lost his opportunity.

In many places also a fine was payable to the lord, if the villein presumed to marry his daughter to any one without leave from the lord: and, by the common law, the lord might also bring an action against the husband for damages in thus purloining his property. For the children of villeins were also in the same state of bondage with their parents; whence they were called in Latin *nativi*, which gave rise to the female appellation of a villein, who was called a *neife*. In case of a marriage between a freeman and a neife, or a villein and a freewoman, the issue followed the condition of the father, being free if he was free, and villein if he was villein; contrary to the maxim of the civil law, that *partus sequitur ventrem*. But no bastard could be born a villein, because by another maxim of our law he is *nullius filius*; and as he can *gain* nothing by inheritance, it were hard that he should *lose* his natural freedom by it. The law, however, protected the persons of villeins against atrocious injuries of the lord: for he might not kill or maim his villein; though he might beat him with impunity.

Villeins might be enfranchised by manumission. In process of time they gained considerable ground on their lords; and in particular strengthened the tenure of their estates to that degree, that they came to have in them an interest in many places full as good, in others better than their lords. For the good-nature and benevolence of many lords of manors having, time out of mind, permitted their villeins and their children to enjoy their possessions without interruption, in a regular course of descent, the common law, of which custom is the life, now gave them title to prescribe against their lords; and, on performance of the same services, to hold their lands, in spite of any determination of the lord's will. For though in general they are still said to hold their estates at the will of the lord, yet it is such a will as is agreeable to the custom of the manor; which customs are preserved and evidenced by the rolls of the several courts-baron in which they are entered, or kept on foot by the constant immemorial usage of the several manors in which the lands lie. And as such tenants had nothing to show for their estates but these customs, and admissions in pursuance of them, entered on those rolls, or the copies of such entries witnessed by the steward, they now began to be called *tenants by copy of court-roll*, and their tenure itself a *copyhold*.

Privileged VILLENAGE, a species of tenure otherwise called *villein-socage*. See TENURE.

Ancient demesne consists of those lands or manors which, though now perhaps granted out to private subjects, were actually in the hands of the crown in the time of Edward the Confessor, or William the Conqueror; and so appear to have been, by the great survey in the exchequer, called *doomsday-book*. The tenants of these lands, under the crown, were not all of the same order or degree. Some of them, as Britton testifies, continued for a long time pure and absolute villeins, dependent on the will of the lord; and common copyholders in only a few points. Others were in a great measure enfranchised by the royal favour; being only bound in respect of their lands to perform some of the better sort of villein-services: but those determinate and certain; as, to plough the king's land for so many days, to supply his court with such a quantity of provisions, and the like; all of which are now changed into pecuniary rents: and in consideration hereof they had many immunities and privileges granted to them; as, to try the right of their property in a peculiar court of their own, called a *court of ancient demesne*, by a peculiar process denominated a writ of right close: not to pay toll or taxes; not to contribute to the expences of knights of the shire; not to be put on juries, and the like.

These tenants therefore, though their tenure be absolutely copyhold, yet have an interest equivalent to a freehold: for though their services were of a base and villenous original, yet the tenants were esteemed in all other respects to be highly privileged villeins, and especially for that their services were fixed and determinate, and that they could not be compelled (like pure villeins) to relinquish these tenements at the lord's will, or to hold them against their own: *et ideo* (says Bracton) *dicuntur liberi*.

Lands holding by this tenure are therefore a species of copyhold, and as such preserved and exempted from the operation of the statute of Charles II. Yet they differ from common copyholds, principally in the privileges before-mentioned:

tenure; as also they differ from freeholders by one especial mark and tincture of villenage, noted by Bracton, and remaining to this day; viz. that they cannot be conveyed from man to man by the general common-law conveyances of feoffment, and the rest; but must pass by surrender to the lord or his steward, in the manner of common copyholds: yet with this difference, that, in the surrenders of these lands in ancient demesne, it is not used to say, "to hold at the will of their lord," in their copies; but only, "to hold according to the custom of the manor."

VILLI, among botanists, a kind of down like short hair, with which some trees abound.

VILLIERS (George duke of Buckingham), an ingenious and witty nobleman, whose mingled character rendered him at once the ornament and disgrace, the envy and ridicule, of the court he lived in, was son to that famous statesman and favourite of king Charles I. who lost his life by the hands of lieutenant Felton. He was born in 1627, the year before the fatal catastrophe of his father's death. The early parts of his education he received from various domestic tutors, after which he was sent to the university of Cambridge. Having there completed a course of studies, he, with his brother lord Francis, went abroad under the care of one Mr Aylesbury.—Upon his return, which was not till after the breaking out of the civil wars, the king being at Oxford, his grace repaired thither, was presented to his majesty, and entered of Christ-church college. Upon the decline of the king's cause, he attended prince Charles into Scotland, and was with him at the battle of Worcester in 1651; after which, making his escape beyond sea, he again joined him, and was soon after, as a reward for this attachment, made knight of the garter.

Desirous, however, of retrieving his affairs, he came privately to England; and in 1657 married Mary, the daughter and sole heiress of Thomas lord Fairfax, through whose interest he recovered the greatest part of the estate he had lost, and the assurance of succeeding to an accumulation of wealth in the right of his wife.

We do not find, however, that this step lost him the royal favour; for after the restoration, at which time he is said to have possessed an estate of L. 20,000 *per annum*, he was made one of the lords of the bed chamber, called to the privy-council, and appointed lord-lieutenant of Yorkshire and master of the horse. All these high posts, however, he lost again in the year 1666. For having been refused the post of president of the north, he became disaffected to the king; and it was discovered that he had carried on a secret correspondence by letters and other transactions with one Dr Heydon, tending to raise mutinies among his majesty's forces, particularly in the navy, to stir up sedition among the people, and even to engage persons in a conspiracy for the seizing the tower of London. Matters were ripe for execution; and an insurrection, at the head of which the duke was openly to have appeared, was on the very eve of breaking out, when it was discovered by means of some agents whom Heydon had employed to carry letters to the duke. The detection of this affair so exasperated the king, who knew Buckingham to be capable of the blackest designs, that he immediately ordered him to be seized; but the duke finding means, having defended his house for some time by force, to make his escape, his majesty struck him out of all his commissions, and issued a proclamation requiring his surrender by a certain day.

This storm, however, did not long hang over his head; for, on his making a humble submission, king Charles, who was far from being of an implacable temper, took him again into favour, and the very next year restored him both to the privy-council and bed chamber. But the duke's disposition for intrigue and machination could not long lie idle; for having conceived a resentment against the duke of Ormond for having acted with some severity against him in regard to the last-mentioned affair, he, in 1670, was supposed to be concerned in an attempt made on that nobleman's life by the same Blood who afterwards endeavoured to steal the crown. Their design was to have conveyed the duke to Tyburn, and there to have hanged him; and so far did they proceed towards the putting it in execution, that Blood and his son had actually forced the duke out of his coach in St James's Street, and carried him away beyond Devonshire house, Piccadilly, before he was rescued from them.

It does not appear, however, that this transaction hurt the duke's interest at court; for in 1671 he was installed chancellor of the university of Cambridge, and sent ambassador to France. Here he was very nobly entertained by Louis XIV. and presented by that monarch at his departure with a sword and belt set with jewels, to the value of 40,000 pistoles; and the next year he was employed in the second embassy to that king at Utrecht. However, in June 1674, he resigned the chancellorship of Cambridge, and about the same time became a zealous partizan and favourer of the Nonconformists. On the 16th of February 1676, his grace, with the earls of Salisbury and Shaftesbury and lord Warton, were committed to the Tower by order of the house of lords, for a contempt in refusing to retract the purport of a speech which the duke had made concerning a dissolution of the parliament. This confinement did not last long; yet we find no material transaction of this nobleman's life recorded after it, till the time of his death, which happened in 1687. Wood tells us that he died at his house in Yorkshire; but Mr Pope, who must certainly have had very good information, and it is to be imagined would not have dared to advance an injurious falsehood of a person of his rank, has, in his epistle to lord Bathurst, given us a most affecting account of the death of this ill-starred nobleman, whom, after having been master of near L. 50,000 *per annum*, he describes as reduced to the deepest distress by his vice and extravagance, and breathing his last moments in a mean apartment at an inn.

As to his personal character, it is impossible to say any thing in its vindication; for though his severest enemies acknowledge him to have possessed great vivacity and a quickness of parts peculiarly adapted to the purposes of ridicule, yet his warmest advocates have never attributed to him a single virtue. His generosity was profuseness, his wit malevolence, the gratification of his passions his sole aim thro' life, his very talents caprice, and even his gallantry the mere love of pleasure. But it is impossible to draw his character with equal beauty, or with more justice, than in that given of him by Dryden, in his Absalom and Achitophel, under the name of *Zimri*, to which the reader is referred.

As a writer, however, he stands in a quite different point of view. There we see the wit, and forget the libertine.—His poems, which indeed are not very numerous, are capital in their kind; but what will immortalize his memory while language shall be understood, or true wit relished, is his celebrated comedy of The Rehearsal.

VILLOSE, or VILLOUS, something abounding with villi or fibres like short hair; such is one of the coats of the stomach.

VINCA, in botany: A genus of plants of the class *pentandria*; and order of *monogynia*; and in the natural system arranged under the 30th order, *Contortæ*. The corolla is twisted; there are two erect follicles; the seeds are naked. There are five species; only two of which are natives of Britain;

Britain: 1. The *major*, great periwinckle. It has a woody, erect stem: leaves broader and sharper pointed; pedicles of the flowers straight, and calyx as long as the tube: otherwise like the former. 2. The *minor*, small periwinckle, has a woody, creeping, slender, crooked stem: leaves long, oval, entire, pointed, opposite, glossy. Flowers single, on long curved pedicles from the alæ of the leaves, which are large and blue.

St VINCENT, one of the windward Caribbee islands, which received its name from being discovered on the 22d of January, the feast of that Saint. It is inhabited by a race of people, of whom Dr Robertson gives this account: "There is a great distinction in character between the Caribbees and the inhabitants of the larger islands. The former appear manifestly to be a separate race. Their language is totally different from that of their neighbours in the large islands. They themselves have a tradition that their ancestors came originally from some part of the continent, and having conquered and exterminated the ancient inhabitants, took possession of their lands and of their women. Hence they call themselves Banaree, which signifies a man come from beyond sea. Accordingly, the Caribbees still use two distinct languages, one peculiar to the men, and the other to the women. The language of the men has nothing common with that spoken in the large islands. The dialect of the women considerably resembles it. This strongly confirms the tradition which I have mentioned. The Caribbees themselves imagine that they were a colony from the Galibis, a powerful nation of Guiana in South America. But as their fierce manners approach nearer to those of the people in the northern continent, than to those of the natives of South America, and as their language has likewise some affinity to that spoken in Florida, their origin should be deduced rather from the former than from the latter. In their wars, they still preserve their ancient practice of destroying all the males, and preserving the women either for servitude or for breeding."

It remained a long time after it was discovered inhabited by these people, and by another race improperly styled *Black Caribs*, who are in reality negroes descended, as is generally believed, from some who escaped out of a Guinea ship wrecked upon the coast, and gradually augmented by such as from time to time fled thither from Barbadoes. These nations were often at war; but when their quarrels were composed, they had a strength sufficient to prevent strangers from settling by force. The French, about half a century ago, at the request of the Caribs, made a descent from Martinico, and attacked the negroes, but were repulsed with loss; and found it their interest to conclude a friendship with both nations by means of presents, and furnishing them with arms and ammunition.

St Vincent was long a neutral island; but, at the peace of 1763, the French agreed that the right to it should be vested in the English; who, in the sequel, at the instance of some rapacious planters, engaged in an unjust war against the Caribbees, who inhabited the windward side of the island, and who were obliged to consent to a peace, by which they ceded a very large tract of valuable land to the crown. The consequence of this was, that in the next war, in 1779, they greatly contributed to the reduction of this island by the French [illegible] 1783. [illegible] Great Britain. During the present war, the Caribs revolted; and, assisted by the French, spread [illegible] the whole island. By the exertions of [illegible], however, and the British forces in the West Indies, the revolt is in a great measure quelled, though it will be long before things are restored to their former state.

St Vincent is in length about 24 miles, and about 18 in breadth; in circumference between 60 and 70. The climate is very warm; at least in the judgment of the Europeans. The country is in general hilly, in some places mountainous; but interspersed with a variety of pleasant valleys, and some luxuriant plains, the soil being everywhere very fertile, and the high grounds are at least in general easy of ascent. Few islands of its extent are so well watered: for several rivers run down from the mountains, and [illegible] streams from almost every hill; there are likewise several fine springs at a little distance from the sea. The inhabitants raise all kinds of ground provisions in plenty, and with little trouble. The rivers supply them with a variety of fish; and the same may be said of the sea that washes their coasts. They have abundance of excellent fruits, and very fine timber fit for almost every use; and with which they formerly supplied their neighbours.

In 1770 its exports were, cotton, 284 bags, at 10l. *per* bag, 2840l. Coffee, [illegible] hundred-weight [illegible] pound, at 3l. [illegible] *per* hundred-weight, [illegible]. Cacao, [illegible] hogsheads and one barrel, at [illegible] *per* hogshead, and 12l. *per* barrel, 25,[illegible]. [illegible] hogsheads, at [illegible] *per* hogshead, [illegible]. [illegible] hogsheads, at [illegible] *per* hogshead, [illegible]. In all to Great Britain, [illegible] 9s. 8¾d. To North America, 13,375 l. Total 110,501 l. 9s. 8¾d. W. Long. 61 [illegible]. N. Lat. 13 [illegible].

VINCI (Leonardo da), an illustrious Italian painter, descended from a noble Tuscan family, was born in the castle of Vinci near Florence in 1445. He was placed under Andrea Verochia, a celebrated painter in that city; but soon surpassed him and all his predecessors so much, as to be reputed the master of the third or golden age of modern painting. But his studies were far from terminating here; no man's genius was more universal: he applied himself to arts, to literature, and to the accomplishments of the body; and he excelled in every thing which he attempted. Lewis Sforza duke of Milan prevailed on him to be director of the academy for architecture he had just established; where Leonardo soon banished all the Gothic fashions, and reduced every thing to the happy simplicity of the Greek and Roman style. By the duke's order he constructed the famous aqueduct that supplies the city of Milan with water: this canal goes by the name of *Mortesano*, being above 200 miles in length, and conducts the water of the river Adda quite to the walls of the city. [illegible] Louis XII. of France, [illegible] into Milan. Leonardo accordingly made a very curious automaton in the form of a lion, which [illegible] meet the king, reared up on its hinder-legs before him, and opening its breast, displayed [illegible] quartered on it. The disorders of Lombardy, with the misfortunes of his patrons the Sforzi, obliging Leonardo to quit Milan, [illegible] the Medici [illegible] Michael Angelo, who was his contemporary; and Raphael, [illegible] [illegible] Francis I. [illegible] France [illegible] a [illegible] number of discourses on curious subjects; but none of them

have

Vinculum || Vinegar.

have been published but his treatise on the Art of Painting. —For his anatomical knowledge, see ANATOMY (history of), p. 679.

VINCULUM, in algebra, a character in form of a line, or stroke drawn over a factor, divisor, or dividend, when compounded of several letters or quantities to connect them, and shows that they are to be multiplied or divided, &c. together by the other term.

Thus $d \times \overline{a+b-c}$ shows that d is to be multiplied into $a+b-c$.

VINE, in botany. See VITIS.

VINEGAR, ACETUM, an agreeable acid and penetrating liquor, prepared from wine, cyder, beer, and other liquors; of considerable use, both as a medicine and a sauce. The word is French, *vinaigre*; formed from *vin*, "wine;" and *aigre*, "sour." See ACETUM, and CHEMISTRY-*Index*.

Wine and other vinous liquors are changed into vinegar by the acetous fermentation. The acetous fermentation is nothing more than the acidification or oxygenation of wine, produced in the open air by means of the absorption of oxygen. Vinegar is composed of hydrogen and carbon, united together in proportions not yet ascertained, and changed into the acid state by oxygen. As vinegar is an acid, we might conclude from analogy, that it contains oxygen; but this is put beyond doubt by direct experiments. In the first place, we cannot change wine into vinegar without the contact of air containing oxygen: secondly, this process is accompanied by a diminution of the air in which it is carried on from the absorption of its oxygen; and, thirdly, wine may be changed into vinegar by any other means of oxydation. Independent of the proofs which these facts furnish of the acetous acid being produced by the oxygenation of wine, an experiment made by Mr Chaptal, professor of chemistry at Montpelier, gives a distinct view of what takes place in this process. He impregnated some water with about its own bulk of carbonic acid gas, procured from beer vats in fermentation; and placed this water in a cellar, in vessels communicating with the air, and in a short time the whole was converted into acetous acid. This carbonic acid gas, procured from beer vats in fermentation, is not perfectly pure, but contains a great quantity of alcohol in solution; wherefore water impregnated with it contains all the materials necessary for forming the acetous acid. The alcohol furnishes hydrogen and one portion of carbon; the carbonic acid furnishes oxygen and the rest of the carbon; and the air of the atmosphere furnishes the rest of the oxygen necessary for changing the mixture into acetous acid. From this observation it follows, that nothing but hydrogen is wanting to convert carbonic acid into acetous acid; or, more generally, that by means of hydrogen; and according to the degree of oxydation, carbonic acid may be changed into all the vegetable acids: and, on the contrary, that, by depriving any of the vegetable acids of their hydrogen, they may be converted into carbonic acid.

Lavoisier's Chemistry.

The process indicated by Boerhaave for making vinegar is still the most frequently used. It consists in fixing two casks in a warm room or place. Two false bottoms of basket-work are fixed at a certain distance from the bottom, upon which the refuse of grapes and vine twigs are placed. One of these tuns is filled with wine, and the other only half filled. The fermentation begins in this last; and, when it is in full action, it is checked by filling the cask up with wine out of the other. The fermentation then takes place in the last-mentioned cask, that remained half filled; and this is checked in the same manner by pouring back the same quantity of liquid out of the other: and in this way the process is continued till the vinegar is made, which is usually in about 15 days. When the fermentation developes itself, the liquid becomes heated and turbid; a great number of filaments are seen in it; it emits a lively smell; and much air is absorbed, according to the observation of the Abbé Rozier. A large quantity of lees is formed, which subsides when the vinegar becomes clear. This lees is very analogous to the fibrous matter.

Chaptal's Chemistry.

Vinegar is purified by distillation. The first portions which pass over are weak; but soon afterwards the acetous acid rises, and is stronger the later it comes over in the distillation. This fluid is called *distilled vinegar*; and is thus cleared of its colouring principle, and the lees, which are always more or less abundant. Vinegar may likewise be concentrated by exposing it to the frost. The superabundant water freezes, and leaves the acid more condensed.

Method of making Cyder VINEGAR.—The cyder (the meanest of which will serve the purpose) is first to be drawn off fine into another vessel, and a quantity of the must of apples to be added: the whole is set in the sun, if there be conveniency for it; and at a week or nine days end it may be drawn off.

Method of making Beer VINEGAR.—Take a middling sort of beer, indifferently well hopped; into which, when it has worked well and grown fine, put some rape, or husks of grapes, usually brought home for that purpose: mash them together in a tub; then letting the rape settle, draw off the liquid part, put it into a cask, and set it in the sun as hot as may be; the bung being only covered with a tile, or slatestone: and in about 30 or 40 days it will become a good vinegar, and may pass in use as well as that made of wine, if it be refined, and kept from turning musty.

Or thus:—To every gallon of spring-water add three pounds of Malaga raisins; which put into an earthen jar, and place them where they may have the hottest sun from May till Michaelmas; then pressing all well, tun the liquor up in a very strong iron-hooped vessel, to prevent its bursting: it will appear very thick and muddy when newly pressed; but will refine in the vessel, and be as clear as wine. Thus let it remain untouched for three months before it is drawn off, and it will prove excellent vinegar.

To make Wine VINEGAR.—Any sort of vinous liquor being mixed with its own fæces, flowers, or ferment, and its tartar first reduced to powder; or else with the acid and austere stalks of the vegetable from whence the wine was obtained, which hold a large proportion of tartar; and the whole being kept frequently stirring in a vessel which has formerly held vinegar, or set in a warm place full of the steams of the same, will begin to ferment anew, conceive heat, grow sour by degrees, and soon after turn into vinegar.

The remote subjects of acetous fermentation are the same with those of vinous; but the immediate subjects of it, are all kinds of vegetable juices, after they have once undergone that fermentation which reduces them to wine: for it is absolutely impossible to make vinegar of must, the crude juice of grapes, and other ripe fruits, without the previous assistance of vinous fermentation.

The proper ferments for this operation, whereby vinegar is prepared, are, 1. The fæces of all acid wines. 2. The lees of vinegar. 3. Pulverized tartar, especially that of Rhenish wine, or the cream or crystals thereof. 4. Vinegar itself. 5. A wooden vessel well drenched with vinegar, or one that has long been employed to contain it. 6. Wine that has often been mixed with its own fæces. 7. The twigs of vines, and the stalks of grapes, currants, cherries, or other vegetables of an acid austere taste. 8. Bakers leven, after it is turned acid. 9. All manner of ferments, compounded of those already mentioned.

VINEGAR Concentrated. See CHEMISTRY, n° 881.

VINEGAR (Salt of). See CHEMISTRY, n° 882.

Eels in Vinegar. See Animalcule, n° 9.

VINEYARD, a plantation of vines. The beſt ſituation of a vineyard is on the declivity of a hill facing the ſouth.

VIO (Thomas de). See Cajetan.

VIOL, a muſical inſtrument of the ſame form with the violin, and, like that, ſtruck with a bow.

VIOLA, in botany: A genus of plants of the claſs *ſyngeneſia*, order *monogynia*; in the natural ſyſtem arranged under the 29th order, *Campanaceæ*. The calyx is pentaphyllous; the corolla five petaled, irregular, with a nectarium behind, horn-ſhaped; the capſule is above the germen, three valved, monolocular. There are 28 ſpecies; ſix of which are natives of Britain. The moſt important of theſe are, 1. The *paluſtris*, marſh violet. The leaves are ſmooth, reniform, two or three on each footſtalk: flowers pale blue, ſmall, inodorous. An infuſion of the flowers is an excellent teſt of the preſence of acids and alkalis. 2. The *odorata*, purple ſweet violet, has leaves heart-ſhaped, notched: flowers deep purple, ſingle; creeping ſcions. The flowers of this plant taken in the quantity of a dram or two are ſaid to be gently purgative or laxative, and, according to Bergius and ſome others, they poſſeſs an anodyne and pectoral quality. 3. *Tricolor*, panſies, heart's eaſe, or three faces under a hood. The ſtems are diffuſe, procumbent, triangular; the leaves oblong, cut at the edges; ſtipulæ dentated: the flowers purple, yellow, and light blue; inodorous.

This elegant little plant merits culture in every garden, for the beauty and great variety of its three-coloured flowers; and it will ſucceed anywhere in the open borders, or other compartments, diſpoſed in patches towards the front; either by ſowing the ſeed at once to remain, or by putting in young plants previouſly raiſed in a ſeed bed: they will be in flowering early in ſummer, and will continue ſhooting and flowering in ſucceſſion till winter; and even during part of that ſeaſon in mild weather.

The common violet is propagated by parting the roots, ſometimes by ſeed.

VIOLATION, the act of violating, that is, forcing a woman, or committing a rape upon her.—This term is alſo uſed in a moral ſenſe, for a breach or infringement of a law, ordinance, or the like.

VIOLET, in botany. See Viola.

Violet-Crab, in zoology. See Cancer.

VIOLIN, or Fiddle, a muſical inſtrument mounted with four ſtrings or guts, and ſtruck or played with a bow. The ſtyle and ſound of the violin is the gayeſt and moſt ſprightly of all other inſtruments; and hence it is of all others the fitteſt for dancing. Yet there are ways of touching it, which render it grave, ſoft, languiſhing, and fit for church or chamber muſic.—It generally makes the treble or higheſt parts in concerts. Its harmony is from fifth to fifth. Its play is compoſed of baſs, counter-tenor, tenor, and treble; to which may be added, a fifth part: each part has four fifths, which riſe to a greater ſeventeenth.

VIOLONCELLO, of the Italians, is properly our fifth violin; which is a little baſs violin half the ſize of the common baſs violin, and the ſtrings bigger and longer in proportion: conſequently its ſound is an octave lower than our baſs violin; which has a noble effect in concerts.

VIPER, in zoology. See Coluber, Poison, and Serpent; in which laſt article every thing concerning the poiſon of the *viper*, for which we referred from Poison, is already diſcuſſed.

VIRAGO, a woman of extraordinary ſtature and courage; and who, with the female ſex, has the mien and air of a man, and performs the actions and exerciſes of men.

VIRGIL, or Publius Virgilius Maro, the moſt excellent of all the Latin poets, was the ſon of a potter of Andes, near Mantua, where he was born, [illegible] years B. C. He ſtudied firſt at Mantua; then at Cremona, Milan, and Naples; whence going to Rome, he acquired the eſteem of the greateſt wits and moſt illuſtrious perſons of his time; and among others of the emperor Auguſtus, Mæcenas, and Pollio. He was well ſkilled not only in polite literature and poetry, but alſo in philoſophy, the mathematics, geography, medicine, and natural hiſtory. Although one of the greateſt geniuſes of his age, and the admiration of the Romans, he always preſerved a ſingular modeſty, and lived chaſte at a time when the manners of the people were extremely corrupt. He carried Latin poetry to ſuch an high perfection, that he was juſtly eſteemed the prince of Latin poets. He firſt turned himſelf to paſtoral; and being captivated with the beauty and ſweetneſs of Theocritus, was ambitious to introduce this new ſpecies of poetry among the Romans. His firſt performance in this way is ſuppoſed to have been written U. C. 709, the year before the death of Julius Cæſar, when the poet was in his 25th year: it is intitled *Alexis*. Poſſibly *Palæmon* was the ſecond: it is a cloſe imitation of the fourth and fifth Idylls of Theocritus. Mr Wharton places *Silenus* next; which is ſaid to have been publicly recited on the ſtage by Cytheris, a celebrated comedian. Virgil's fifth eclogue is compoſed in alluſion to the death and deification of Cæſar. The battle of Philippi in 712 having put an end to the Roman liberty, the veteran ſoldiers began to murmur for their pay; and Auguſtus, to reward them, diſtributed among them the lands of Mantua and Cremona. Virgil was involved in this common calamity; and applied to Varus and Pollio, who warmly recommended him to Auguſtus, and procured for him his patrimony again. Full of gratitude to Auguſtus, he compoſed the *Tityrus*, in which he introduces two ſhepherds: one of them complaining of the diſtraction of the times, and of the havock the ſoldiers made among the Mantuan farmers; the other rejoicing for the recovery of his eſtate, and promiſing to honour as a god the perſon who reſtored it to him. But our poet's joy was not of long continuance; for we are told, that when he returned to take poſſeſſion of his farm, he was violently aſſaulted by the intruder, and would certainly have been killed by him if he had not eſcaped by ſwimming haſtily over the Mincio. Upon this unexpected diſappointment, he returned to Rome to renew his petition; and during his journey ſeems to have compoſed his ninth eclogue. The celebrated eclogue, intitled *Pollio*, was compoſed U. C. 714, upon the following occaſion: The conſul Pollio on the part of Antony, and Mæcenas on the part of Cæſar, had made up the differences between them; by agreeing, that Octavia, half ſiſter to Cæſar, ſhould be given in marriage to Antony. This agreement cauſed an univerſal joy; and Virgil, in his eclogue, teſtified his. Octavia was with child by her late huſband Marcellus at the time of this marriage; and whereas the Sibylline oracles had foretold, that a child was to be born about this time, who ſhould rule the world, and eſtabliſh perpetual peace, the poet ingeniouſly ſuppoſes the child in Octavia's womb to be the glorious infant, under whoſe reign mankind was to be happy, the golden age to return from heaven, and fraud and violence to be no more. In this celebrated poem, the author, with great delicacy at the ſame time, pays his court to both the chiefs, to his patron Pollio, to Octavia, and to the unborn infant. In 715, Pollio was ſent againſt the Parthini, a people of Illyricum; and during this expedition, Virgil addreſſed to him a beautiful eclogue, called *Pharmaceutria*. His tenth and laſt eclogue was addreſſed to Gallus.

In his 34th year, he retired to Naples, and laid the plan of his Georgics; which he undertook at the intreaties of Mæcenas, to whom he dedicated them. This wiſe and

Virgil. able miniſter reſolved, if poſſible, to revive the decayed ſpirit of huſbandry; to introduce a taſte for agriculture, even among the great; and could not think of a better method to effect this, than to recommend it by the inſinuating charms of poetry. Virgil fully anſwered the expectations of his patron by his Georgics. They are divided into four books. Corn and ploughing are the ſubject of the firſt, vines of the ſecond, cattle of the third, and bees of the fourth.

He is ſuppoſed to have been in his 45th year when he began to write the Æneid; the deſign of which was to reconcile the Romans to the government of Auguſtus. Auguſtus was eager to peruſe this poem before it was finiſhed; and intreated him by letters to communicate it. Macrobius has preſerved to us part of one of Virgil's anſwers to the emperor, in which the poet excuſes himſelf: who, however, at length complied, and read himſelf the ſixth book to the emperor; when Octavia, who had juſt loſt her ſon Marcellus, the darling of Rome, and adopted ſon of Auguſtus, made one of the audience. Virgil had artfully inſerted that beautiful lamentation for the death of young Marcellus, beginning with—*O nate, ingentem luctum ne quære tuorum*—but ſuppreſſed his name till he came to the line—*Tu Marcellus eris*: upon hearing which, Octavia could bear no more, but fainted away; overcome with ſurpriſe and ſorrow. When ſhe recovered, ſhe made the poet a preſent of ten ſeſterces for every line, which amounted in the whole to above 2000l.

The Æneid being brought to a concluſion, but not to the perfection our author intended to give it, he reſolved to travel into Greece, to correct and poliſh it at leiſure. It was probably on this occaſion that Horace addreſſed that affectionate ode to him, *Sic te Diva potens Cypri, &c.* Auguſtus returning victorious from the eaſt, met with Virgil at Athens, who thought himſelf obliged to attend the emperor to Italy: but the poet was ſuddenly ſeized with a fatal diſtemper, which being increaſed by the agitation of the veſſel, put an end to his life as ſoon as he landed at Brunduſium, in his 52d year. He had ordered in his will, that the Æneid ſhould be burnt as an unfiniſhed poem; but Auguſtus forbade it, and had it delivered to Varius and Tucca, with the ſtricteſt charge to make no additions, but only to publiſh it correctly. He died with ſuch ſteadineſs and tranquillity, as to be able to dictate his own epitaph in the following words:

Mantua me genuit: Calabri rapuere, tenet nunc
Parthenope: cecini Paſcua, Rura, Duces.

His bones were carried to Naples, according to his earneſt requeſt; and a monument was erected at a ſmall diſtance from the city.

Virgil was of a ſwarthy complexion, tall, of a ſickly conſtitution, and afflicted with frequent head-achs and ſpitting of blood. He was ſo very baſhful, that he often ran into the ſhops to prevent being gazed at in the ſtreets; yet was ſo honoured by the Roman people, that once coming into the theatre, the whole audience roſe up out of reſpect to him. He was of a thoughtful and melancholy temper; he ſpoke little, and loved retirement and contemplation. His fortune was affluent; he had a fine houſe and well-furniſhed library near Mæcenas's gardens, on the Eſquiline mount at Rome, and alſo a delightful villa in Sicily. He was ſo benevolent and inoffenſive, that moſt of his contemporary poets, though they envied each other, agreed in loving and eſteeming him. He reviſed his verſes with prodigious ſeverity; and uſed to compare himſelf to a ſhe bear, which licked her cubs into ſhape.

The beſt edition of Virgil's works are thoſe of Moſvicius, with the notes of Servius, printed at Lewarden in 1717, 2 vols 4to; and that of Burman, at Amſterdam, 1746, in 4 vols 4to. There are ſeveral Engliſh tranſlations, which are well known.

Virgil (Polydore), an Engliſh hiſtorian, born at Urbino in Italy, was ſent in the beginning of the 16th century, by pope Alexander VI. as ſub collector of the Papal tax, called *Peter-pence*, in this kingdom. He had not been long in England before he obtained preferment in the church; for in 1503 he was preſented to the rectory of Church-Langton in the archdeaconry of Leiceſter. In 1507 he was collated to the prebend of Scamleſby in the church of Lincoln; and in the ſame year was made archdeacon of Wells, and prebendary of Hereford. In 1513, he reſigned his prebend of Lincoln, and was collated to that of Oxgate in St Paul's, London. We are told, that on his preferment to the archdeaconry of Wells, he reſigned the office of ſub-collector to the pope, and determined to ſpend the remainder of his life in England, the Hiſtory of which kingdom he began in the year 1505, at the command of Henry VII. That work coſt him 12 years labour. In 1526, he finiſhed his treatiſe on Prodigies. Polydore continued in England during the whole reign of Henry VIII. and part of that of Edward VI. whence it is concluded that he was a moderate Papiſt. In 1550, being now an old man, he requeſted leave to reviſit his native country. He was accordingly diſmiſſed with a preſent of 300 crowns, together with the privilege of holding his preferments to the end of his life. He died at Urbino in the year 1555. As an hiſtorian, he is accuſed by ſome as a malignant ſlanderer of the Engliſh nation; yet Jovius remarks, that the French and Scotch accuſe him of having flattered that nation too much: (See his *Elog.* cap. 135. p. 179). Beſides the above, he wrote, 1. *De rerum inventoribus*; of which an Engliſh tranſlation was publiſhed by Langley in 1663. It was alſo tranſlated into French and Spaniſh. 2. *De prodigiis et ſortibus* 3. *Epiſcoporum Angliæ catalogus.* Manuſcript. 4. *De vita perfecta*, Baſil, 1546, 1553, 8vo. 5. *Epiſtolæ eruditæ*; and ſome other works.

VIRGINIA, one of the United States of North America, is bounded on the eaſt by the Atlantic Ocean, on the north by Pennſylvania and the river Ohio, on the weſt by the Miſſiſſippi, on the ſouth by North Carolina.

Theſe boundaries include an area ſomewhat triangular of 121,525 miles, whereof 79,650 lie weſtward of the Allegany mountains, and 57,034 weſtward of the meridian of the mouth of the Great Kanhaway. This ſtate is therefore one third larger than the iſlands of Great Britain and Ireland, which are reckoned at 88,357 ſquare miles.

The principal rivers in Virginia are, Roanoke, James river, which receives the Rivanna, Appamattox, Chickahominy, Nanſemond, and Elizabeth rivers; York river, which is formed by the junction of Pamunky and Mattapony rivers; Rappahannok, and Patomak.

The mountains are not ſolitary and ſcattered confuſedly over the face of the country; they commence at about 150 miles from the ſea-coaſt, and are diſpoſed in ridges one behind another, running nearly parallel with the coaſt, though rather approaching it as they advance north-eaſtwardly. To the ſouth-weſt, as the tract of country between the ſea-coaſt and the Miſſiſſippi becomes narrower, the mountains converge into a ſingle ridge, which, as it approaches the Gulph of Mexico, ſubſides into plain country, and gives riſe to ſome of the waters of that Gulph. Jefferſon's Virginia.

From the great extent of Virginia, it may be expected that the climate is not the ſame in all its parts. It is remarkable that, proceeding on the ſame parallel of latitude weſtwardly, the climate becomes colder in like manner as when you proceed northwardly. This continues to be the caſe till you attain the ſummit of the Allegany, which is the higheſt land between the ocean and the Miſſiſſippi.

From

From thence, descending in the same latitude to the Mississippi, the change reverses; and, if we may believe travellers, it becomes warmer there than it is in the same latitude on the sea-side. Their testimony is strengthened by the vegetables and animals which subsist and multiply there naturally, and do not on the sea-coast. Thus catalpas grow spontaneously on the Mississippi as far as the latitude of 37, and reeds as far as 38, degrees. Perroquets even winter on the Sioto in the 39th degree of latitude. In the summer of 1779, when the thermometer was at 90 degrees at Monticello, and 96 degrees at Williamsburg, it was 110 degrees at Kaskaskia. Perhaps the mountain, which overhangs this village on the north side, may by its reflection have contributed somewhat to produce this heat.

The number of free inhabitants in this state in 1782 was 296,852, slaves 270,762. The number of free inhabitants were to the number of slaves nearly as 11 to 10.

The college of William and Mary is the only public seminary of learning in Virginia. It was founded in the time of king William and queen Mary, who granted to it 20,000 acres of land, and a penny a pound duty on certain tobaccoes exported from Virginia and Maryland. The assembly also gave it by temporary law a duty on liquors imported, and skins and furs exported. From these resources it received upwards of 3000 l. *communibus annis.* The buildings are of brick, sufficient for an indifferent accommodation of perhaps 100 students. By its charter it was to be under the government of 20 visitors, who were to be its legislators; and to have a president and six professorships, which at present stand thus:—A professorship for Law and Police; Anatomy and Medicine; Natural Philosophy and Mathematics; Moral Philosophy, the Law of Nature and Nations, the Fine Arts; Modern Languages. For the Brafferton. The college edifice is a huge, misshapen pile, which, but that it has a roof, would be taken for a brick-kiln. In 1787, there were about 30 young gentlemen members of this college, a large proportion of which were law students. There are a number of flourishing academies in Virginia; one in Prince Edward county, one at Alexandria, one at Norfolk, one at Hanover, and others in other places.

The present denominations of Christians in Virginia are Presbyterians, who are the most numerous, and inhabit the western parts of the state; Episcopalians, who are the most ancient settlers, and occupy the eastern and first settled parts of the state. Intermingled with these are great numbers of Baptists and Methodists. The bulk of these last mentioned religious sects are of the poorer sort of people, and many of them are very ignorant (as is indeed the case with the other denominations), but they are generally a virtuous well-meaning set of people.

Virginia has produced some of the most distinguished men that have been active in effecting the two late important revolutions in America, whose political and military character will rank among the first in the page of history. The great body of the people do not concern themselves with politics; so that their government, though nominally republican, is in fact oligarchical or aristocratical. The Virginians who are rich, are in general sensible, polite, and hospitable and of an independent spirit. The poor are ignorant and abject; all are of an inquisitive turn, and in many other respects very much resemble the people in the eastern states. There is a much greater disparity between the rich and the poor in Virginia than in any of the northern states. A spirit for literary inquiries, if not altogether confined to a few, is, among the body of the people, evidently subordinate to a spirit of gaming and barbarous sports. At almost every tavern or ordinary on the public road there is a billiard table, a backgammon table, cards, and other implements for various games. To these public houses the gambling gentry in the neighbourhood resort to kill time which hangs heavily upon them; and at this business they are extremely expert, having been accustomed to it from their earliest youth. The passion for cock-fighting, a diversion not only inhumanly barbarous, but infinitely beneath the dignity of a man of sense, is so predominant, that they even advertise their matches in the public newspapers.

The executive powers are lodged in the hands of a governor chosen annually, and incapable of acting more than three years in seven. He is assisted by a council of eight members. The judiciary powers are divided among several courts. Legislation is exercised by two houses of assembly, the one called the *House of Delegates*, composed of two members from each county, chosen annually by the citizens possessing an estate for life in 100 acres of uninhabited land, or 25 acres with a house on it, or in a house or lot in some town. The other called the *Senate*, consisting of 24 members, chosen quadrennially by the same electors, who for this purpose are distributed into 24 districts. The concurrence of both houses is necessary to the passage of a law. They have the appointment of the governor and council, the judges of the superior courts, auditors, attorney-general, treasurer, register of the land office, and delegates to Congress.

Before the present war, there was exported from this state, *communibus annis*, nearly as follows:

Articles.	Quantity.
Tobacco, - - - -	55,000 hhds. of 1000 lb
Wheat, - - - -	800,000 bushels
Indian Corn, - - - -	600,000 bushels
Shipping,	
Masts, planks, skantling, shingles, staves,	
Tar, pitch, turpentine, - -	30,000 barrels
Peltry, viz. skins of deer, beavers, otters, musk-rats, racoons, foxes, -	180 hhds. of 600 lb.
Pork, - - - -	4,000 barrels
Flax-seed, hemp, cotton,	
Pit coal, pig iron,	
Peas, - - -	5,000 bushels
Beef, - - -	1,000 barrels
Sturgeon, white shad, herring,	
Brandy from peaches and apples, whisky,	
Horses,	

The amount of the above articles is 850,000 l. Virginia money, or 607,142 dollars.

The whole country before it was planted was one continued forest interspersed with marshes, which in the West Indies they call *swamps.* No country now produces greater quantities of excellent tobacco; and the soil is generally so sandy and shallow, that after they have cleared a fresh piece of ground out of the woods, it will not bear tobacco after two or three years unless cow-penned and well dunged. The forests yield oaks, poplars, pines, cedars, cypresses, sweet myrtles, chesnuts, hickery, live oak, walnut, dog-wood, alder, hazel, chinkapins, locust-trees, sassafras, elm, ash, beech, with a great variety of sweet gums and incense, which distil from several trees; pitch, tar, rosin, turpentine, plank-timber, masts, and yards. Virginia yields also rice, hemp, Indian corn, plenty of pasture, with coal, quarries of stone, and lead and iron ore.

VIRGO, in astronomy, one of the signs or constellations of the zodiac.

VIRGULA Divinatoria, divining rod. See Mine, Vol. XII p. 41.

VIRTUAL, or Potential; something that has a power or virtue of acting or doing. The term is chiefly understood of something that acts by a secret invisible cause, in opposition to actual and sensible.

VIRTUE, a term used in various significations. In the general

general it denotes power, or the perfection of any thing, whether natural or ſupernatural, animate or inanimate, eſſential or acceſſory. But, in its more proper or reſtrained ſenſe, virtue ſignifies a habit, which improves and perfects the poſſeſſor and his actions. See MORAL PHILOSOPHY, nº 84.

VIRTUOSO, an Italian term lately introduced into the Engliſh, ſignifying a man of curioſity and learning, or one who loves and promotes the arts and ſciences. But among us the term ſeems to be appropriated to thoſe who apply themſelves to ſome curious and quaint rather than immediately uſeful art or ſtudy; as antiquaries, collectors of rarities of any kind, microſcopical obſervers, &c.

VIRULENT, a term applied to any thing that yields a virus; that is, a contagious or malignant pus.

VISCERA, in anatomy, a term ſignifying the ſame with entrails; including the heart, liver, lungs, ſpleen, inteſtines, and other inward parts of the body.

VISCIDITY, or VISCOSITY, the quality of ſomething that is viſcid or viſcous; that is, glutinous and ſticky like bird-lime, which the Latins call by the name of *viſcus*.

VISCOUNT (*Vice Comes*), was anciently an officer under an earl, to whom, during his attendance at court, he acted as deputy to look after the affairs of the country. But the name was afterwards made uſe of as an arbitrary title of honour, without any ſhadow of office pertaining to it, by Henry VI.; when, in the 18th year of his reign, he created John Beaumont a peer by the name of *viſcount Beaumont;* which was the firſt inſtance of the kind.

A viſcount is created by patent as an earl is; his title is *Right Honourable;* his mantle is two doublings and a half of plain fur; and his coronet has only a row of pearls cloſe to the circle.

VISCUM, in botany; a genus of plants of the claſs *diœcia*, order *tetrandria*, and in the natural ſyſtem arranged under the 48th order, *aggregatæ*. The male calyx is quadripartite; the antheræ adhere to the calyx: the female calyx conſiſts of four leaves; there is no ſtyle; the ſtigma is obtuſe. There is no corolla; the fruit is a berry with one ſeed. There are 9 ſpecies; only one of which is a native of Britain, viz. the *album*, or common miſſeltoe. It is a ſhrub growing on the bark of ſeveral trees: the leaves are conjugate and elliptical, the ſtem forked; the flowers whitiſh in the alæ of the leaves. This plant was reckoned ſacred among the druids.

VISHNOU, that perſon in the triad of the Bramins who is conſidered as the *preſerver* of the univerſe. *Brahma* is the creator and *Siva* the deſtroyer; and theſe two, with Viſhnou, united in ſome inexplicable manner, conſtitute *Brahme*, or the ſupreme numen of the Hindoos. See POLYTHEISM, nº 36.

VISIBLE, ſomething that is an object of ſight or viſion; or ſomething whereby the eye is affected ſo as to produce this ſenſation.

VISIER, an officer or dignitary in the Ottoman empire, whereof there are two kinds; one called by the Turks *Viſier-azem*, that is, "grand viſier," is the prime miniſter of ſtate in the whole empire. He commands the army in chief, and preſides in the divan or great council. Next to him are ſix other ſubordinate viſiers, called *viſiers of the bench;* who officiate as his counſellors or aſſeſſors in the divan.

VISION, in optics, the act of ſeeing or perceiving external objects by means of the organ of ſight, the eye. See ANATOMY, nº 142, and METAPHYSICS, nº 49—54.

VISTULA, or WEISEL, a large river of Poland, which taking its riſe in the mountains ſouth of Sileſia, viſits Cracow, Warſaw, &c. and continuing its courſe northward, falls into the Baltic ſea below Dantzic.

VISUAL, in general, ſomething belonging to viſion.

VITAL, in phyſiology, an appellation given to whatever miniſters principally to the conſtituting or maintaining life in the bodies of animals: thus the heart, lungs, and brain, are called *vital parts;* and the operations of theſe parts by which the life of animals is maintained are called *vital functions*.

VITALIANO (Donati), an eminent naturaliſt, was born in Padua the 8th of September 1717. He ſhowed from his childhood the greateſt inclination for botany and natural hiſtory; and, at the age of twelve years, knew all the medicinal plants, and had made a collection of natural productions. When ſome years older, he profited by the friendſhip of the celebrated Pontedero, and was generouſly furniſhed with books and informations by the living profeſſor Valliſneri junior. His beſt maſters were, however, his own mountain and maritime peregrinations; which he began in Dalmatia in 1743, and continued for five years. He was choſen for adjutant to the marquis Poleni, public profeſſor of experimental phyſic, and cultivated under ſo great a maſter all the parts of phyſico-mathematics. With him he made a journey to Rome, and there became an intimate friend of Leprotti the papal phyſician, to whom he afterwards dedicated his *Saggio della ſtoria naturale dell' Adriatico;* a work of great merit, which count Ginanni of Ravenna endeavoured to depreciate, though with little ſucceſs. The eſſay of Donati was publiſhed in 1750, and was afterwards tranſlated into French. The fame which our author acquired induced his Sardinian majeſty to appoint him profeſſor of botany and natural hiſtory at Turin. He went there very willingly; made many excurſions among the mountains of Savoy and Genoa, and would have been happy could he always have converſed with the mountaineers, who generally are harmleſs people. The king his maſter ſent him out of the way of his enemies, whoſe envy and hatred his merit alone had raiſed; he commanded him to ſet out on a voyage to Egypt, and from thence to viſit Syria, Paleſtine, Arabia, and the Eaſt Indies, to make obſervations and to collect the rareſt productions of nature. In 1759 he was in Alexandria, ſaw Egypt as far as the great cataract of the Nile, and a great part of Paleſtine, Arabia, and Chaldea; and in all thoſe travels was expoſed to ſuffer the cruel conſequences of a bad choice which he had made of his companions. While he ſtaid at Baſſora, waiting for orders from court, he fell ill of a putrid fever, and died in a few days. The news of his death came to Turin about the end of October 1763. He left in manuſcript two volumes in folio.

VITELLUS, the yolk of an egg. See EGG.

VITIS, in botany: A genus of the claſs *pentandria*, order *monogynia;* and in the natural ſyſtem arranged under the 46th order, *hederaceæ*. The petals cohere at the top, and are withered; the fruit is a berry with five ſeeds. There are 11 ſpecies; the moſt important of which is the *vinifera* or common vine, which has naked, lobed, ſinuated leaves. There are a great many varieties; but a recital of their names would be tireſome without being uſeful. All the ſorts are propagated either from layers or cuttings, the former of which is greatly practiſed in England, but the latter is much preferable.

In chooſing the cuttings, you ſhould always take ſuch ſhoots of the laſt year's growth as are ſtrong and well ripened; theſe ſhould be cut from the old vine, juſt below the place where they were produced, taking a knot, or piece of the two-years wood to each, which ſhould be pruned ſmooth; then you ſhould cut off the upper part of the ſhoots, ſo as to leave the cutting about ſixteen inches long. When the piece or knot of old wood is cut at both ends, near the young

young shoot, the cutting will resemble a little mallet; from whence Columella gives the title of *malleolus* to the vine-cuttings. In making the cuttings after this manner, there can be but one taken from each shoot; whereas most persons cut them into lengths of about a foot, and plant them all: which is very wrong, for various reasons too tedious to mention.

When the cuttings are thus prepared, if they are not then planted, they should be placed with their lower part in the ground in a dry soil, laying some litter upon their upper parts to prevent them from drying: in this situation they may remain till the beginning of April (which is the best time for planting them); when you should take them out, and wash them from the filth they have contracted; and if you find them very dry, you should let them stand with their lower parts in the water six or eight hours, which will distend their vessels, and dispose them for taking root. If the ground be strong and inclined to wet, you should open a trench where the cuttings are to be planted, which should be filled with lime rubbish, the better to drain off the moisture: then raise the borders with fresh light earth about two feet thick, so that it may be at least a foot above the level of the ground: then you should open the holes at about six feet distance from each other, putting one good strong cutting into each hole, which should be laid a little sloping, that their tops may incline to the wall; but it must be put in so deep, as that the uppermost eye may be level with the surface of the ground; for when any part of the cutting is left above ground, most of the buds attempt to shoot, so that the strength of the cuttings is divided to nourish so many shoots, which must consequently be weaker than if only one of them grew; whereas, by burying the whole cutting in the ground, the sap is all employed on one single shoot, which consequently will be much stronger; besides, the sun and air are apt to dry that part of the cutting which remains above ground, and so often prevents their buds from shooting.

Having placed the cutting into the ground, fill up the hole gently, pressing down the earth with your foot close about it, and raise a little hill just upon the top of the cutting, to cover the upper eye quite over, which will prevent it from drying. Nothing more is necessary but to keep the ground clear from weeds until the cuttings begin to shoot; at which time you should look over them carefully, to rub off any small shoots, if such are produced, fastening the first main shoot to the wall, which should be constantly trained up, as it is extended in length, to prevent its breaking or hanging down. You must continue to look over these once in about three weeks during the summer season, constantly rubbing off all lateral shoots which are produced; and be sure to keep the ground clear from weeds, which, if suffered to grow, will exhaust the goodness of the soil and starve the cuttings. The Michaelmas following, if your cuttings have produced strong shoots, you should prune them down to two eyes. In the spring, after the cold weather is past, you must gently dig up the borders to loose the earth; but you must be very careful, in doing this, not to injure the roots of your vines: you should also raise the earth up to the stems of the plants, so as to cover the old wood, but not so deep as to cover either of the eyes of the last year's wood. After this they will require no farther care until they begin to shoot; when you should rub off all weak dangling shoots, leaving no more than the two produced from the two eyes of the last year's wood, which should be fastened to the wall. From this time till the vines have done shooting, you should look them over once in three weeks or a month, to rub off all lateral shoots as they are produced, and to fasten the main shoots to the wall as they are extended in length; about the middle or latter end of July, it will be proper to nip off the tops of these two shoots which will strengthen the lower eyes. During the summer season you must constantly keep the ground clear from weeds: nor should you permit any sort of plants to grow near the vines, which would not only rob them of nourishment, but shade the lower parts of the shoots, and thereby prevent their ripening; which will not only cause their wood to be spongy and luxuriant, but render it less fruitful.

As soon as the leaves begin to drop in autumn, you should prune these young vines again, leaving three buds to each of the shoots, provided they are strong: otherwise it is better to shorten them down to two eyes if they are good; for it is a very wrong practice to leave much wood upon young vines, or to leave their shoots too long, which greatly weakens the roots: then you should fasten them to the wall, spreading them out horizontal each way, that there may be room to train the new shoots the following summer, and in the spring the borders must be digged as before.

The uses of the fruit of the vine for making wine, &c. are well known. The vine was introduced by the Romans into Britain, and appears formerly to have been very common. From the name of vineyard yet adhering to the ruinous sites of our castles and monasteries, there seem to have been few in the country but what had a vineyard belonging to them. The county of Glocester is particularly commended by Malmsbury in the twelfth century, as excelling all the rest of the kingdom in the number and goodness of its vineyards. In the earlier periods of our history, the isle of Ely was expressly denominated the *Isle of Vines* by the Normans. Vineyards are frequently noticed in the descriptive accounts of doomsday; and those of England are even mentioned by Bede as early as the commencement of the eighth century.

Doomsday exhibits to us a particular proof that wine was made in England during the period preceding the conquest. And after the conquest the bishop of Ely appears to have received at least three or four tuns of wine annually, as tythes, from the produce of the vineyards in his diocese; and to have made frequent reservations in his leases of a certain quantity of wine for rent. A plot of land in London, which now forms East-Smithfield and some adjoining streets, was withheld from the religious house within Aldgate by four successive constables of the Tower, in the reigns of Rufus, Henry, and Stephen, and made by them into a vineyard to their great emolument and profit. In the old accounts of rectorial and vicarial revenues, and in the old registers of ecclesiastical suits concerning them, the tithe of wine is an article that frequently occurs in Kent, Surry, and other counties. And the wines of Glocestershire, within a century after the conquest, were little inferior to the French in sweetness. The beautiful region of Gaul, which had not a single vine in the days of Cæsar, had numbers so early as the time of Strabo. The south of it was particularly stocked with them; and they had even extended themselves into the interior parts of the country: But the grapes of the latter did not ripen kindly. France was famous for its vineyards in the reign of Vespasian, and even exported its wines into Italy. The whole province of Narbonne was then covered with vines: and the wine-merchants of the country were remarkable for all the knavish dexterity of our modern brewers, tinging it with smoke, colouring it (as was suspected) with herbs and noxious dyes, and even adulterating the taste and appearance with aloes. And, as our first vines would be transplanted from Gaul, so were in all probability those of the Allobroges in Franche Compte. These were peculiarly fitted for cold countries. They ripened even in the frosts of the advancing winter. And they were of the same colour,

colour, and seem to have been of the same species, as the black Muscadines of the present day, which have lately been tried in the island, I think, and found to be fittest for the climate. These were pretty certainly brought into Britain a little after vines had been carried over all the kingdoms of Gaul, and about the middle of the third century; when the numerous plantations had gradually spread over the face of the latter, and must naturally have continued their progress into the former.

The Romans, even nearly to the days of Lucullus, were very seldom able to regale themselves with wine. Very little was then raised in the compass of Italy. And the foreign wines were so dear, that they were rarely produced at an entertainment; and when they were, each guest was indulged only with a single draught. But in the seventh century of Rome, as their conquests augmented the degree of their wealth, and enlarged the sphere of their luxury, wines became the object of particular attention. Many vaults were constructed, and good stocks of liquor deposited in them. And this naturally gave encouragement to the wines of the country. The Falernian rose immediately into great repute; and a variety of others, that of Florence among the rest, succeeded it about the close of the century. And the more westerly parts of the European continent were at once subjected to the arms, and enriched with the vines, of Italy.

But the scarcity of the native, and dearness of the foreign, wines in that country, several ages before the conquest of Lancashire, had called out the spirit of invention, and occasioned the making of factitious wines. These were still continued by the Romans, and naturally taught to the Britons. And they were made of almost all the products of the orchard and garden, the pear, the apple, mulberry, servis, and rose. Two of them, therefore, were those agreeable liquors which we still denominate *cyder* and *perry*. The latter would be called *pyrum* by the Romans, and is therefore called *perry* or *pear-water* by us. And the former assumed among the Romans the appellation of *sicera*, which was colloquially pronounced by them *sidera*, as the same pronunciation of it among the present Italians shows; and retains therefore the denomination of *cyder* among ourselves.

VITREOUS HUMOUR OF THE EYE. See ANATOMY, n° 142.

VITRIFICATION, in chemistry, the conversion of a body into glass by means of fire. See GLASS.

VITRIOL, a compound salt, formed by the union of iron, copper, or zinc with the sulphuric acid. It is of three colours, white, blue, and green, according to the metal. See CHEMISTRY *Index*.

VITRIOLATED, among chemists, something impregnated, or supposed to be so, with vitriol or its acid.

VITRIOLIC ACID. See *Sulphuric Acid* and CHEMISTRY-*Index*.

VITRUVIUS POLLIO (Marcus), a very celebrated Roman architect, was, according to the common opinion, born at Verona, and lived in the reign of Augustus, to whom he dedicated his excellent treatise on architecture, divided into ten books. William Philander's edition of this celebrated work is esteemed. Claudius Perrault has given an excellent translation of it in French, with learned notes. There are also several English translations of Vitruvius.

VITUS's DANCE. See MEDICINE, n° 284.

VIVERRA, THE WEASEL; a genus of quadrupeds belonging to the order of feræ. They have six fore-teeth, the intermediate ones being shorter, and more than three grinders, and the claws are exserted. There are 27 species, the principal of which are,

1. The ichneumon, with the tail tapering to a point, and the toes distant from each other; inhabits Egypt, Barbary, India and its islands. It is there a most useful animal, being an inveterate enemy to the serpents and other noxious reptiles which infest the torrid zone: it attacks without dread that most fatal of serpents the Naja, or Cobra de Capello; and should it receive a wound in the combat, instantly retires, and is said to obtain an antidote from a certain herb (according to Sparmann the *ophiorhiza*); after which it returns to the attack, and seldom fails of victory: it is a great destroyer of the eggs of crocodiles, which it digs out of the sand: and even kills multitudes of the young of those terrible reptiles: it was not therefore without reason that the ancient Egyptians ranked the ichneumon among their deities. This animal is at present domesticated and kept in houses in India and in Egypt, for it is more useful than a cat in destroying rats and mice; and grows very tame. It is very active; springs with great agility on its prey; will glide along the ground like a serpent, and seem as if without feet. It sits up like a squirrel, and eats with its forefeet, catching any thing that is flung to it. It is a great enemy to poultry, and will feign itself dead till they come within reach: loves fish; draws its prey, after sucking the blood, to its hole. Its excrements are very fetid; when it sleeps, it brings its head and tail under its belly, appearing like a round ball, with two legs sticking out. Rumphius observes how skilfully it seizes the serpents by the throat, so as to avoid receiving an injury; and Lucan beautifully describes the same address of this animal in conquering the Egyptian asp.

2. The vulpecula, or stifling weasel, has a short slender nose; short ears and legs; black body, full of hair; the tail long, of a black and white colour; length from nose to tail about 18 inches. It inhabits Mexico, and perhaps other parts of America. This and some other species are remarkable for the pestiferous, suffocating, and most fetid vapour they emit from behind, when attacked, pursued, or frightened: it is their only means of defence. Some turn their tail to their enemy, and keep them at a distance by a frequent crepitus; and others ejaculate their urine, tainted with the horrid effluvia, to the distance of 18 feet. The pursuers are stopped with the terrible stench. Should any of this liquor fall into the eyes, it almost occasions blindness: if on the clothes, the smell will remain for several days, in spite of all washing; they must even be buried in fresh soil, in order to be sweetened. Dogs that are not true bred, run back as soon as they perceive the smell: those that have been used to it, will kill the animal; but are often obliged to relieve themselves by thrusting their noses into the ground. There is no bearing the company of a dog that has killed one for several days. Professor Kalm was one night in great danger of being suffocated by one that was pursued into a house where he slept; and it affected the cattle so, that they bellowed through pain. Another, which was killed by a maid-servant in a cellar, so affected her with its stench, that she lay ill for several days; all the provisions that were in the place were so tainted, that the owner was obliged to throw them away. Notwithstanding this, the flesh is reckoned good meat, and not unlike that of a pig; but it must be skinned as soon as killed, and the bladder taken carefully out. It breeds in hollow trees, or holes under ground, or in clefts of rocks; climbs trees with great agility; kills poultry; eats eggs, and destroys young birds.

3. The zibetha, or civet-cat, has short rounded ears; the back and sides cinereous, tinged with yellow, marked with large dusky spots disposed in rows; the hair coarse; that on the top of the body longest, standing up like a mane; the

the tail ſometimes wholly black; ſometimes ſpotted near the baſe; length, from noſe to tail, about two feet three inches: the tail 14 inches; the body pretty thick. It inhabits India, the Philippine Iſles, Guinea, Ethiopia, and Madagaſcar. The famous drug muſk, or civet, which is produced from an aperture between the privities and the anus, in both ſexes, is ſecreted from certain glands. The perſons who keep them procure the muſk by ſcraping the inſide of this bag twice a-week with an iron ſpatula, and get about a dram each time: but it is ſeldom ſold pure, being generally mixed with ſuet or oil, to make it more weighty. The males yield the muſk, eſpecially when they are previouſly irritated. They are fed, when young, with pap made of millet, with a little fleſh or fiſh; when old, with raw fleſh. In a wild ſtate, they prey on fowl. Theſe animals ſeem not to be known to the ancients: it is probable the drug was brought without their knowing its origin; for it is certain the fine gentlemen in Rome uſed perfumes.

VIVES, in farriery. See there, § xiv.

VIVIPAROUS, in natural hiſtory, an epithet applied to ſuch animals as bring forth their young alive and perfect: in contradiſtinction to thoſe that lay eggs, which are called *oviparous* animals.

UKRAINE, a large country of Europe, lying on the borders of Turkey in Europe, Poland, Ruſſia, and Little Tartary. Its name properly ſignifies a *frontier*. By a treaty between Ruſſia and Poland in 1693, the latter remained in poſſeſſion of all that part of the Ukraine lying on the weſt ſide of the river Dnieper, which is but indifferently cultivated; while the country on the eaſt ſide, inhabited by the Coſſacs, is in much better condition. The Ruſſian part is compriſed in the government of Kiof; and the empreſs of Ruſſia having obtained the Poliſh palatinate of Kiof, by the treaty of partition in 1793, the whole of the Ukraine, on both ſides of the Dnieper, belongs now to that ambitious and formidable power. The principal town is Kiof.

ULCER, in ſurgery. See Chap. IV. Sect. 1.

ULCER, in farriery. See FARRIERY, Sect. 28.

ULEX, in botany: A genus of plants of the claſs of *diadelphia*, and order of *decandria*; and in the natural ſyſtem arranged under the 32d order, *Papilionaceæ*. The calyx conſiſts of two leaves quinquedentate: pod almoſt covered by the calyx. There are two ſpecies; one of which, the *Europæus*, the furze, gorſe, or whin, is a native of Britain; it is too well known to need deſcription. Its uſes, however, are many; as a fuel where wood and coals are ſcarce: and as underwood upon high barren land: its uſe as horſe provender too ſeems to be fully proved though not yet eſtabliſhed. See AGRICULTURE, n° 47. and FENCE.

ULIETEA, one of the Society Iſlands. This iſland is about 21 leagues in circuit. Its productions are plantains, cocoa nuts, yams, hogs, and fowl; the two latter of which are ſcarce. The ſoil on the top of one of the hills was found to be a kind of ſtone marle; on the ſides were found ſome ſcattered flints, and a few ſmall pieces of a cavernous or ſpongy ſtone lava, of a whitiſh colour, which ſeemed to contain ſome remains of iron, ſo that it may poſſibly be here lodged in the mountains in a great quantity. Nothing was ſeen on this iſland to diſtinguiſh either its inhabitants, or their manners, from the other neighbouring iſlands. The firſt Europeans who landed on this ſhore were Mr (now Sir Joſeph) Banks and Dr Solander; they were received by the natives in the moſt courteous manner, reports concerning them having been their harbingers from Otaheite. Every body ſeemed to fear and reſpect them, placing in them at the ſame time the utmoſt confidence: behaving, as it conſcious that their viſitors poſſeſſed the power of doing them miſchief without a diſpoſition to make uſe of it.

ULIGINOUS, in agriculture, an appellation given to a moiſt, mooriſh, and fenny ſoil.

ULLAGE, in gauging, is ſo much of a caſk or other veſſel as it wants of being full.

ULM, a free and imperial city of Germany, in the circle of Swabia, ſeated on the river Iller. It is a pretty large place, defended by fortifications; and the inhabitants are Proteſtants. Here the archives of the circle are depoſited, and it carries on a very great trade. The elector of Bavaria became maſter of it, in 1702, by a ſtratagem; but, in 1704, the French being vanquiſhed at the battle of Hochſtet, the Bavarians ſurrendered it by capitulation. The Roman Catholics have but two churches, all the reſt belonging to the Proteſtants. E. Long. 10. 12. N. Lat. 48. 25.

ULMUS, in botany: A genus of plants belonging to the claſs of *pentandria*, and order of *digynia*; and in the natural ſyſtem arranged under the 53d order, *Scabridæ*. The calyx is quinquefid; there is no corolla. The fruit is a dry, compreſſed, membranaceous berry. There are three ſpecies, one of which is a native of Britain. The *campeſtris*, common elm. The leaves are rough, oval pointed, doubly ſerrated, unequal at the baſe. Bark of the trunk cracked and wrinkled. Fruit membranous. The *montana*, or wych elm, is generally reckoned a variety of this ſpecies.

All the ſorts of elm may be either propagated by layers or ſuckers taken from the roots of the old trees, the latter of which is generally practiſed by the nurſery-gardeners: but as theſe are often cut up with indifferent roots, they often miſcarry, and render the ſucceſs doubtful; whereas thoſe which are propagated by layers are in no hazard, and always make better roots, and come on faſter than the other, and do not ſend out ſuckers from their roots in ſuch plenty, for which reaſon this method ſhould be more univerſally practiſed.

The elm delights in a ſtiff ſtrong ſoil. It is obſervable, however, that here it grows comparatively ſlow. In light land, eſpecially if it be rich, its growth is very rapid; but its wood is light, porous, and of little value, compared with that which grows upon ſtrong land: which is of a cloſer ſtronger texture, and, at the heart, will have the colour, and almoſt the heavineſs and the hardneſs, of iron: On ſuch ſoils the elm becomes profitable, and is one of the trees which ought in preference to all others to engage the planter's attention.

ULSTER, the moſt northerly province of Ireland. In Latin it is called *Ultonia*, in Iriſh Cuige Ulla, and gives the title of *earl* to the dukes of York of the royal family. It is bounded by the Atlantic Ocean on the weſt, St George's Channel and the Iriſh Sea on the eaſt, the Deucaledonian Ocean on the north, and on the ſouth and ſouth weſt the provinces of Leinſter and Connaught. Its greateſt length is near 120 miles, its breadth about 100; and its circumference, including the windings and turnings, 460; containing 9 counties, 58 market-towns and boroughs, 1 archbiſhopric, 6 biſhoprics, and 214 pariſhes. Ulſter abounds in lakes and rivers, which ſupply it with variety of fine fiſh, eſpecially ſalmon, beſides what it has from the ſea, with which a great part of it is bounded. The ſouthern parts of it are rich, fertile, well cultivated, and incloſed; but the greater part of the northern is open and mountainous.—The towns of this province are in general the neateſt and beſt built of any in Ireland, as well as the farm-houſes; which in moſt parts of the kingdom are conſtructed of no better materials than clay and ſtraw. The inhabitants of Ulſter are alſo more like the Engliſh in their manners and dialect than thoſe of the other three provinces: for as it

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includes within itself the whole, or by far the greater part, of the linen manufactory, the best branch of trade in the kingdom, they have consequently the greatest intercourse with England. An Englishman, in some parts of it, indeed, will imagine himself, from the similarity of their language and manners, in his own country. This province had anciently petty kings of its own. It was first subjected to the English in the reign of Henry II. by John Courcy, the first who bore the title of *earl of Ulster*; but it afterwards threw off the yoke, and was never entirely reduced till the reign of James I. when great numbers of Scots by his encouragement went and settled in it. Of these, most of the present inhabitants are the descendants. This province was the first and principal scene of the bloody massacre in 1641.

ULTERIOR, in geography, is applied to some part of a country or province, which, with regard to the rest of that country, is situated on the farther side of the river, mountain, or other boundary, which separates the two countries.

ULTRAMARINE, a beautiful blue colour used by the painters, prepared from the lapis lazuli by calcination.

ULTRAMONTANE, something beyond the mountains. The term is principally applied in relation to France and Italy, which are separated by the Alps.

ULVA, in botany; a genus of plants of the class of *cryptogamia*, and order of *algæ*. The fructification is inclosed in a diaphanous membrane. There are 17 species; 12 of which are British plants.

They are all sessile, and without roots, and grow in ditches and on stones along the sea-coast. None of them are applied to any particular use different from the rest of the algæ, except perhaps the *umbilicalis*, which in England is pickled with salt and preserved in jars, and afterwards stewed and eaten with oil and lemon-juice. This species, called in English the *navel laver*, is flat, orbicular, sessile, and coreaceous.

ULUG BEIG, a Persian prince and learned astronomer, was descended from the famous Tamerlane, and reigned at Samarcand about 40 years; after which he was murdered by his own son in 1449. His catalogue of the fixed stars, rectified for the year 1434, was published at Oxford by Mr Hyde, in 1665, with learned notes. Mr Hudson printed in the English Geography Ulug Beig's Tables of the Longitude and Latitude of Places; and Mr Greaves published, in Latin, his Astronomical Epochas, at London, in 1650. See ASTRONOMY-*Index*.

ULYSSES, king of Ithaca, the son of Laertes, and father of Telemachus and one of those heroes who contributed most to the taking of Troy. After the destruction of that city, he wandered for 10 years; and at last returned to Ithaca, where, with the assistance of Telemachus, he killed Antinous and other princes who intended to marry his wife Penelope and seize his dominions. He at length resigned the government of the kingdom to his son Telemachus; and was killed by Telegonus, his son by Circe, who did not know him. This hero is the subject of the Odyssey.

UMBELLA, an UMBEL, in botany: A species of receptacle; or rather a mode of flowering, in which a number of slender footstalks proceed from the same centre, and rise to an equal height, so as to form an even and generally round surface at top. See BOTANY.

UMBELLATÆ, the name of a class in Ray's and Tournefort's methods, consisting of plants whose flowers grow in umbels, with five petals that are often unequal, and two naked seeds that are joined at top and separated below.

The same plants constitute the 45th order of Linnæus's Fragments of a Natural Method. See BOTANY.

UMBELLIFEROUS PLANTS, are such as have their tops branched and spread out like an umbrella.

UMBER, or UMBRE, in natural history, a fossil brown or blackish substance, used in painting; so called from *Ombria*, the ancient name of the duchy of Spoleto in Italy, whence it was first obtained; diluted with water, it serves to make a dark brown colour, usually called with us an *hair colour*.

Dr Hill and Mr da Costa consider it as an earth of the ochre kind. It is found in Egypt, Italy, Spain, and Germany; in Cyprus also it is found in large quantities; but what we have brought into England is principally from different parts of the Turkish dominions. But it might be found in considerable plenty also in England and Ireland, if properly looked after, several large masses of it having been thrown up in digging on Mendip hills in Somersetshire, and in the county of Wexford in Ireland: it is also sometimes found in the veins of lead-ore both in Derbyshire and Flintshire.

UMBILICAL, among anatomists, something relating to the umbilicus or navel.

UMBRELLA, a moveable canopy, made of silk or other cloth spread out upon ribs of whale-bone, and supported by a staff, to protect a person from rain, or the scorching beams of the sun.

UMPIRE, a third person chosen to decide a controversy left to arbitration.

UNCIA, in general, a Latin term, denoting the twelfth part of any thing; particularly the twelfth part of a pound, called in English an *ounce*; or the twelfth part of a foot, called an *inch*.

UNCTION, the act of anointing or rubbing with oil or other fatty matter.

UNCTION, in matters of religion, is used for the character conferred on sacred things by anointing them with oil. Unctions were very frequent among the Hebrews. They anointed both their kings and high-priests at the ceremony of their inauguration. They also anointed the sacred vessels of the tabernacle and temple, to sanctify and consecrate them to the service of God. The unction of kings is supposed to be a ceremony introduced very late among the Christian princes. It is said that none of the emperors were ever anointed before Justinian or Justin. The emperors of Germany took the practice from those of the eastern empire: king Pepin of France was the first who received the unction. In the ancient Christian church, unction always accompanied the ceremonies of baptism and confirmation. Extreme unction, or the anointing persons in the article of death, was also practised by the ancient Christians, in compliance with the precept of St James, chap. v. 14th and 15th verses; and this extreme unction the Romish church has advanced to the dignity of a sacrament. It is administered to none but such as are affected with some mortal disease, or in a decrepit age. It is refused to impenitent persons, as also to criminals. The parts to be anointed are the eyes, the ears, the nostrils, the mouth, the hands, the feet, and the reins. The laity are anointed in the palms of the hands, but priests on the back of it; because the palms of their hands have been already consecrated by ordination.

The oil with which the sick person is anointed represents the grace of God, which is poured down into the soul, and the prayer used at the time of anointing expresses the remission of sins thereby granted to the sick person; for the prayer is this: "By this holy unction, and his own most pious mercy, may the Almighty God forgive thee whatever sins thou hast committed *by the sight*," when the eyes are anointed; *by the hearing*, when the ears are anointed; and so of the other senses *.

UNDECAGON, is a regular polygon of 11 sides.

* *The cere[...] C[...] an inf[...] from t[...] Writ[...] Word[...]*

UNDECEMVIR, a magiſtrate among the ancient Athenians, who had 10 other colleagues or aſſociates joined with him in the ſame commiſſion. The functions of the undecemviri at Athens were much the ſame as thoſe of the late *prevots de marechauſſe* in France. They took care of the apprehending of criminals; ſecured them in the hands of juſtice; and when they were condemned, took them again into cuſtody, that the ſentence might be executed on them. They were choſen by the tribes, each tribe naming its own; and as the number of the tribes after Calliſthenes was but 10, which made 10 members, a ſcribe or notary was added, which made the number 11.

UNDERSTANDING. See METAPHYSICS and LOGIC.

UNDERWALD, a canton of Swiſſerland, and the ſixth in rank. It is bounded on the north by the canton of Lucern and by the Lake of the Four Cantons, on the eaſt by the high mountains which ſeparate it from the canton of Bern, and on the weſt by the canton of Bern. The religion of this canton is the Roman Catholic.

UNDERWOOD, is coppice, or any wood that is not accounted timber.

UNDULATION, in phyſics, a kind of tremulous motion or vibration obſervable in a liquid, whereby it alternately riſes and falls like the waves of the ſea.

UNGUENT, in medicine and ſurgery, a topical remedy or compoſition, chiefly uſed in the dreſſing of wounds or bliſters. See PHARMACY, n° 635.

UNICORN, an animal famous among the ancients, and thought to be the ſame with the rhinoceros. See RHINOCEROS.

Sparmann informs us, that the figure of the unicorn deſcribed by the ancients has been found delineated by the Sneſe Hottentots on the plain ſurface of a rock in Caffraria; and therefore conjectures, that ſuch an animal either does exiſt at preſent in the internal parts of Africa, or at leaſt once did ſo. Father Lobo affirms that he has ſeen it.

UNICORN-Fiſh. See MONODON.

UNIFORM, denotes a thing to be ſimilar, or conſiſtent either with another thing, or with itſelf, in reſpect of figure, ſtructure, proportion, or the like; in which ſenſe it ſtands oppoſed to difform.

UNIFORMITY, regularity, a ſimilitude or reſemblance between the parts of a whole. Such is that we meet with in figures of many ſides, and angles reſpectively equal, and anſwerable to each other. A late ingenious author makes beauty to conſiſt in uniformity, joined or combined with variety. Where the uniformity is equal in two objects, the beauty, he contends, is as the variety; and where the variety is equal, the beauty is as the uniformity.

UNIFORMITY, is particularly uſed for one and the ſame form of public prayers, and adminiſtration of ſacraments, and other rites, &c. of the church of England, preſcribed by the famous ſtat. 1 Eliz. and 13 and 14 Car. II. cap. 4. called the *Act of Uniformity*. See LITURGY.

UNION, a junction, coalition, or aſſemblage of two or more different things in one.

UNION, or *The Union*, by way of eminence, is more particularly uſed to expreſs the act by which the two ſeparate kingdoms of England and Scotland were incorporated into one, under the title of *The kingdom of Great Britain*. This union, in vain attempted by king James I. was at length effected in the year 1707, 6 Annæ, when 25 articles were agreed to by the parliament of both nations; the purport of the moſt conſiderable being as follows:

1. That on the firſt of May 1707, and for ever after, the kingdoms of England and Scotland ſhall be united into one kingdom, by the name of *Great Britain*.

2. The ſucceſſion to the monarchy of Great Britain ſhall be the ſame as was before ſettled with regard to that of England. Union

3. The united kingdom ſhall be repreſented by one parliament.

4. There ſhall be a communication of all rights and privileges between the ſubjects of both kingdoms, except where it is otherwiſe agreed.

9. When England raiſes 2,000,000 l. by a land tax, Scotland ſhall raiſe 48,000 l.

16, 17. The ſtandards of the coin, of weights, and of meaſures, ſhall be reduced to thoſe of England throughout the united kingdoms.

18. The laws relating to trade, cuſtoms, and the exciſe, ſhall be the ſame in Scotland as in England. But all the other laws of Scotland ſhall remain in force; but alterable by the parliament of Great Britain. Yet with this caution, that laws relating to public policy are alterable at the diſcretion of the parliament; laws relating to private right are not to be altered but for the evident utility of the people of Scotland.

22. Sixteen peers are to be choſen to repreſent the peerage of Scotland in parliament, and 45 members to ſit in the houſe of commons.

23. The 16 peers of Scotland ſhall have all privileges of parliament; and all peers of Scotland ſhall be peers of Great Britain, and rank next after thoſe of the ſame degree at the time of the union, and ſhall have all privileges of peers, except ſitting in the houſe of lords, and voting on the trial of a peer.

Theſe are the principal of the 25 articles of union, which are ratified and confirmed by ſtatute 5 Ann. c. 8. in which ſtatute there are alſo two acts of parliament recited; the one of Scotland, whereby the church of Scotland, and alſo the four univerſities of that kingdom, are eſtabliſhed for ever, and all ſucceeding ſovereigns are to take an oath inviolably to maintain the ſame; the other of England, 5 Annæ, c. 6. whereby the acts of uniformity of 13 Eliz. and 13 Car. II. (except as the ſame had been altered by parliament at that time), and all other acts then in force for the preſervation of the church of England, are declared perpetual; and it is ſtipulated, that every ſubſequent king and queen ſhall take an oath inviolably to maintain the ſame within England, Ireland, Wales, and the town of Berwick upon Tweed. And it is enacted, that theſe two acts "ſhall for ever be obſerved as fundamental and eſſential conditions of the union."

Upon theſe articles and act of union, it is to be obſerved, 1. That the two kingdoms are ſo inſeparably united, that nothing can ever diſunite them; except the mutual conſent of both, or the ſucceſsful reſiſtance of either, upon apprehending an infringement of thoſe points which, when they were ſeparate and independent nations, it was mutually ſtipulated ſhould be "fundamental and eſſential conditions of the union." 2. That whatever elſe may be deemed "fundamental and eſſential conditions," the preſervation of the two churches, of England and Scotland, in the ſame ſtate that they were in at the time of the union, and the maintenance of the acts of uniformity which eſtabliſhed the liturgy, are expreſsly declared ſo to be. 3. That therefore any alteration in the conſtitution of either of theſe churches, or in the liturgy of the church of England (unleſs with the conſent of the reſpective churches, collectively or repreſentatively given), would be an infringement of theſe "fundamental and eſſential conditions," and greatly endanger the union. 4. That the municipal laws of Scotland are ordained to be ſtill obſerved in that part of the iſland, unleſs altered by parliament; and as the parliament has not yet thought proper,

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proper, except in a few instances, to alter them, they still, with regard to the particulars unaltered, continue in full force.

UNISON, in music. See INTERVAL.

UNIT, or UNITY, in arithmetic, the number one; or one single individual part of discrete quantity.

UNITARIANS, in ecclesiastical history, a name given to those who confine the glory and attribute of divinity to the One only great and supreme God, and Father of our Lord Jesus Christ.

UNITED BRETHREN, or *Unitas Fratrum*, in ecclesiastical history, a church of which many of our readers will think that an account sufficiently full has been given under the word HERRNHUT. With that account, however, some of the brethren have expressed themselves dissatisfied, in terms which might, without impropriety, be called acrimonious; and the present Editor of this Work, being convinced by his own experience how difficult it is to extract pure and unsophisticated truth from the perplexed writings of angry polemics, resolved, when he entered upon his laborious task, to permit every sect of Christians to plead its own cause, upon the single condition of not loading its opponents with opprobrious epithets. He hopes therefore that the public will forgive him for inserting the following account of the rise, progress, worship, and discipline, of the church of the *United Brethren*, extracted from a tedious manuscript sent to him by one of their clergy. He has faithfully abridged the narrative of his author; but does not consider himself as under any obligation either to maintain its truth, or to convict it of falsehood.

According to this writer, the church of the United Brethren took its rise in Moravia during the 14th century; though in the sentence immediately following this assertion, he says, that it derived its origin from the Greek church in the 9th century, when, by the instrumentality of Methodius and Cyrillus, two Greek monks, the kings of Bulgaria and Moravia being converted to the faith, were, together with their subjects, united in communion with the Greek church. Methodius was their first bishop; and for their use Cyrillus translated the Scriptures into the Sclavonian language.

The antipathy of the Greek and Roman churches is well known; and by much the greater part of the brethren were in process of time compelled, after many struggles, to submit to the see of Rome. A few, however, adhering to the rites of their mother church, united themselves in 1176 to the Waldenses, and sent missionaries into many countries. In 1457 they were called *fratres legis Christi* or brethren of the law of Christ, because about that period they had thrown off all reverence for human compilations of the faith, professing simply to follow the doctrines and precepts contained in the word of God.

There being at this time no bishops in the Bohemian church who had not submitted to the papal jurisdiction, three priests of the society of United Brethren were, about the year 1467, consecrated by Stephen bishop of the Waldenses in Austria (see WALDENSES); and these prelates, on their return to their own country, consecrated ten co-bishops, or conseniors, from among the rest of the presbyters. In 1523, the United Brethren commenced a friendly correspondence, first with Luther, and afterwards with Calvin and other leaders among the Reformers. A persecution, which was brought upon them on this account, and some religious disputes which took place among themselves, threatened for a while the society with ruin; but the disputes were in 1570 put an end to by a synod, which decreed that differences about non-essentials should not destroy their union; and the persecution ceased in 1575, when the United Brethren obtained an edict for the public exercise of their religion. This toleration was renewed in 1609, and liberty granted them to erect new churches. But a civil war which in 1612 broke out in Bohemia, and a violent persecution which followed it in 1621, occasioned the dispersion of their ministers, and brought great distress upon the Brethren in general. Some of them fled to England, others to Saxony and Brandenburg, whilst many, overcome by the severity of the persecution, conformed to the rites of the church of Rome. One colony of these, who retained in purity their original principles and practice, was, in 1722, conducted by a brother named *Christian David*, from Fulneck in Moravia to Upper Lusatia, where they put themselves under the protection of NICHOLAS LEWIS COUNT OF ZINZENDORF, and built a village on his estate, at the foot of a hill called *Hutberg*, or "Watch Hill" (see HERRNHUT). The count, who soon after their arrival removed from Dresden to his estate in the country, showed every mark of kindness to the poor emigrants; but being a zealous member of the church established by law, he endeavoured for some time to prevail upon them to unite themselves with it, by adopting the Lutheran faith and discipline. This they declined; and the count, on a more minute inquiry into their ancient history and distinguishing tenets, not only desisted from his first purpose, but became himself a convert to the faith and discipline of the United Brethren.

The synod, which in 1570 put an end to the disputes which then tore the church of the Brethren into factions, had considered as non-essentials the distinguishing tenets of their own society, of the Lutherans, and of the Calvinists. In consequence of this, many of the Reformers of both these sects had followed the Brethren to Herrnhut, and been received by them into communion; but not being endued with the peaceable spirit of the church which they had joined, they started disputes among themselves, which threatened the destruction of the whole establishment. By the indefatigable exertions of Count Zinzendorf these disputes were allayed; and statutes being in 1727 drawn up and agreed to for the regulation both of the internal and of the external concerns of the congregation, brotherly love and union was again established; and no schism whatever, in pointe of doctrine, has since that period disturbed the church of the United Brethren.

In 1735 the Count, who under God had been the instrument of renewing the Brethren's church, was consecrated one of their bishops, having the year before been examined and received into the clerical orders by the Theological Faculty of Tubingen. Dr Potter, then archbishop of Canterbury, congratulated him upon this event, and promised his assistance to a church of confessors, of whom he wrote in terms of the highest respect for their having maintained the pure and primitive faith and discipline in the midst of the most tedious and cruel persecutions. That his Grace, who had studied the various controversies about church-government with uncommon success, admitted the Moravian episcopal succession, we know from the most unquestionable authority; for he communicated his sentiments on the subject to Dr Secker while bishop of Oxford, and from his Lordship they came through a dignitary of the church of England to the compiler of this article. In conformity with these sentiments of the archbishop, we are assured that the parliament of Great Britain, after mature investigation, acknowledged the *Unitas Fratrum* to be a Protestant episcopal church; and in 1794 an act was certainly passed in their favour.

We have elsewhere (see HERRNHUT) mentioned the

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favourable report that was made to the court of Dreſden by a deputation which was appointed to examine into the principles and practices of the United Brethren; of which the conſequence was, a toleration through all Saxony, as well as in Upper Luſatia. It is, however, acknowledged by the author of the manuſcript which we are abridging, that ſome of the converts to the faith and diſcipline of the *Unitas Fratrum*, having previouſly imbibed extravagant notions, propagated them with zeal among their new friends, in a phraſeology extremely reprehenſible; and that Count Zinzendorf himſelf ſometimes adopted the very improper language of thoſe fanatics, whom he wiſhed to reclaim from their errors to the ſoberneſs of truth; but it is added, that much of the extravagance and abſurdity which has been attributed to the Count, is not to be charged to him, but to thoſe perſons who, writing his *extempore* ſermons in ſhort hand, printed and publiſhed them without his knowledge or conſent. This account of the matter appears indeed extremely probable; and it is but juſtice to the Count to acknowledge, that he ſeems to have been very deſirous to diſclaim the improper expreſſions, and to vindicate his church from countenancing that impurity which, whether juſtly or not, was attributed to himſelf.

This eminent benefactor to the United Brethren died in 1760; and it is with reaſon that they honour his memory, as having been the inſtrument by which God reſtored and built up their church. But they do not regard him as their head, nor take his writings, nor the writings of any other man, as the ſtandard of their doctrines, which they profeſs to derive immediately from the word of God.

It has been already obſerved, that the church of the United Brethren is epiſcopal; but though they conſider epiſcopal ordination as neceſſary to qualify the ſervants of the church for their reſpective functions, they allow to their biſhops no elevation of rank or pre-eminent authority; their church having from its firſt eſtabliſhment been governed by ſynods, conſiſting of deputies from all the congregations; and by other ſubordinate bodies, which they call *conferences*. The ſynods, which are generally held once in ſeven years, are called together by the elders who were in the former ſynod appointed to ſuperintend the whole unity. In the firſt ſitting a preſident is choſen, and theſe elders lay down their office; but they do not withdraw from the aſſembly, for they, together with all biſhops, *ſeniores civiles*, or lay-elders, and thoſe miniſters who have the general care or inſpection of ſeveral congregations in one province, have ſeats in the ſynod without any particular election. The other members are, one or more deputies ſent by each congregation, and ſuch miniſters or miſſionaries as are particularly called to attend. Women approved by the congregations are alſo admitted as hearers; and are called upon to give their advice in what relates to the miniſterial labour among their ſex; but they have no deciſive vote in the ſynod. The votes of all the other members are equal.

In queſtions of importance, or of which the conſequences cannot be foreſeen, neither the majority of votes nor the unanimous conſent of all preſent can decide; but recourſe is had to the *lot*. For adopting this unuſual mode of deciding in eccleſiaſtical affairs, the Brethren allege as reaſons the practices of the ancient Jews and the apoſtles; the inſufficiency of the human underſtanding amidſt the beſt and pureſt intentions to decide for itſelf in what concerns the adminiſtration of Chriſt's kingdom; and their own confident reliance on the comfortable promiſes that the Lord Jeſus will approve himſelf the head and ruler of his church. The *lot* is never made uſe of but after mature deliberation and fervent prayer; nor is any thing ſubmitted to its deciſion, which does not, after being thoroughly weighed, appear to the aſſembly eligible in itſelf.

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In every ſynod the inward and outward ſtate of the unity, and the concerns of the congregations and miſſions, are taken into conſideration. If errors in doctrine or deviations in practice have crept in, the ſynod endeavours not only to remove them, but by ſalutary regulations to prevent them for the future. It conſiders how many biſhops are to be conſecrated to fill up the vacancies occaſioned by death; and every member of the ſynod gives his vote for ſuch of the clergy as he thinks beſt qualified. Thoſe who have the majority of votes are taken into the *lot*, and they who are approved are conſecrated accordingly; but by conſecration they are veſted with no ſuperiority over their Brethren, ſince it behoves him who is the greateſt to be the ſervant of all.

Towards the concluſion of every ſynod, a kind of executive board is choſen, and called *the Elder's Conference of the Unity*. At preſent it conſiſts of 13 elders, and is divided into four committees or departments: 1. The *miſſion's* department, which ſuperintends all the concerns of the miſſions into Heathen countries. 2. The *helper's* department, which watches over the purity of doctrine and the moral conduct of the different congregations. 3. The *ſervant's* department, to which the economical concerns of the Unity are committed. 4. The *overſeer's* department, of which the buſineſs is to ſee that the conſtitution and diſcipline of the Brethren be everywhere maintained. No reſolution, however, of any of theſe departments has the ſmalleſt force, till it be laid before the aſſembly of the whole *Elder's Conference*, and have the approbation of that body. The powers of the *Elder's Conference* are indeed very extenſive. Beſides the general care which it is commiſſioned by the ſynods to take of all the congregations and miſſions, it appoints and removes every ſervant in the unity, as circumſtances may require; authoriſes the biſhops to ordain preſbyters or deacons, and to conſecrate other biſhops; and, in a word, tho' it cannot abrogate any of the conſtitutions of the ſynod, or enact new ones itſelf, it is poſſeſſed of the ſupreme executive power over the whole body of the United Brethren.

Beſides this general conference of elders, which ſuperintends the affairs of the whole unity, there is another conference of elders belonging to each congregation, which directs its affairs, and to which the biſhops and all other miniſters, as well as the lay-members of the congregation, are ſubject. This body, which is called the *Elder's Conference of the Congregation*, conſiſts, 1. Of the *miniſter* as preſident, to whom the ordinary care of the congregation is committed, except when it is very numerous, and then the general inſpection of it is entruſted to a ſeparate perſon, called the *Congregation Helper*; 2. Of the *warden*, whoſe office it is to ſuperintend with the aid of his council all outward concerns of the congregation, and to aſſiſt every individual with his advice; 3. Of a *married pair*, who care particularly for the ſpiritual welfare of the married people; 4. Of a *ſingle clergyman*, to whoſe care the young men are more particularly committed; and, 5. Of *thoſe women*, who aſſiſt in caring for the ſpiritual and temporal welfare of their own ſex, and who in this conference have equal votes with the men. As the *Elder's Conference of each Congregation* is anſwerable for its proceedings to the *Elder's Conference of the Unity*, viſitations from the latter to the former are held from time to time, that the affairs of each congregation, and the conduct of its immediate governors, may be intimately known to the ſupreme executive government of the whole church.

We have already mentioned the epiſcopacy of the Bre-

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United Brethren, United Provinces.

thren, and the very limited powers of their bishops; and have to add, that, in their opinion, episcopal consecration does not confer any power to preside over one or more congregations; and that a bishop can discharge no office but by the appointment of a synod, or of the Elder's conference of the Unity. Presbyters among them can perform every function of the bishop except ordination; for if we understand the manuscript before us, he confirms by the laying on of hands young persons when they first become candidates for the communion. Deacons are assistants to the presbyters much in the same way as in the church of England; and in the Brethren's churches deaconesses are retained, for the purpose of privately admonishing their own sex, and visiting them in their sickness: but though they are solemnly elected to this office, they are not permitted to teach in public, and far less to administer the sacraments. They have likewise *seniores civiles*, or lay-elders, in contradistinction to spiritual elders or bishops, who are appointed to watch over the constitution and discipline of the Unity of the Brethren; over the observance of the laws of the country in which congregations or missions are established; and over the privileges granted to the Brethren by the governments under which they live. They do not consider a regular course of literary education as at all necessary to qualify persons for admission into orders, provided they possess a thorough knowledge of the word of God, what they call *solid Christian experience*, and a well regulated zeal to serve God and their neighbours.

We have mentioned elsewhere (HERRNHUT) their daily meetings in church for worship and edification. On Sunday, besides the public prayers, which are either read from a liturgy or pronounced extempore by the minister, one or two sermons are preached in every church or chapel; and after the morning service an exhortation is given to the children. Previous to the holy communion, which is administered on some Sunday once a month, and likewise on *Maunday Thursday*, each person who intends to communicate converses with one of the elders on the state of his soul, expressing his desire to partake of the sacrament. The celebration of the communion is generally preceded by a *love-feast*, which is also kept on other solemn occasions. On Maunday Thursday, before communion, the Brethren have a solemn *foot-washing*; and at this, and we suppose at other times, they greet one another with *the kiss of charity*. These ceremonies they consider as religious rites, authorised thro' all ages of the church by our Saviour himself and his two apostles St Peter and St Paul *.

Our limits will not permit us to give a systematic view of the doctrinal tenets of the Brethren. Though they acknowledge no other standard of truth than the sacred Scriptures, they adhere to the Augsburg Confession, and speak respectfully of the 39 articles of the church of England. They profess to believe that the kingdom of Christ is not confined to any particular party, community, or church; and they consider themselves, though united in one body or visible church, as spiritually joined in the bond of Christian love to all who are taught of God, and belong to the universal church of Christ, however much they may differ in forms, which they deem non-essentials. But the reader who wishes to have a fuller account of this society of Christians, we must refer to *Cranz's Ancient and Modern History of the Protestant Church of the United Brethren*, printed in London, 1780; and to a work entitled *An Exposition of Christian Doctrine as taught in the Protestant Church of the United Brethren*, London, 1784.

* John xiii. 14. 1 Peter v. 14. Rom. xvi. 16.

UNITED PROVINCES, or UNITED *Netherlands*, otherwise called the *Republic of Holland*, consist of the seven provinces of Holland, Zealand, Friesland, Groningen, Overyssel, Zutphen, and Utrecht. They are bounded on the west by the German Ocean; on the east by the circle of Westphalia; and on the south by Flanders, Brabant, and the duchy of Cleves. They compose the greatest part of the ancient Batavia, whose inhabitants were formerly so much renowned for their valour. Under the Romans they were exempt from imposts and taxes, in consequence of bearing the honourable title of *Allies of the Republic*.

The Netherlands came into the possession of the house of Austria by the marriage of Mary of Burgundy with the emperor Maximilian: but on that prince's resigning the imperial crown, the 17 provinces of the Netherlands devolved of right on Don John of Spain; but he and his successor Philip le Beau dying in a short time after, they, in 1505, fell under the dominion of Charles V. at that time a minor.

At this period the seven provinces, which now compose the Republic of Holland, enjoyed a kind of independence; but the policy and warlike disposition of Charles soon reduced them to obedience. When he resigned the sceptre to his son Philip, the Low Countries were in a most flourishing condition. In this small tract of country were reckoned no fewer than 350 large cities inclosed with walls, and 6300 considerable towns, all become rich by their application to the arts and to commerce. At the same time, the love of liberty was very prevalent among the inhabitants, and they were jealous of every invasion of their rights and privileges. The arbitrary government of Philip was therefore very disagreeable to his subjects in the Low Countries, and the partiality shown on all occasions to the Spaniards soon lost their affections altogether.

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The extreme superstition, however, and cruel bigotry of Philip, proved the greatest source of discontent. The doctrines of the reformers had been preached and received with avidity in the Low Countries. A cruel persecution of the reformed had been commenced by Charles V. insomuch that he is said to have destroyed no fewer than 100,000 persons on account of religion. This cruelty had no effect except to increase the number of heretics; which being observed by Mary queen of Hungary, sister to the emperor, she invited him to the Low Countries, that he might personally behold the bad effects of his cruelty. On this the emperor granted a toleration, but Philip was altogether inflexible. In order to proceed more effectually against the reformed, a court of inquisition was instituted; and under pretence that the three bishoprics, which at that time comprehended the whole country, were too large, 17 of these dignitaries were erected, three with the title of archbishops. To afford sufficient revenues for these, it became necessary to suppress several abbeys, which of itself produced great discontent. But what gave the finishing stroke to the whole was, Philip's announcing his intention of residing constantly in Spain; his appointing the duchess of Parma, his natural sister, to be regent of the Netherlands; and giving her for a counsellor cardinal Granvele, a bloody persecutor of the reformed; at the same time that the provinces were oppressed by the violences of foreign troops, for the payment of whom they were also oppressed by taxes. Three councils were established at Brussels; one to preside over the laws and courts of justice; a second to direct every thing respecting peace or war; and the third to manage the revenues: but still the duchess of Parma was ordered to consult Granvele in every matter, and make him at all times her chief confidant.

5 Court of inquisition established.

6 Duchess of Parma appointed governess.

7 Universal discontent.

The duchess took upon her the government of the Low Countries in the year 1560; and was no sooner arrived at Brussels, than complaints poured from all quarters against the inquisition, cardinal Granvele, and the new bishoprics.

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The duchefs endeavoured to allay the ferment by fair words, but in vain. At the head of the malecontents were the prince of Orange, count Egmont, and count Horn, who ftrenuoufly infifted on calling an affembly of the States-general, and laying before them the grievances by which the country was oppreffed. The event was, that in 1564 the cardinal was obliged to refign his dignity; which yet did not produce any good effect, as he was fucceeded by two of his creatures, Barlaimont and Viglius, who trod exactly in his footfteps. They pufhed on the inquifition to frefh executions; ftigmatized the principal nobility as heretics; and on all occafions fhowed fuch violent and intolerable zeal for the Catholic religion, that one of Philip's minifters reprefented to him the danger there was of a total revolt of the provinces, unlefs the rigours of perfecution were fomewhat relaxed. But Philip no fooner received this intelligence, than he replied, "that he had rather be without fubjects, than be a king of heretics." Agreeable to this reply, all the obnoxious decrees were enforced with double rigour; upon which the ftate of affairs became fo alarming, that it was thought neceffary to fend count Egmont into Spain, in order to have a perfonal interview with the king on the fubject. Philip, accuftomed to deceit, gave a fmooth anfwer, abated the rigour of his decrees, and ordered the governante fometimes to confult with the prince of Orange. Thus tranquillity was for a time reftored; but in the year 1566, it being difcovered that a fcheme for the total extirpation of the Proteftants had been concerted by the queen-mother of France, her fon Charles IX. and Ifabella queen of Spain, in a conference at Bayonne, matters became worfe than ever. That the information received concerning this deteftable combination was true, very foon appeared, from Philip's difclaiming all the favourable interpretations which had been put upon his anfwer to count Egmont, and from his ordering the inquifition to proceed with more fury than ever.—The confequence of this was a general affociation againft this abominable tribunal, which was fubfcribed by all orders and degrees of men, Roman Catholics as well as Proteftants. The confederates, headed by Henry de Brodenrode, a defcendant of the ancient earls of Holland, waited on the duchefs of Parma, in fuch a formidable body, that fhe was obliged to difmifs them with an abfolute promife that their demands fhould be granted. Thefe demands were, that the inquifition fhould be abolifhed, and the edicts againft liberty of confcience recalled; and for this fhe immediately interpofed all her intereft with Philip. Sir William Temple alleges, that Philip, in confequence of the governante's remonftrances, granted all that was defired, but too late. All other hiftorians, however, agree that he was inflexible, and that the duchefs could procure no better conditions than that heretics fhould from that time forward be hanged inftead of being burned. Even this appeared a conceffion unworthy of the king; the royal name was therefore forbid to be ufed.

Before the confederates proceeded to extremities, they fent deputies to Madrid: but, according to fome authors, they were refufed admittance into the king's prefence. It appears, however, that they had found means of reprefenting the true ftate of affairs to the king, and of informing him that the difturbances proceeded from the deteftation in which the inquifition was everywhere held in the Low Countries. Their reprefentations produced no other effect than an equivocal promife, which was evidently never intended to be kept. The governante received orders to proceed againft heretics with the utmoft feverity; upon which the people broke out into acts of open rebellion. In feveral towns of Flanders the churches were deftroyed, images pulled down, and all thofe acts of violence committed which are the ufual operations of a lawlefs mob. The principal inhabitants, however, ftill remained quiet, and even did all in their power to reftrain the violence of the commonalty; fo that, had Philip made any kind of reafonable conceffion, the public tranquillity might have been reftored. Inftead of this, however, a new oath of allegiance was adminiftered by the governante, and all perfons were obliged to fwear that they would regard as traitors and enemies to their country all whom the king fhould think proper to profcribe. This extraordinary proceeding was followed by the moft cruel perfecution that can be imagined; at the fame time that the duke of Alva was fent into the Netherlands with an army of 10,000 veteran troops, to put the laft hand to the mifery of the people, and fully to eftablifh the defpotifm of the court. Counts Egmont and Horn took the above mentioned oath; but the prince of Orange could by no means be induced to it, and therefore retired into Germany, along with counts Brodenrode and Hoogftrate. Their example was followed by great numbers of all ranks and conditions; and after the arrival of the army commanded by the duke of Alva, fuch multitudes continued to emigrate, that the duchefs of Parma informed the king, that within a few days 100,000 families had left his dominions; that in a fhort time the country muft be depopulated, in which cafe there were would be no occafion for a governante; fhe therefore begged leave to refign, before fhe fhould have the mortification and difgrace of being left alone in the Netherlands.

United Provinces.

11 New oath of allegiance required.

12 Prince of Orange retires.

13 Duchefs of Parma refigns.

Philip immediately complied with the requeft of the princefs, and the duke of Alva was appointed to fucceed her in the government. It may eafily be imagined that the miferies of the people would now become intolerable. The king was a proud and mercilefs tyrant, fet at too great a diftance from his fubjects to be thoroughly fenfible of their calamities, and totally deftitute of compaffion had he known them ever fo well. The new governor was of the fame difpofition; and the army he commanded was fierce, rapacious, and cruel, defiring nothing more ardently than to enrich themfelves at the expence of the inhabitants. The whole country was filled with blood and horror; counts Egmont and Horn were ignominioufly executed, and the eftate of the prince of Orange was confifcated. Thefe laft proceedings drove the people into defpair; and they invited the prince to return, in order to take upon him the defence of the country from fuch infufferable tyranny and oppreffion.

14 Is fucceeded by the duke of Alva.

15 Prince of [illegible]

All this time the prince of Orange, and his brother Louis of Naffau, had been labouring to form alliances for the defence of the liberties of their country. He had reprefented matters in fuch a light to the emperor Maximilian, that his Imperial majefty fent an ambaffador to Philip, exhorting him to treat his fubjects in the Netherlands with lefs rigour. This embaffy was haughtily received; Philip continued his perfecutions, and the prince of Orange his preparations for entering the Low Countries. His firft efforts, however, were very unfuccefsful. A detachment of Germans in the fervice of the prince attempted to penetrate into Brabant and furprife Ruremond; but were defeated by a detachment from the duke of Alva's army. Another party, confifting chiefly of French, attempted to penetrate into Artois by the way of Picardy; but their officers were arrefted by order of Charles IX. Louis of Naffau, however, defeated a body of Spaniards, and killed 6[illegible] of them on the fpot; but the vigilance of his enemies prevented him from drawing any advantage of confequence from his victory.

16 [illegible]

The duke of Alva was fo much chagrined at the defeat fuftained by his party, that he inftantly affembled his troops from all quarters. His army then appeared too formidable to be oppofed, and the prince of Naffau with count [illegible]

ſtrate retired towards the river Ens. But being hard puſhed by the duke of Alva, and mutinies ariſing among their troops for want of pay, they were ſoon brought to an action, and totally defeated. The infantry were entirely cut in pieces; the cavalry were ſaved, but all the baggage and artillery were taken by the enemy. In the mean time, the prince of Orange was haſtening to the relief of his diſtreſſed allies with an army of 28,000 men; but having the misfortune of being alſo defeated, and count Hoogſtrate killed in the action, his ſoldiers deſerted in ſuch crowds, that he was at laſt obliged to diſband his army and return to Germany.

17 Prince of N[illegible]

18 Prince of Orange defeated, and diſbands his army.

This diſaſter happened in the year 1569. The duke of Alva reſolved to make the moſt of his time. He entered Bruſſels in triumph; and let looſe his vengeance againſt all who had in the leaſt aſſiſted, or been ſuppoſed to aſſiſt, the prince of Orange. All the priſoners taken in the laſt campaign were put to death: and, not contented with this barbarity, the cruel governor projected nothing leſs than the total extirpation of the reformed religion, by the deſtruction of every one who profeſſed it; and of rendering himſelf deſpotic, by erecting citadels in all the conſiderable towns, which were to be garriſoned by his ſoldiers. He began with Amſterdam, in which he laid the foundations of a ſtrong citadel. The people complained of it as an infringement of their rights, but the duke was deaf to their complaints. At Antwerp he cauſed his ſtatue to be erected; and here he was figured treading on the necks of two ſmaller ſtatues, which repreſented the two eſtates of the Low Countries. This piece of inſolent vanity exaſperated the people to a great degree; and they were ſtill farther provoked by a demand of the hundredth part of every man's eſtate to be paid immediately for the ſupport of the army, beſides the tenth of all the merchandiſe, and the twentieth of all immoveables, to be annually levied as a ſtanding revenue. The provinces remonſtrated, and refuſed to ſubmit to ſuch intolerable exactions: the governor was inflexible; and being incenſed at their reſiſtance, he ſent the regiment of Lombardy to live at free quarters in the province of Utrecht.

19 Cruelty of the duke of Alva.

20 His intolerant principles and exactions.

21 Duke of Alva attempts in vain to eſtabliſh his new taxes at Bruſſels.

All this time the prince of Orange was employed in laying plans for the deliverance of his diſtreſſed country; but in 1571, the duke of Alva growing impatient, ordered the edict concerning the new taxes to be publiſhed at Bruſſels. The city was inſtantly filled with confuſion; the ſoldiers ſeized on the goods of the inhabitants by force; tradeſmen ſhut up their ſhops; and the peaſants refuſed to bring proviſions to the market. The ſtates offered to pay a ſubſidy of 2,000,000 of florins annually in lieu of the intended tax; but their offer was rejected. The drum beat to arms, and orders were iſſued to hang all who refuſed to comply. The ſoldiers were preparing to obey, when news arrived of the ſurrender of Briel in the iſland of Voorn, at the entrance of the Meuſe, to a ſquadron of ſhips of war that had been fitted out by the prince of Orange. Lumey, who commanded the ſquadron, made a deſcent on the iſland from 40 ſhips, deſtroyed the churches, broke the images, and executed the prieſts, but offered no violence to the other inhabitants.

22 Briel taken by the Orange party.

However unimportant the conqueſt of ſo inconſiderable a place might appear, it alarmed the duke of Alva, and produced the moſt extravagant rejoicings in Bruſſels. The duke regarding it as the harbinger of further oppoſition, dropped his taxes and executions for the preſent, and diligently applied himſelf to ſuppreſs the growing ſpirit of rebellion. He withdrew the garriſon from Bruſſels, and detached it under the command of Maximilian Hermin Boſſu, againſt the ſhips of war which were called *Gueux*. This officer, endeavouring to force Briel, was defeated by the Orange faction, and forced to retire with loſs to the iſland of Beverland. Trifling as this victory might ſeem, it ſerved to animate the depreſſed ſpirits of the enemies to the government. The prince of Orange, ſenſible of the advantage of poſſeſſing this iſland, exhorted the nobility of his party to fortify and garriſon it; his orders were obeyed, by which means he ſoon became maſter of Delfshaben, a town ſituated on the oppoſite banks of the Meuſe. It appeared in Boſſu's retreat how unpopular the duke of Alva was in every part of the country. Dordrecht ſhut its gates againſt him; Rotterdam refuſed to admit his troops; but Boſſu obtaining permiſſion that they ſhould paſs through in ſeparate ſmall diviſions, ſeized the gates, and began a general maſſacre of the inhabitants. Four hundred periſhed by the ſword, the town was pillaged, the women were raviſhed, and every poſſible act of barbarity and inhumanity committed. Retribution was ſoon made by the enemy. Alva had detached Oſſorio d'Angulo with a body of forces to ſecure Fluſhing, a conſiderable port in Zealand, and to erect a citadel. The inhabitants denied Oſſorio admittance, ſhut their gates, and ſeized Pacanco, a famous engineer, who had come to meaſure the ground where the citadel was to be erected. Apprehending that attempts would be made to force them to ſubmiſſion, they petitioned Lumey, admiral of the Gueux, for aſſiſtance; and he furniſhed them with 200 men, under the command of Captain Treſlong. On the arrival of this reinforcement, the Spaniſh engineer was hanged, and an unſucceſsful attempt made to ſurpriſe Middleburg, the capital of the iſland of Walcheren. Not diſpirited by this diſappointment, the Zealanders aſſiduouſly proſecuted their cruizes upon the Spaniards, and obtained as much wealth as purchaſed a large ſtore of arms and ammunition at Antwerp. Joined by great numbers of Engliſh and Scotch adventurers, they ventured to attack the duke of Medina Celi, ſent with a ſtrong ſquadron to ſucceed the duke of Alva in the government of the Netherlands. The duke was completely defeated, a great number of his ſhips were taken, and a booty, amounting to near 1,000,000 livres, was carried off by the Zealanders.

23 Duke of Alva deſiſts from enforcing his taxes.

United Prov[inces]

2[illegible] A par[ty of] his fo[rces] defea[ted by] the G[ueux].

2[illegible] The [illegible] take [Delfs]haben.

2[illegible] Inhab[itants] of Ro[tter]dam [maſſa]cred [by the] Spani[ards].

2[illegible] Duke [of] Med[ina] Celi [complete]ly de[feated] by th[e Zea]lande[rs at] ſea.

The duke of Alva now ordered a ſquadron of ſhips to be equipped at Amſterdam, to bridle the inſolence of Lumey and the Zealanders, while he buſied himſelf in raiſing an army to oppoſe the prince of Orange and Lewis de Naſſau, who were making great preparations in Germany and France. To augment the army in the field, he had draughted moſt of the garriſons. By this means the prince's friends gained poſſeſſion of North Holland; and Louis de Naſſau was projecting a ſcheme to ſurpriſe Mons, with the inhabitants of which he held a ſecret correſpondence. The deſign ſucceeded; which emboldened moſt of the cities and towns in Holland to declare againſt the government. The count de Bergues gained over ſeveral cities in Overyſſel, Guelderland, and Frieſland. In a word, the revolt became ſo general, that the duke of Alva ſoon found he could not long reſiſt the torrent. He now, when too late, publiſhed an edict to appeaſe the people, ſetting forth, that he would conſent to remit the moſt oppreſſive taxes, if the ſtates could ſuggeſt any other means of raiſing the neceſſary ſupplies. He convoked the States-general to meet at the Hague, but his orders were now diſregarded; and the States, in contempt of his authority, aſſembled at Dordrecht, inviting deputies from the prince of Orange, the nobility, and the towns that had declared againſt the governor. Here money was raiſed to enable the prince of Orange to begin his march. His forces amounted to 15,000 foot and 7000 horſe. He had promiſed to advance three months pay; and was enabled to perform his engagements by the liberality and public ſpirit of the States-general and the cities. He

[illegible] Moſt towns [in] Holl[and] decla[re a]gainſt Spain.

Proc[eed]ings [of the] States-ge[neral in fa]vour [of the] prince [of] Oran[ge].

He showed the address with which he could manage and direct the people; and without the name of sovereign of the provinces under his government, he possessed the authority. He presided at all military operations by sea and land; made and disposed of offices at pleasure; assembled the States; and published all ordonnances and regulations relative to the present state of affairs, without controul. However, he conducted matters with the utmost delicacy, and used his power with great moderation, to avoid giving offence to the free spirit of the Hollanders. The Popish religion was banished the churches, and persons of that persuasion were, with great caution, admitted into public employments. Not only the king's revenue and church tythes were appropriated to the public service, but the estates of those who remained firm in their loyalty. In short, the most vigorous measures were taken for resisting the tyranny of Spain; and those persons who had refused the tythes to the government, voluntarily subscribed their all to support a party formed in defence of liberty.

While the States-general were employed in ways and means to maintain an army, the prince of Orange advanced to Ruremonde, which he took by assault, on the refusal of the city to supply him with necessaries. From thence he marched to Brabant, and raised heavy contributions. He took Mechlin, Oudenarde, and Dendermonde; and could not restrain the excesses of the soldiers, who pillaged the churches, massacred the priests, and committed other barbarities. Next he approached to Mons, besieged by the duke of Alva, with design, if possible, to engage him to give battle. The duke baffled all his endeavours to force him, and carried Mons by capitulation. The whole Spanish dominion, however, lately so insolent and exulting, was ready to expire in the Netherlands, had it not been revived by the massacre of the Protestants in Paris.

While the fate of Mons was depending, the states of Holland met at Haarlem, to deliberate on the defence of the province and the prosecution of the war. Amsterdam was in the enemy's hands, which greatly obstructed all their measures. It was therefore determined to besiege it; and the enterprise was committed to Lumey, chief of the Gueux. After putting the States to considerable expence, the project miscarried through Lumey's misconduct. Water was his element, but his vanity led him to display his abilities as a land-officer. He made regular approaches, and was foiled in every attempt.

The reduction of Mons, and the depression of spirit consequent on the massacre at Paris, obliged the prince of Orange to retire to Holland, and encouraged Alva to invest Dendermonde, Oudenarde, and Mechlin. The latter, being in no condition to resist, opened its gates; but the Spanish soldiers chose to scale the walls, to give an air of assault to the enterprise, and countenance to the horrid barbarities intended. Protestants and Catholics were massacred without distinction. The town was pillaged, and the booty estimated at 400,000 florins. All the other towns were evacuated by the garrisons, and loaded with heavy impositions by Alva. As to the prince, he had now removed the seat of war into the province of Holland. Only this province and Zealand remained firm to their engagements: the rest, overwhelmed with consternation, capitulated on the best terms they could procure from the government. However, the country being strong by its nature and situation among the waters, and more so by a fierce, rough, and sturdy people, proud of their ancient fame, and the most implacable enemies of Spanish tyranny, it was determined to make the most vigorous resistance. Frederic de Toledo was dispatched by Alva to begin the operations in Holland. He had already reduced Zutphen and Guelderland; and, flushed with success, appeared before Waerden, which he summoned to admit a garrison. The burghers replied, that they were intrusted by the king with the defence of the place, and could not receive a military force without violence to their privileges and engagements. They soon had reason to repent their firmness: the town was taken by surprise; and all the burghers, assembled in the great church to take the oaths of fidelity to the king, were wantonly butchered. Infants, old men, women, and the sick, were all put to the sword, without pity or remorse; and of all the barbarities hitherto committed, this was the most horrible. It was imagined that the terror inspired by such instances of severity, would reduce the people to obedience, and shake the obstinacy of the other towns. The contrary effects were produced; rage and despair took possession of every breast; and all determined to suffer the last extremities rather than submit to so cruel a tyranny.

Having finished this tragedy, Frederic went to Amsterdam, to deliberate with the officers of the army about the siege of Haarlem. Here it was determined, before they proceeded to extremities, that the city of Amsterdam should write to the magistrates, exhorting them, in the most pathetic terms, to submit, rather than incur the punishment inflicted on Waerden. The council of Haarlem met to take this letter into consideration. Some were for soliciting an immediate reinforcement from the prince of Orange; and others, who apprehended the prince was too weak to afford the necessary relief, were for making the best terms possible with the king. Those of the latter opinion were the magistrates. Accordingly, without consulting the burghers, deputies were dispatched to Frederic to stipulate conditions. In their absence, Ripperda, a gentleman of Friesland, strongly attached to the prince of Orange and the cause of liberty, assembled the chief burghers; and so animated them against the Spaniards, that they resolved to stand a siege, and suffer all the horrors of war, rather than submit. They sent to the prince of Orange to acquaint him with their determination, and to implore assistance. Four companies of Germans were detached to reinforce the garrison of Haarlem; and the deputies, on their return, were seized as traitors to their country, sent to the prince of Orange, and by his order beheaded. Frederic was preparing to compel the burghers to submission. On the 10th of December he invested the town after carrying Sparendam fort by assault, with great loss and slaughter of his soldiers. A variety of errors were committed in the attack, in the defence, and manner of succouring Haarlem. The assailants and defendants had equally shown themselves ignorant of the art of war, and implacable in their resentment. The prince of Orange tried every expedient to relieve the town; but all his attempts were frustrated by untoward accidents, and the vigilance of the Spaniards. At last, quite spent with fatigue, despairing of relief, weakened by losses, and totally exhausted of provisions and ammunition, the burghers of Haarlem surrendered upon more favourable terms than they could well expect. A few only of the most obstinate were executed; the rest were pardoned on taking an oath of fidelity, and paying an acknowledgment of [illegible] florins.

Haarlem besieged,

During the siege of Haarlem, the Zealanders were performing glorious atchievements by sea, and gaining victories over the Spanish naval armaments. All the efforts of the governor of Antwerp could not prevent their carrying off a great number of ships out of the harbour. To revenge the insult, and relieve Middleburg and Ramakins blocked up by the Zealanders, he equipped a squadron, and gave battle to Wertz, the Zealand admiral, but was defeated. After repairing and augmenting his fleet, he again set sail with sixty large vessels, encountered a squadron of Zealanders

much

much inferior in ftrength, and met with his former fortune. Moft of his fhips were funk or taken; but he found means to pufh into Middleburg, with the broken remains of his fquadron, to the great joy of the garrifon, now reduced by the fcarcity of provifions to the laft extremity. D'Avila's difgrace did not end here; for, on his return to Antwerp, he was a third time attacked and defeated, with confiderable lofs, by Wertz, who thus repaired the difappointment of an unfuccefsful attempt made on Tolen.

Soon after the reduction of Haarlem, Alva, perceiving that his feverity anfwered no other purpofe than irritating the people more againft the Spanifh government, publifhed a proclamation, couched in the moft foothing terms: but the people were not difpofed to confide in promifes fo often violated, nor to throw themfelves on the clemency of a prince and governor who had fhown themfelves inflexible, implacable, perfidious, and inhuman. They now expected the worft that could happen, and bid defiance to fortune. The Spaniards were preparing to inveft Alcmar, and the Hollanders put every means in practice to refift them. Eight months pay was due to the garrifon, who began to mutiny; but contributions were raifed, which filenced their clamours. Frederic of Toledo, with 16,000 men, fat down before a town fortified by no regular works, and defended only by 300 burghers, and 800 foldiers, in extreme want of provifions, and without the profpect of relief. Sonoi, the governor, defpairing of being able to fuftain a fiege, wrote to the prince of Orange, that a place deftitute of troops, provifions, ammunition, money, and every neceffary, ought to be evacuated, and the few foldiers in garrifon, and the burghers, faved from falling into the hands of the enemy. But the prince of Orange fo animated them by a letter, that, to a man, the townfmen, governor, and foldiers, determined to facrifice their lives, and fpill the laft drop of their blood in the breach. Perfeverance had made the Zealanders mafters of Rammekins, contrary to all hope and probability; the fame virtue, the prince obferved, might fave Alcmar, a town of the utmoft confequence to the caufe of liberty. What particularly infpired the defendants with courage, was the prince's good fortune in furprifing Gertrudenburg. Frederic pufhed the fiege with great vigour. He ordered the inhabitants of Haarlem to work in the trenches, and fuftain the firft fire of their friends and countrymen. On the 18th of September, a battery of 20 pieces of heavy cannon began to play; a breach was foon effected; the affault was given, and repulfed with vigour, though fuftained by the bulk of the Spanifh army. From a Spanifh officer taken, the garrifon were informed, that Alva had given orders to retire, in cafe he failed in the third affault; but if he fucceeded, to put all to the fword. Their courage was whetted by this account, and preparations were cheerfully made for withftanding the utmoft efforts. Frederic was foiled in every attempt; the affailants were driven from the breach with prodigious flaughter; the Spanifh foldiers refufed to mount the walls; in a word, the fiege was raifed, and the town relieved, to the exceeding joy of the prince of Orange, and great mortification of Alva.

36 The Spaniards repulfed before Alcmar.

This advantage was attended with another of lefs importance, but which equally ferved to infpirit the Hollanders. The duke of Alva's grand fleet, equipped with great labour and expence, was defeated by the Zealanders. Though the action did not prove decifive, it greatly chagrined the duke, as Boffu, one of his beft officers, was taken prifoner, and his fleet afterwards dreaded to look the enemy in the face.

37 They are defeated at fea.

Notwithftanding this fuccefs, the affairs of the States were yet in a moft precarious fituation; and their ability to fupport themfelves appeared in the higheft degree problematical. The Duke of Alva had refigned the government, and his fucceffor Don Louis de Requefnes had orders to pufh the war with vigour, while his antagonifts prepared for the moft obftinate refiftance. The firft advantage appeared on the fide of the prince of Orange, by the furrender of Middleburg. But this was foon balanced by the defeat and death of prince Louis of Naffau. The Spaniards, however, were prevented from purfuing the advantage they had gained, by a mutiny among their troops. This mutiny took place on a regular and well-concerted plan. The foldiers depofed all their officers, appointed new ones, and eftablifhed a fort of community, vefting one of their number with the chief authority. The diftreffes of the Spaniards on account of this tumult were likewife augmented by a victory gained by the Zealanders at fea; when almoft 40 of the Spanifh fhips were taken or deftroyed. Philip then perceiving that numberlefs difficulties would attend the reduction of the provinces by force, publifhed an act of grace; but in fuch a limited manner, that it was unanimoufly rejected. Requefnes then determining to clofe the campaign with fome remarkable exploit, laid fiege to Leyden. The city was reduced to the utmoft diftrefs for want of provifions; the whole country was laid under water; and they could receive no relief except what was obtained by boats forcing themfeves through the enemy to the city. In fhort, they were reduced to the brink of deftruction, when a violent fouth-weft wind drove the inundation againft the works of the befiegers with fuch violence, that they were obliged to relinquifh the enterprize for fear of being entirely fwallowed up. In their retreat they were attacked by the garrifon, and 500 of them deftroyed. This difappointment fo provoked the Spanifh foldiery, that they depofed Valdes the commander, whom they had chofen for themfelves, and proclaimed their old one: a fecond mutiny enfued, and they marched in a tumultuous manner to Utrecht. Here, however, they met with a very unfavourable reception. Barlaimont the governor declared them rebels and traitors to their king; and gave free liberty to every one to maffacre them wherever they could be found. The mutineers attempted to fet fire to the gates; but being repulfed, and their leader flain, they capitulated, were received into favour, and fent into winter-quarters.

U[…] Pro[…]

Mu[…] the arm[…]

The year 1575 commenced with fome negociations for peace; but thefe proving ineffectual, though the emperor interpofed his mediation as far as poffible, the war was renewed with redoubled fury. Fortune now declared in favour of the Spaniards; and the States were reduced to fuch defpair, that they began ferioufly to think of making an offer of the provinces to fome Proteftant power who might be able to defend them againft the tyranny of the Spaniards. This offer was made to queen Elizabeth of England; but fhe declined it, for political reafons. A negociation was even fet on foot for this purpofe with France, in favour of the duke of Anjou; but it ended in nothing befides the advantage of eftablifhing a mart at Calais for the difpofal of the prizes made by the Gueux. Philip, however, notwithftanding his power, had the utmoft difficulty in fupporting the expence of the war. He had already borrowed more than 40,000,000 crowns from the Spanifh and Genoefe merchants, and the intereft ftill unpaid now amounted to as much as the capital. The war had befides coft a greater fum fent in fpecie from Spain and the Indies, which, with the immenfe loffes occafioned by the ftagnation of trade in the Netherlands, had quite exhaufted the treafury. Large arrears were due to the troops; they were every day mutinying, and fome broke out into actual rebellion. To remedy thefe evils, Requefnes demanded a fupply of the provinces; and they anfwered him, by requiring reftitution of

The […] offer […] vereig[…] to qu[…] Eliza[…] &c.

Phili[…] ftreff[…] his fi[…] ces.

of their privileges, and dismission of the Spanish troops. Flanders, in particular, paid the desired subsidy, by balancing it against half the damages the province sustained from the misconduct of the governors, and the wars wantonly and unnecessarily excited. While this affair was in agitation, Requesnes died of an ardent fever: the council of state assumed the administration, and the prince of Orange took the opportunity of the confusion that ensued to lay the first foundation of the Pacification of Ghent, by which his affairs were considerably retrieved, and the greatest blow given to the court of Spain she had yet sustained. All now was anarchy in the Low Countries. The garrison of Ziriczee mutinied for want of pay; and to appease them, the council of state sent 100,000 livres, which the Walloon regiments under Madragon seized upon, after expelling the Spanish soldiers, and wounding and murdering their officers. This did not unite the Spanish mutineers among themselves; they turned out the few remaining officers, and made new appointments. Joining with the garrison of Lillo, they marched, to the number of 2000 men, towards the capital; committed horrible outrages; overwhelmed the inhabitants of Brussels with consternation; and, upon the 26th of July, seized upon Alost, confined the principal burghers, and hanged up a king's officer. The most favourable conditions were offered by the council of state, in order to appease the tumult, and provisions were sent to the mutineers. This created suspicion in the inhabitants of Brussels, that the mutiny was excited by the connivance of the council, with a view of ruining the provinces, without incurring the resentment and odium consequent on any appearance of legal oppression. They arrested the council, declared the Spaniards rebels, and took measures in concert with the other cities and provinces for expelling foreigners out of the Netherlands. A confederacy to this purpose was formed between the provinces of Hainault, Artois, and Flanders, to which all the rest except Luxemburgh acceded; and Don John of Austria, who had entered the Low Countries in quality of governor and successor to Requesnes, was obliged to live in obscurity in Luxemburgh until the storm should subside.

The prince of Orange was all this while profiting by these commotions. He had long laboured to have the States-general convoked; and he now saw them not only assembled, but preparing to make head against the Spaniards, by a strange vicissitude of fortune, arising from accidents which all his penetration and sagacity could not foresee. United in councils against the common enemy, every measure was taken for reducing the citadels of Ghent, Antwerp, and Maestricht, the chief places in the hands of the Spaniards, and what must principally contribute to their expulsion. Ghent citadel was taken on the 27th of November, by the assistance of a strong reinforcement of troops and artillery sent by the prince of Orange. At Antwerp the states of Brabant were less successful. The citadel was vigorously attacked; but the mutineers at Alost entering the citadel to assist their countrymen, a sally was made, the besiegers were driven from their trenches, great part of the town was consumed by fire, and the rest pillaged for three days with every kind of insolence and brutality, at a time when Antwerp was the most flourishing and populous city in the Netherlands, and indeed among the most wealthy in Europe. It is affirmed that the treasure carried off amounted to four millions, besides an infinity of rich merchandise. This terrible calamity united Papists and Protestants without distinction in a confederacy, and co-operated with the measures of the prince of Orange to form the Pacification of Ghent: which was a confederacy of all the provinces to expel foreign soldiers; to restore the ancient form of government; to refer matters of religion to the several states of the provinces; for ever to unite the other 15 provinces in the same common interest with Holland, Zealand, and the prince of Orange; to renew the commerce and amity between them; to [illegible] the manner practised under the [illegible] and Charles V.; to suspend all the rigorous edicts of the duke of Alva on the subject of religion, until the States general should take the matter into consideration; to release all the [illegible], without ransom; and to restore all things upon the same footing as before the war, and the tyrannical government of the duke of Alva.

The States general began with soliciting aid from the queen of England. Their ambassador had a gracious reception; and Elizabeth advanced them a [illegible] on condition that the French should not be invited into the Netherlands, that they would accept of reasonable terms of accommodation if offered, and that the loan should be repaid the ensuing year. Next a cessation of hostilities was agreed upon with Don John, upon his assurances that every reasonable request of the provinces should be granted. On the 27th of December, deputies were sent with proposals to Don John to disband the foreign troops: but he desired to know what security the States would give for their allegiance after the departure of the Spanish forces; and remonstrated against the unreasonableness of disarming the king, while his rebellious subjects were in arms, and ready to seize the first opportunity of deserting their obedience. He likewise demanded security with respect to religion; and insisted so warmly on this head, that it was obvious he had no inclination to part with the Spanish army before the provinces of Zealand and Holland embraced the Catholic religion. After much altercation, [illegible] at length obliged Don John to grant all that was required, to confirm the Pacification of Ghent, and dismiss the Spanish army. He had the king's authority for his proceedings; the treaty was proclaimed at Brussels and Antwerp on the 17th of February; and Don John immediately [illegible] governor, and the king's lieutenant of the Netherlands.

44 The States receive assistance from Elizabeth.

45 Don John accedes to the pacification of Ghent.

46 Objections made to the pacification by the provinces of Holland and Zealand.

It must be observed, however, that when this edict was signed, the provinces of Holland and Zealand, by the advice of the prince of Orange, made the following objections, *viz.* that the States-general had not established the right of assembling this sovereign tribunal in the person [illegible] invested with that power by the constitution: that in some particular instances they had suffered an infraction of their privileges; that the Spanish troops were allowed to carry off the immense wealth they had acquired in the Netherlands, and by the destruction of the city of Antwerp in particular; that no stipulation was made in favour of those dispossessed of their estates, &c. For these reasons the States and the prince refused to sign the edict, though they consented to all the articles that did not contradict those specified. This raised a contention, by which the public peace was soon broken. Don John was strenuous in recommencing violent measures against the prince and his party. To this purpose he wrote a letter in cipher to the king; but this letter fell into the hands of Henry IV. of France, who transmitted it to the prince of Orange. Escovedo, secretary to Don John, was next sent into Spain with a message to the same purpose; but the governor becoming impatient for his return, left the country himself, under pretence of complimenting Margaret queen of Navarre on her journey to Spaw. In this expedition he seized on the citadel of Namur: but attempted to justify his conduct to the states by [illegible], that he was under a necessity of [illegible], while the [illegible] him; and concluded with desiring the States to disarm the burghers of Brussels, who were chiefly attached to the

47 Hostilities recommenced.

United Provinces.

prince of Orange. This letter was anſwered by an invitation from the States to return; promiſing at the ſame time, that they would, to the utmoſt of their power, bring to puniſhment all thoſe who ſhould form any deſigns againſt him. This, however, was not only refuſed, but the whole tenor of his conduct afterwards ſhowed, that he was reſolved to commence hoſtilities, and that he was encouraged to

48 Don John depoſed.

do ſo by Philip. The event was, that Don John was depoſed from his dignity, the archduke Matthias was appointed governor-general, and preparations were made for a new and vigorous war. The Spaniſh troops were ordered to aſſemble in Naples and Milan; levies were made in Burgundy and Luxemburgh; and a reſolution was taken of ſupporting Don John with the whole power of the Spaniſh monarchy.

49 New treaty with queen Elizabeth.

To oppoſe this formidable power, the States, in 1578, entered into a new treaty with the queen of England; by which that princeſs agreed to advance them 100,000l. Sterling, and to aſſiſt the provinces with 5000 foot and 1000 horſe; on condition that the loan ſhould be repaid with intereſt in eight months; that certain towns ſhould be ceded to her in ſecurity; and that the States ſhould defray the expence of tranſporting their troops, and take them into pay, while they acted in their ſervice. Elizabeth, however, afterwards departed from theſe conditions, under pretence that the French would ſuſpect her having ſome deſigns on the Netherlands, and would for that reaſon unite their forces with thoſe of Spain againſt her. Inſtead of the Engliſh troops, ſhe now propoſed to ſend John Caſimir, count Palatine, with 3000 foot and 3000 horſe; refuſing at the ſame time to pay the money ſtipulated, until the States had conſented to this alteration.

Before this treaty was concluded, Don John was joined by an army of 16,000 foot and 2000 horſe, all choſen veterans, commanded by Alexander Parneſe, duke of Parma, the beſt officer in the Spaniſh ſervice. Being thus ſuperior to the prince of Orange, the Spaniards gained ſeveral advantages; which, however, were more than balanced by the

50 Amſterdam concludes a treaty with the prince of Orange.

loſs of the city of Amſterdam. This place had been cloſely blocked up for ſeveral months by ſea and land, and at laſt concluded a treaty with the friends of the prince of Orange; by which it was ſtipulated, that the Proteſtants ſhould hold their religious meetings without the walls, and have a burying-place within; that the garriſon ſhould be diſbanded, and 600 men, commanded by the burghers, levied for the defence of the city; that all perſons baniſhed on account of religion ſhould be recalled; that Amſterdam ſhould enjoy all its ancient privileges, and that all vacancies in public employments ſhould be filled without diſtinction of party or connection. This capitulation, however, was ſoon after broken; the Catholic magiſtrates were driven out of the city, attended by the prieſts and Popiſh clergy of every denomination; the images were pulled down, and only the reformed clergy ſuffered to preach publicly. Some ineffectual negociations next took place; after which the States, ſenſible that the misfortunes and loſſes in the winter aroſe from the irreſolution of the provincial ſtates, veſted the archduke, the council of ſtate, and the prince of Orange, with a power of levying what number of troops they ſhould think neceſſary, and diſpoſing of them as they thought proper, without referring to the ſtates in every particular: they only recommended that they would proportion

51 Revolution in Guelderland,

the expences to the revenue, which at that time amounted to 600,000 livres. About this time a revolution, greatly beneficial to the common cauſe, was effected in Guelderland; John of Naſſau, brother to the prince of Orange, had been appointed governor of this province. Upon entering on the adminiſtration, he perceived that the whole conduct of affairs was in the hands of perſons ſtrongly affected to king Philip and the Catholic religion; moſt of the cities profeſſed Popery; and the count, who had ſworn to the pacification of Ghent, was reſtrained from attempting any change in religion. The face of affairs, however, took a ſudden turn; John acquired great popularity, and ſoon diſcovered that foreigners were the leading perſons. By his artifice and policy he ſtimulated the people againſt them; they were deprived of their ſeats in the provincial ſtates, and turned out of their offices in the government of the cities. Thus Naſſau obtained the chief direction, and was able to co-operate with the meaſures planned by his brother. Another revolution happened in Groningen, of which the ſieur

Ano[ther revolution in] Gro[ningen].

de Billy was governor. Billy was by birth a Portugueſe, by religion a Catholic, and conſequently a dependent on the court of Spain: he refuſed to accede to the union of the provinces, and the States-general found it neceſſary to ſend to him Francis Martin Stella, with propoſals for ſigning the pacification of Ghent. Billy, ſuſpecting that the deputy's real deſign was to excite a revolt in the province, put him to the torture to extort confeſſion; after having firſt wounded him with his own hand. The deputy bore the moſt excruciating tortures with firmneſs; and having a ſurgeon to dreſs his wound to enable him to undergo a ſecond trial, he communicated ſomething in the Greek language, which the ſurgeon ſoon made public: in conſequence, the mob aſſembled, reſcued Stella, declared for the pacification of Ghent, and obliged Billy to quit his government. The change of councils in theſe two provinces was of the utmoſt ſervice to the confederacy; and would have enabled the province to have encountered the whole power of Spain, had not their affairs been diſtracted by diſſentions among themſelves.

At laſt the prince of Orange, perceiving that little confidence was to be placed in the unanimity of provinces rent by faction, different in religion, and divided by ambition, political maxims, and private intereſt, formed the ſcheme of more cloſely uniting the provinces of which he was governor, and cementing them with thoſe more contiguous, in which the Proteſtant intereſt prevailed. Such an alliance was ſubject to fewer difficulties than attended the more general one of uniting all the provinces; it was in fact the only meaſure that could be propoſed with ſafety, and it was proſecuted with that alacrity and addreſs for which William was deſervedly celebrated.

Uni[on of] Utre[cht].

On the 23d of January 1579, deputies from the provinces of Holland, Zealand, Utrecht, Frieſland, Groningen, Overyſſel, and Guelderland, met at Utrecht, and ſigned the alliance ever ſince known by the name of the *Union of Utrecht*, the baſis of that commonwealth ſo renowned by the appellation of the *United Provinces*. This treaty of alliance was founded upon the infraction of the pacification of Ghent ſolemnly acceded to by Philip, and the late invaſion of certain towns in Guelderland. It was not hereby intended to divide the ſeven provinces from the other ten, or to renounce the pacification of Ghent; its object was to preſerve the liberty ſtipulated in that pacification, by more vigorous operations, and united councils. The chief articles of this union are the following.

The ſeven provinces ſhall unite themſelves in intereſt as one province, never to be ſeparated or divided by teſtament, donation, exchange, ſale, or agreement; reſerving to each particular province and city all its privileges, rights, cuſtoms, and ſtatutes. In all diſputes ariſing between either of the provinces, the reſt ſhall interpoſe only as mediators. They ſhall aſſiſt each other with life and fortune againſt every foreign attempt upon any particular province, whether to eſtabliſh ſovereignty, the Catholic religion, arbitrary meaſures, or whatever elſe may appear inconſiſtent with the liberties of the provinces and the intention of the alliance. All frontier towns belonging to the United Provinces ſhall,

if old, be fortified at the expence of the provinces; if new, at the joint expence of the union. The public imposts and duties shall be farmed for three months to the highest bidder, and employed with the king's taxes in the public service. No province, city, or member of the union, shall contract an alliance with any foreign prince or power, without the concurrence of all the other members. Foreign powers shall be admitted into the alliance, only by consent of all the contracting parties. As to religion, the provinces of Holland and Zealand shall act in that particular as they think advisable; the rest shall adhere to the purport of the edict published by the archduke Matthias, which prescribed that no man should be oppressed on the account of conscience. All the inhabitants, from the age of 18 to 60, shall be trained and disciplined to war. Peace and war shall be declared by the unanimous voice of all the provinces, other matters that concern the internal policy shall be regulated by a majority. The states shall be held in the usual constitutional manner, and coinage shall be deferred to future determination. Finally, the parties agree, that the interpretation of these articles shall remain in the States-general; but in case of their failing to decide, in the stadtholder.

This alliance was so universally approved, that in a short time the cities of Ghent, Nimeguen, Arnheim, Leewarden, Venlo, Ypres, Antwerp, Breda, Bruges, with several other towns, besides a great number of noblemen and persons of distinction, embraced and signed the union. Thus the foundation of a commonwealth was laid, but in a fluctuating and uncertain state of affairs, when men were actuated by different passions, views, and interests; intimidated by the great strength of the Spanish monarchy, and supported chiefly by a zealous adherence to liberty, and firm resolution to perish in defence of freedom. The first coin struck after this alliance is expressive of the situation of the infant republic. Here was represented a ship labouring amidst the waves, unassisted by sails or oars, with this motto, *Incertum quo fata ferant.*

It was expected, that the important object of this alliance would have attracted the attention of the Walloons, and indeed of all the Catholic inhabitants of the Netherlands: it in fact did so, but in a different manner from what was imagined. The Walloons not only refused to accede to the union, but they made the strongest remonstrances to the States-general upon the danger, impropriety, and illegality of such a confederacy. It appears from Strada and Bentivoglio, that the duke of Parma was at the bottom of their intrigues. He stimulated and prompted their measures, inspiring them with a jealousy of the Protestant designs on the Catholic religion. In the end, he contracted an alliance with them; and thereby confirmed by his own example the legality and necessity of the union of Utrecht. Immediately they began levying an army; but still kept up appearances with the confederated provinces, though it was obvious that hostilities must soon commence. To prevent the effusion of blood, the emperor, as mediator, set on foot another negociation; but Philip would allow no reasonable terms of accommodation, and give no security for liberty of religion. Instead of granting equitable conditions, he laboured to detach the prince of Orange from the union; made him extraordinary proposals; offered to restore him to all his estates, indemnify his losses, raise him to the height of power, and give him the first place in his esteem and favour. But William was too wise to rely on the promises of a king who had shown himself perfidious. He determined to share the fate of the United Provinces, to fulfil his engagements, and the hope conceived of his conduct.

While the prince of Orange was busied in conciliating [illegible] alliances, and strengthening the union, the duke of Parma was taking measures to disconcert his projects, and reduce the provinces to the king's obedience. He dispatched Gonzaga and Mondragon with some men to lay siege to Marlien. The town was taken by assault: the governor hanged; and 45 of the chief inhabitants were tortured to death, for having valiantly defended themselves, and faithfully discharged their duty. It is said the duke of Parma disavowed this bloody proceeding, so inconsistent with the character of a hero. After some farther inconsiderable advantages obtained in the neighbourhood of Ruremonde, the king's army insulted Antwerp, where the archduke and the prince of Orange then resided. The States army was intrenched near Borgerhont, a post attacked without success by the duke of Parma, after a brisk skirmishing of two hours between the armies. La Noue, however, the general of the states army, not choosing to expose himself to continual alarms from the enemy's cavalry, retired under the cannon of Antwerp.

United Provinces.

57 Maestricht taken, and the inhabitants massacred.

On La Noue's retreat, the duke of Parma invested Maestricht. The siege began on the 8th of March, and continued without remission to the 29th of June. This defence was deemed very extraordinary, as the fortifications were in bad order, the garrison slender, and the place but poorly provided with the necessaries of a siege. One Sebastian Tappin, an engineer by profession, a Protestant, and a brave and alert soldier, by his indefatigable vigilance raised continual obstructions to the duke's approaches. The garrison had sustained frequent assaults, and made divers bloody sallies, by which they were so much fatigued, that during a parley the town was surprised and a great many soldiers were put to the sword; but Tappin was saved by favour of the duke of Parma, who gave strict orders that he should have quarter. For three days Maestricht was a scene of the utmost desolation and horror, the Spanish soldiers committing every excess and enormity, in despite of all the endeavours of the general to restrain their licentiousness, and maintain discipline. With such diligence did the duke apply himself to this siege, that, unable to support the fatigue, he was seized with a fever, which had near proved fatal. His situation inspired the enemy with fresh courage. They ventured to appear in the field; reduced Alost, and some other places of little consequence; but could not prevent the loss of Menin taken by assault, though it was soon after retaken by the prince of Orange. In Brabant the states likewise obtained some advantages, though of too unimportant a nature to merit attention. The truth is, all the United Provinces were in a deplorable situation; and their trifling successes were owing entirely to accident, or the duke of Parma's illness. Several provinces contributed nothing to the common cause; others furnished but a small proportion of the taxes agreed upon at the union. The army had large arrears due, and lived at discretion; in a manner more oppressive to the people than taxes to the amount of their regular pay. The people clamoured against the states; they threw the blame on the officers for relaxing in the point of discipline; and the officers recriminated, alleging, that the fault was in the states, who failed in performing their engagements to the army. All was in confusion; but as no person would acknowledge his error, there appeared little hopes of amendment. In a word, nothing besides the same distress in the Spanish army could have prevented the duke of Parma from reducing the revolted provinces to accept any terms he should think fit to prescribe. He was equally in want of money; and his late treaty with the Walloons required that he should dismiss all his foreign troops in the space of six weeks after the publication of the treaty. His situation indeed was so deplorable, that he requested leave to resign his command, and retire with the foreign soldiers to Italy;

58 Distressed situation of the republic.

United Provinces.

but the court of Spain had too much confidence in his ability to entrust so important a charge to another. In this state of affairs the animosity of the parties remained, without the power of shewing their resentment. The states were resolute, but too weak to defend their liberties. Philip was determined, but too weak to be despotic; and both were obliged to content themselves with publishing bitter remonstrances against each other.

At last the prince of Orange renewed the treaty with the duke of Anjou. The queen of England was again offered the sovereignty, but she declined it for political reasons. The duke of Anjou was, however, opposed by a great number of the Reformed, on account of the share his mother had in the horrid massacre of the Protestants at Paris. All arguments to remove their prejudices were in vain. Anjou was a Roman Catholic, and that alone was sufficient to render him detestable. The prince of Orange urged the necessity of receiving the prince. The doctors and civilians allowed that it was lawful to have recourse in extremity to a Papist, but the people continued obstinate. This determined the prince of Orange to have recourse to the States-general, to whom he sent a long remonstrance, pointing out the causes why the confederacy did not produce the intended effect; and exhorting them to re-consider the affair respecting the duke of Anjou. In consequence, the States-general referred the prince's remonstrances to the provincial states and cities; and after long deliberations, and warm debates, it was at length determined, in 1580, to call in the duke of Anjou, as the only resource in so great a calamity. Accordingly the year began with a solemn treaty, whereby the United Provinces renounced their allegiance to Philip, and acknowledged Francis Hercules de Valois, duke of Alençon and Anjou, for their sovereign. The treaty consisted of 27 articles, of which this we have mentioned was the chief. Deputies were sent to the duke of Anjou, to explain the articles, and congratulate him on his accession. As to the archduke Matthias, finding himself unsupported by the emperor, the empire, and the numerous friends whom he expected would have joined him on his elevation, he expressed no resentment at the conduct of the provinces, which with great moderation he attributed to necessity. He only demanded to know their intention with respect to his own person; and the states made their apology, by representing the situation of their affairs, assuring him of their esteem, permitting him to reside in the Netherlands as long as he thought convenient, and highly applauding the prudence and equity of his conduct during his administration. As to the provinces of Holland and Zealand, they were left wholly in the hands of the prince of Orange, whose power as stadtholder was in no respect limited by the duke's sovereignty. After all, Grotius affirms, that the duke's authority was merely nominal, that the real power devolved on the prince of Orange, whose name, however, was used in all public acts only in a subaltern capacity. It was apparent indeed to the French, that William concealed ambitious views under the cloak of patriotism; but it was not convenient to discover their sentiments.

59 Duke of Anjou chosen sovereign.

60 Prince of Orange proscribed.

When the king of Spain was informed of this open defection of the Provinces, he attributed the whole to the prince of Orange, and proceeded directly to proscribe him; he confiscated his estate, upbraided him with ingratitude, and attempted to stain his character with ignominy. He even promised a reward of 25,000 crowns to whoever should bring him the prince of Orange dead or alive; the same to his heirs, in case the person perished in the enterprise; and he declared all those proscribed, their estates confiscated, their honours and dignities abolished, who adhered to William a month after the publication of this edict.

The prince of Orange did not silently pass over this proscription. He employed one Villiers, a Frenchman, to refute the edict: his answer was well received, and is recorded by historians as a proof of the spirit, the equity, the prudence, and the moderation of the prince. However, when it was proposed to the states for their opinion, with a request they would publish it in their own name, they declined it; assigning for a reason, that it contained some facts too little known to be credited, and perhaps too much acrimony and resentment against a prince whose power they still dreaded. With these recriminations ended the transactions of the year.

The following year the states, after long deliberations at the Hague, published an edict, excluding king Philip from any sovereignty, right, or authority, over the Netherlands. This writing appeared on the 26th of July 1581, under the title of *The Abdication of Philip king of Spain*. It was extremely well drawn up; stated in the strongest manner the mutual privileges of the king and people; proved that the allegiance of the latter was voided by the breach of contract on the side of the former; enumerated the oppressive and tyrannical acts of his government; set aside his authority for the most cogent reasons; forbad money to be coined in his name; and took every other step towards independence. It was in vain for Philip to remonstrate: he knew the states were to be convinced only by the sword; to this therefore he appealed. The duke of Parma blocked up Cambray so closely, that the garrison was reduced to the extremity of living upon horses, dogs, and cats; though they still refused to capitulate, in hopes of being succoured. At length the duke of Anjou assembled a body of 10,000 foot and 4000 horse, and approached Cambray. The viscount de Turenne and count Voulandois undertook to force themselves with a body of men into the town; but they were surrounded and taken prisoners by the Spaniards. This disappointment did not discourage the duke of Anjou; he still pressed forward with intention to attack the Spanish lines: but the duke of Parma, not caring to hazard a battle, deserted his works, and retired to Bouchain. As soon as the duke of Anjou entered the city, he took an oath to govern it agreeable to its ancient laws, and to preserve the citizens in the full possession of all its liberties. He was now pressed by the states and the prince of Orange to march directly into Flanders: he endeavoured to comply; but his army, composed chiefly of volunteers, was so weakened by desertion that the design was laid aside.

It was about this time that the duke of Anjou resumed the notion of addressing Elizabeth queen of England. Not deterred by the ill success of his former negociation, he determined upon a voyage to England; an excursion which proved equally unsuccessful to himself and unfortunate to the United Provinces, as during his absence the duke of Parma made himself master of Tournay, which concluded the transactions of this campaign. He was magnificently entertained, led into a persuasion that all would succeed according to his wish, and at length tired out with tedious expectation. In his absence, St Guilan was reduced by the prince of Espinoi. This general directed his march towards Dunkirk, with intention to join the French forces. The duke of Parma, who had notice of his motion, resolved to seize the opportunity of investing Tournay. He began his approaches, and was vigorously received by that garrison, inspirited by the courage of the princess Maria d'Espinoi, niece of the count Horn so cruelly beheaded by the duke d'Alva. The town was stormed in breach by the duke of Parma, who supported the assailants in person, received a wound, and had the mortification to see his Spaniards thrown headlong from the walls. The duke of Anjou

jou repeatedly promised succours; but either forgot, or could not perform his engagements: the latter indeed is the most probable; as he was certainly a dupe to the superior policy of Elizabeth, who had not yet declared openly in favour of the States. In the end, despairing of relief, harassed with perpetual watching, and weakened by losses, the garrison capitulated on the 20th of November. The conditions were honourable; and the princess d'Espinoi was treated with particular marks of distinction by the duke of Parma, who highly esteemed the heroic qualities of this amazon. This advantage was succeeded by another, obtained by the Spanish general Verdugo, over the confederate army in Friesland, commanded by general Norris and William Lewis of Nassau, a young prince of great expectation. It appears from the Spanish account, that Norris was attacked in a defile, where he could not draw out his troops in battalia; and that he was put in confusion, and defeated with great loss. On the other hand, the Dutch writers allege, that he attacked the enemy; but being inferior to them in cavalry, retreated in good order, with scarce any loss.

The year 1582 began with a spectacle very unusual in the Netherlands, the public entry of a sovereign elected by the people. The duke of Anjou setting sail from England on the 8th day of February, arrived on the 10th at Flushing, where he was received by the princes of Orange and d'Espinoi. Next day they set out for Antwerp with a magnificent retinue, and went up the Scheld attended by 50 barges. His reception at Antwerp was splendid beyond any thing ever seen in the provinces; they even exceeded the preparations made for Philip himself on his being appointed to the government in the Netherlands by Charles V. his father. A theatre was erected before the walls of the citadel, in which was placed a chair of state, covered with cloth of gold. There the duke was seated, and the conditions were read to him, upon which he was received as duke of Brabant. When he had sworn to observe the articles, he was clothed with the ducal robe, and his head adorned with the ducal coronet by the prince of Orange; who said, "I will pin it in such a manner that it will not be easily shaken:" an expression which at that time was taken for a happy omen, though it soon proved fallacious.

While the states of Brabant were employed in festivity and mirth, a Biscayan merchant, named *Gaspar Anastro*, had contrived a project to retrieve his shattered fortune by the death of the prince of Orange. He corrupted one of his domestics, by the promise of half the reward, to strike the blow. The assassin entered the citadel; and as the prince was passing after dinner into another room, discharged a pistol, and dangerously wounded him behind the ear. The prince was stunned with the force of the ball, and before he recovered the assassin was killed by his attendants; which prevented for a time the absolute discovery of the plot, though it afterwards appeared from circumstances. It was traced that he had confessed the secret to a Dominican named *Antonio Tunmermon*, receiving from the wicked priest absolution, and a promise of eternal reward. Tunmermon was hanged, drawn, and quartered, his limbs being fixed upon the walls of Antwerp. But though for this time the prince escaped the danger, he was in 1584 assassinated at Delft, by one Balthazar Gerrard or Guion, a person who had before served his highness with fidelity and zeal. He was at that very time employed by the prince to carry letters into France, and had received money to bear his expences, with which he purchased pistols to murder his benefactor. At the criminal's examination, it appeared that he had long meditated this bloody action, and was confirmed in his resolution by the Jesuits and Catholic priests; he even affirmed on the rack, that the duke of Parma was privy to the design, who promised he should have the reward: upon the whole, Gerrard seems to have been an enthusiast, and his crime the result rather of insanity, than of any concerted scheme, or malicious intention. His punishment, however, regarded only the action: it was cruel beyond measure, shocking to humanity, and a striking instance of the vehement party spirit of the times; not of the justice of the judges, or the attachment of the people to the prince of Orange.

The United Provinces were now in a most deplorable situation. The duke of Anjou had been totally unable to resist the duke of Parma, in consequence of which many towns had been taken; and in other respects the provinces had sustained immense losses. The duke of Anjou, disgraced and disappointed, had retired to France, where he died. But above all the loss of the prince of Orange seemed to give the finishing stroke to the affairs of the states; and confusion and anarchy now reigned in their councils. The provinces of Zealand and Holland alone endeavoured to repair the loss, and show their gratitude to William by electing his son Maurice their stadtholder and captain-general by sea and land. Maurice was at that time only 18 years of age; but appeared in every respect worthy of the high dignity which had been conferred upon him. The first step taken by the confederates was a solemn renewal of the treaty of Utrecht; after which the most vigorous preparations were made for the defence of the country. But before any thing of consequence could be done, the duke of Parma had reduced Dixmude, Dendermonde, Vilvorde, Ghent, and Antwerp; which struck the states with such terror, that they again offered the sovereignty to queen Elizabeth. This was once more refused; though that princess engaged, by a new treaty, to assist the states both with men and money. An army was accordingly sent into the Netherlands under the command of the earl of Leicester: but it does not appear that this was of any essential service to the states; for the conduct of that general was so exceedingly improper, that he was not only baffled in every military enterprise, but drew upon himself a general odium. It is very probable indeed that the States could not long have supported themselves in such circumstances, had not Philip rashly engaged in a war with England, with whose naval power he could never be enabled to cope by any superiority in numbers whatever. The defeat of the Spanish armada in 1588 gave such a blow to the power of that nation, as totally disabled them from carrying on the war in the Netherlands. Instead of sending the proper assistance to the duke of Parma, that general received orders to hasten to the aid of the duke of Mayenne, who had been defeated by Henry IV. The duke was obliged to comply with this order, though he was sensible the loss of the United Provinces would be the consequence. Prince Maurice now carried every thing before him; and by the end of the year 1597, the Dutch saw their frontiers extended, the whole country secured by rivers and covered by fortified towns, with the general probability of driving the Spaniards out of Friesland in another campaign.

The remainder of the history of this war is only a detail of the [illegible] sieges and negotiations, which [illegible]. Their affairs were at last totally ruined by a decisive victory gained by prince Maurice, in the year 1600, over the archduke Albert, who had been appointed the Spanish governor of the Netherlands. King Philip II. died in 1598, leaving the affairs of his kingdom in the most wretched situation, notwithstanding which, his successor Philip III. was too haughty to consent to peace, or allow that the States were free, though he was plainly unable to keep

United Provinces.

66 Prince Maurice [illegible] stadtholder.

67 [illegible]

68 [illegible] France.

United Provinces. them in subjection. At last, in 1606, the courts of Madrid and Brussels began to think of peace in good earnest. In 1607 a suspension of hostilities took place, and in 1609 a treaty was concluded. In the first article of the treaty, the archduke, in his own and the king of Spain's name, acknowledged the United Provinces, and renounced all claim to sovereignty over them, but in such general terms as would admit of altercation In the second, a truce for 12 years, by sea and land, through all the dominions of both parties, was concluded. By the third article, the parties were to remain in possession of what they now held, without cession or exchange. In the fourth, a general amnesty was stipulated, and full freedom of trade by sea and land to each others dominions granted. This necessarily implied a cessation of hostilities in the Indies; however, great debates afterwards arose upon this account. Spain observing the rapid progress of the Hollanders in the India trade, apprehended they would soon become too powerful in that quarter; and the Dutch were willing to maintain the advantage of their superiority. Both, for this reason, disputed the article; yet it could not be set aside without destroying the whole treaty, and the fruits of all their laboured conferences. The fifth article regulated the imports, and the duties to be paid by the subjects of the archduke and the States, trading to each others dominions, which were to be on the same footing with those of other nations. The archduke used his utmost endeavours to have the duties at Lillo, on the Scheld, abolished, and the commerce of Antwerp restored to its former grandeur; but this was so diametrically opposite to the interest of the Hollanders, that it was impossible it should ever take place. The sixth and seventh articles likewise regarded commercial affairs. But it would be unnecessary to dwell on particulars. Sufficient is it, that the truce was mutually beneficial, Spain being no longer in condition to support the war, and the Hollanders having obtained the end of all their desperate resistance and invincible perseverance in the cause of liberty. Philip of Nassau, by the truce, entered into possession of all his paternal estates in the Spanish Netherlands and Burgundy; while the States rewarded the faithful services of Maurice with a pension of 25,000 florins, to be paid annually out of the public treasury, besides an appointment of 6,000 francs as governor general. Pensions were likewise settled on the other princes of the house of Nassau: all were gratified in a manner that demonstrated the high sense the republic had of their merit, though they might possibly be disappointed in their great design of raising prince Maurice to the sovereign authority

69 A truce of twelve years concluded with Spain.

No sooner were the Dutch freed from this extreme danger, and felt the blessings of liberty, than dissentions among themselves took place. The disputes betwixt the Arminians and Calvinists produced violent disturbances, which frequently ended in the persecution of the former. In 1621 war was renewed with Spain; and it may be remarked, that during the whole course of it, the subjects of the republic traded to the Spanish ports, as if there had been an entire friendship subsisting between the two nations. It was no uncommon practice with them to supply towns with provision that were besieged by their own armies; and to furnish the enemy with ammunition and other necessaries, without which they could not carry on the war. Their motive and apology for this conduct was, that thus they kept in their own hands the profits by which other nations would be enriched. By steadily pursuing this line of conduct, making as many prizes as they could by force, and at the same time making as much profit of their enemies as could be obtained by a lucrative trade, it is no wonder that the republic should flourish, and rival in wealth the greatest nations of Europe. In 1628 the Spaniards met with a dreadful blow by the capture of their flota from Mexico. This was the greatest prize the Hollanders had ever met with; being valued at no less than 15,000,000 livres. From this time the Spaniards were everywhere defeated and baffled in almost every enterprize they undertook; nevertheless, they carried on the war, with an obstinacy hardly to be matched, for 20 years longer. At last, in 1648, a treaty was concluded, by which his Catholic Majesty renounced all right and sovereignty over the Lords the States-general of the United Provinces, who were henceforth declared a free and independent republic, and that both sides should remain in the unmolested possession of what they held severally at the signing of the treaty.

70 War renewed.

71 Spaniards totally defeated.

72 Peace concluded.

From this time to the year 1670 we meet with nothing very remarkable in the history of the United Provinces. By invariably pursuing the maxims of prudence, industry, and frugality, the republic had attained the highest pitch of grandeur. Amsterdam was become the emporium of Europe, and the richest city in the universe. Holland alone contained 3,000,000 of souls, and all the other provinces were proportionably populous. The States dispatched ministers and consuls to China, Siam, and Bengal, to the Great Mogul, the king of Persia, the khan of Tartary, the Grand Signior, the czar of Muscovy, and the princes of Africa. They were considered as an important weight in the scale of Europe, and no treaty was concluded without their ambassadors. The triple alliance with England and Sweden, into which they had entered, gave Louis suspicion that they proposed to set bounds to his ambition, and clip those bold pinions which had so swiftly conveyed his conquests over the Low Countries. Van Beuningen's insolence, in comparing himself to Joshua stopping the course of the sun, which was the French king's device, highly disgusted his majesty; who was shocked at the presumption and pride of a republic just started out of obscurity, and gained, in the space of a century, from the ocean. But what was still more alarming to Louis, was the probability that the Dutch would ruin the manufactures of France, and his new established commerce of the Indies. His jealousy discovered itself in divers instances; and the pensioner De Witt, who at that time had the leading of affairs, his brother, and his party, did all in their power to remove these prejudices; but the unhappy differences which then prevailed in the United Provinces frustrated all their endeavours.

73 Flourishing state of the republic.

74 Cause of the war with France.

Louis now sought every opportunity of breaking with the Dutch; less perhaps from any dread of their power, or ability to injure him, than with a view to enlarge his dominions by the entire conquest of the Low Countries. He knew that the whole strength of the republic consisted in her marine; that her frontier was weak, her provinces divided, and the chief power in the hands of men inveterately set against the family of Orange, the ancient captains of the republic. His first attempt was to dissolve the triple alliance, and disengage from it Charles II. king of England. In this business the duchess of Orleans was employed: she went to England under pretence of visiting the king her brother; and her negociation was successful. In the mean time Louis possessed himself of Lorrain, under pretence that duke Charles was forming alliances in the empire against France.

75 Treaty between the kings of France and England.

The following year was spent in negociations with the emperor, Spain, and Sweden, with the electors of Cologne and Brandenburg, with the bishop of Munster, and other spiritual and German princes. The design of Louis was to prevent their acceding to the triple alliance; from which he had already weaned one power, the most considerable of the whole. The bishop of Munster beheld with uneasiness the

the growing power of the United Provinces: he pretended that they had made feveral attempts upon the counties of Stirum, Oldenberg, Bentheim, and Eaft Friefland; that they had feized on Ravenftein on the Meufe, and feveral other places belonging to his bifhopric. In his own defence he concluded a treaty with France, and prevailed on the elector of Cologne to follow his example. By figning a treaty with thefe two princes, the king opened a way to Holland by the Meufe and the Rhine; he eftablifhed by this means places of arms and magazines in a country diftant from his own dominions, and fecured a retreat in cafe his enterprife proved abortive. With refpect to the emperor, every artifice was ufed to keep him neutral; and indeed his own inclinations co-operated but little in favour of the Dutch, whom he regarded as fubjects revolted from the princes of his family, and in poffeffion of feveral places belonging to the empire. In Sweden, Louis's negociations were equally fuccefsful; for here he prevailed fo far with Charles XI. as to obtain a ftipulation, that if the emperor, or any of the princes of the empire, joined their forces to the Dutch, a Swedifh army fhould march into the very heart of Germany and join the French, in order to force thofe princes to obferve the treaty of Weftphalia.

5 Of all the Germanic body, the elector of Brandenburgh alone interefted himfelf for the fafety of the States-general. The peace of Weftphalia had prevented this enterprifing prince from extending his dominions in Germany, and retaking Pomerania from the Swedes. He had long afpired at the ftadtholderfhip of Holland; and though that office had been for fix years fuppreffed, yet he flattered himfelf, that in cafe of a war he might obtain it, perpetuate it in his family, and in time reduce Holland by dint of force, intrigue, and ftratagem. With this view, he rejected the propofals of feveral princes of the empire, and even thofe of France, endeavouring by every poffible method to infinuate himfelf into the friendfhip and confidence of the States. In the end he concluded a treaty with them, whereby it was ftipulated that he fhould affift the republic with 25,000 men. Beverning, the Dutch ambaffador at Madrid, difconcerted all the fchemes of France at that court, and engaged the queen of Spain to furnifh money and troops for the defence of the United Provinces. Thus was the face of Europe wholly changed. France and England, who had contributed largely to the raifing and aggrandizing the republic, were now incited to deftroy her; while Spain, which for an age had been endeavouring to fupprefs her, was arming for her fupport. Pierre de Groot, the Dutch minifter at the Hague, was employed to penetrate into Louis's defigns; he gave his conftituents notice that he forefaw a terrible ftorm ready to fall upon them, which they might neverthelefs break by feafonable fubmiffions and proper acknowledgments. Upon this the States wrote to the king, endeavouring to appeafe his wrath; but finding him inexorable, they prepared for receiving him, and provided for the fecurity of their provinces. But the long peace the republic had enjoyed deftroyed her ftanding forces, and little confidence could be repofed in her new levied foldiers.

7 As foon as matters were ripe for execution, Louis ordered an army of 100,000 men to file off towards the Rhine. Before the opening of the campaign, and previous to his declaration of war, he divided his army into four columns; commanding one in perfon, with the marfhal Turenne under him. Another was led by the prince of Conde, affifted by the marfhals Humieres and Bellefonds; the third was headed by Crequi; and the fourth marched to Weftphalia under the conduct of the duke of Luxemburgh, to join the bifhop of Munfter. As the marfhals Crequi, Bellefonds, and Humieres, refufed to receive orders from Turenne, they were banifhed; but after fix months exile, were recalled, at the inftance of the whole body of marfhals in France, upon their making proper fubmiffions.

Such an army drawing towards their frontiers could not but terrify the Dutch, now torn with civil factions. The partifans of the Orange family were for abolifhing the perpetual edict, and raifing William III. to the dignity enjoyed by his predeceffors; but the De Witt faction oppofed him violently, though they could not prevent the young prince from being chofen captain-general and high admiral. Many perfons hoped that William's new dignity would incline his uncle Charles II. to return to the triple alliance: but that hope was fruftrated by the conduct of his majefty; who, in conjunction with the moft Chriftian king, declared war againft the States-general on the 7th day of April. A month after, the elector of Cologne and bifhop of Munfter followed the example of the two kings. The Dutch put themfelves in the beft pofture of defence that circumftances would admit. Maeftricht was ftrongly garrifoned; the prince of Orange had affembled an army of 25,000 men, with which he advanced to the banks of the Iffel, and the Dutch fleet cruifed off the mouth of the Thames to prevent the junction of the naval forces of England and France, which amounted to 150 fhips. All Europe watched the firft motions of two powerful kings, feconded by the beft generals of the age.

His moft Chriftian majefty joined his army at Charleroy. It was compofed of 23 companies of *gens d'armes*, lifeguards, mufqueteers, and light-horfe, two regiments of the French and Swifs guards, 14 regiments of foreign infantry, and 60 regiments of light horfe or dragoons, comprifing in all an army of 110,000 fighting men, under the command of marfhal Turenne as captain-general. Holland could only be attacked by the Rhine or the Meufe; and the generals and minifters differed by which of thefe inlets they were to make the firft impreffions. At laft, after feveral deliberations, it was determined to make both attacks at the fame time, in order the more to difconcert their councils. It is probable that Turenne always oppofed the fiege of Maeftricht; for we find him immediately after the furrender of Mafeik ftrongly diffuading the king from that enterprize, in oppofition to the fentiments of the prince of Conde. At laft he prevailed; and it was refolved in council to advance towards the Rhine, and befiege at the fame time the towns of Rhinberg, Veffel, Orfoi, and Burick. Thefe places were all well fortified, and deemed the keys of Holland; however, the Dutch did not appear difturbed at their being invefted, as they were only under the protection, and did not immediately belong to, the United Provinces. They were befides in hopes that any attempts upon the territory of Cleves would haften the preparations of the elector of Brandenburgh, and even rouze the emperor into a fenfe of the 78
danger he was in from the vaft defigns of Louis. Nothing Succeffes of the French.
could oppofe armies fo well appointed, led by generals fo fkilful and fo experienced. The four towns furrendered within a few days of each other; and Rhinberg, that held out longeft, opened its gates on the feventh of June. A few days after, the town and fort of Rhees, and the town of Emerick, furrendered; upon which the king refolved to pafs the Rhine by a ford, over which the cavalry were to fwim. This bold enterprife was projected and conducted by Conde; who, in the face of two regiments of foot, and feveral fquadrons of horfe, under general Wartz, intrenched on the oppofite fide, effected the paffage, in the fame order, and with as much regularity, as if he had marched his troops on dry land. The enemy made a ftout refiftance; but were driven from their poft, after having killed the duke de Longueville on the fpot, and wounded

2 the

United Provinces.

the prince of Condé, which diſabled him for ſome time from attending the ſervice, and obliged him to reſign the command of his army to Turenne.

It is almoſt incredible with what rapidity towns and fortreſſes yielded to the fortune of his majeſty's arms. The reduction of Betau, the moſt fruitful country of the United Provinces, and the ſurrender of Tolhus fort, obliged the prince of Orange to abandon the Iſſel, leſt he ſhould be attacked in the rear, and to retire to the very heart of the country, as far as Rhenen, in the province of Utrecht. By this means the town of Arnheim, the forts of Knotſenborough, Voorn, St André, and Sheneck, this laſt, the ſtrongeſt in the Netherlands (having coſt the great Henry Frederic prince of Orange a ſeven months ſiege), with a variety of other forts and towns, ſurrendered as ſoon as ſummoned; and at laſt Nimeguen, a town ſtrong from the nature of the works and fortifications, and garriſoned by 8000 fighting men, including the inhabitants, was inveſted. After the citizens had for eight days exhibited ſignal proofs of courage in defence of their liberties, they were forced to yield to the ſuperior ſkill of Turenne.

In the mean time the biſhop of Munſter and elector of Cologne, having joined that body of troops under the command of the duke of Luxemburgh, the united army entered the province of Overyſſel, and by dint of cruelty, and terror which the duke ſpread, reduced the towns as ſoon as he appeared before them. Animated by that implacable rage that conſtantly attends religious wars, the two prelates obliged the duke to exert a ſeverity, by no means ſuited to his nature, againſt heretics and the rebellious ſubjects of the houſe of Auſtria. Next the king's forces penetrated into the province of Utrecht, where their conqueſts went on with the ſame rapidity, and put the capital of the province in the utmoſt danger. To retard its fate, the Dutch could imagine no other expedient than opening their ſluices, and overflowing the country. The other towns followed the example of Utrecht; and Holland, Brabant, and Dutch Flanders, was one vaſt lake, the towns riſing like iſlands in the midſt of the waters. Farther to ſtem the torrent of Louis's conqueſts, the people were perſuaded the only barrier was to lodge the ſupreme power in the hands of the prince of Orange. They accordingly obliged the ſtates of Holland and Weſt Frieſland to unite the dignity of ſtadtholder to thoſe of captain-general and high-admiral, with which the prince was already inveſted. They likewiſe ſent remonſtrances ſo pathetic to the king of England, that Charles, moved with the ſituation of the republic, and jealous of the deſigns of Louis, diſpatched the duke of Buckingham and earl of Arlington into Holland, to quiet the fears of the Dutch, and inſiſt upon the king's penetrating no farther into Holland. In caſe of Louis's refuſal, Charles declared he would break the alliance; as he perceived that, inſtead of ſecuring Zealand to the Engliſh, agreeable to the treaty, the deſigns of France were to unite the whole republic to their own monarchy. His moſt Chriſtian majeſty had in fact no great regard to the menaces of his ally; but as perſiſting obſtinately to advance into a country which the inundation rendered impaſſable, might terminate in the ruin of all his ſchemes, he ſeemed, out of compliment to the king of England, to liſten to terms of accommodation; which, after all his victories, could not fail of proving advantageous. In the ſpace of three months he had conquered the provinces of Guelderland, Overyſſel, and Utrecht, taken about 50 towns and forts, and made 24,000 priſoners. Condé and Turenne adviſed his majeſty to ſend the priſoners to work upon the canal of Languedoc, and to leave all the places that were not eſſential to the preſervation of his conqueſts; the miniſter Louvois was of a different opinion, and his ſentiments determined the king. The priſoners were releaſed for a trifling ranſom, and the king's army totally reduced and exhauſted by the continual drains made to garriſon the conquered places.

79
The Dutch obliged to overflow the country.

80
Unſucceſsful negotiation.

A negociation was ſet on foot at Boxtel, near Bois-le-duc, whither the king, attended by the Engliſh ambaſſadors and the Dutch deputies, repaired: but the terms required of the republic were ſo hard, that they were rejected with diſdain by the Dutch; who, animated by their ſtadtholder, reſolved to wait a change of fortune in the midſt of the waters. They uſed every expedient to rouſe the princes of Germany in their defence; and ſo ſucceſsfully, that the elector of Brandenburg, the neareſt and moſt intereſted prince, prepared to take the field. The undaunted courage, the vigilance, the public ſpirit of the prince of Orange, gained him the entire confidence and affection of the republic; and excited their reſentment againſt the two brothers De Witts, his implacable enemies, whom they accuſed of receiving penſions from Louis. The ſuggeſtion was falſe; but poſſibly their love of liberty, and jealouſy of the houſe of Orange, had carried thoſe two great politicians too far in their pacific meaſures and complaiſance to the power of the French monarch. The penſionary was attacked in the ſtreet by the populace; but by his perſonal bravery broke through the crowd, and ſaved his life, though covered with wounds. Soon after the ſedition broke out afreſh, and the partiſans of the houſe of Orange again ſtirred up the animoſity of the republic againſt the De Witts. Several crimes were laid to the penſioner's charge, but he cleared himſelf. Suborned witneſſes accuſed his brother of an attempt to poiſon the prince of Orange. Cornelius was impriſoned and treated with great barbarity. While he was under the torture, he ſung that ode of Horace, *Juſtum et tenacem propoſiti virum*. His brother took him out of priſon after ſentence of baniſhment was pronounced; the tumult roſe high, and both the De Witts were cruelly torn in pieces in the ſtreets. William of Orange ſeemed touched at this terrible ſacrifice; he made the penſionary's eulogium, and ordered the murderers to be proſecuted; however, the clemency he ſhowed them, the advantages he obtained by the maſſacre, and the animoſity he bore the De Witts, convinced all men that he countenanced the murder.

81
The De Witts cruelly murdered.

William of Orange, in the mean time, daily ingratiated himſelf more. He gave up his whole fortune for the ſafety of the ſtate; and exerted himſelf with ſuch prudence and ability, that all Europe began to unite againſt the two kings by the month of July. Every prince in Germany was in motion to ſuccour the Dutch. The emperor, the king of Denmark, the elector of Brandenburg, the duke of Brunſwick Lunenburg, the landgrave of Heſſe, immediately ordered their troops to join; ſeveral of the other princes were preparing to take the field. All were jealous, England began to waver, and there was not a power in Europe upon whom Louis XIV. could heartily rely. The army of Brandenburg, commanded by the elector in perſon, and the forces of the empire under the famous Montecuculi, joined near Heildeſheim, and compoſed a body of 40,000 men. Turenne, now appointed generaliſſimo of the king's army on his majeſty's return to Paris, marched to oppoſe the enemy's paſſing the Rhine. For three whole months were the elector and Montecuculi employed in abortive attempts to effect a paſſage at Mentz, Coblentz, Straſburgh, and other places. This anſwered the purpoſe of making a powerful diverſion in favour of the Dutch, though they could not accompliſh their deſign of joining the prince of Orange. After repeated diſappointments, the Imperial army directed its march to Weſtphalia; and Turenne followed, in order to keep the biſhop of Munſter ſteady to his engagements. For half the campaign,

82
Exploits of Turenne.

paign, he, with a body of 16,000 men, baffled [illegible] stratagem of the elector and Montecuculi, the latter the most renowned general of the empire, at the head of an army near triple his strength. He obliged them to go into winter-quarters, in a country harassed and exhausted; and confirmed the bishop of Munster in the alliance of France, at the very time he was on terms with the emperor. He obliged the elector of Brandenburg, who took the chief command during Montecuculi's illness, to abandon the siege of Werle; took Unna, Kamen, Altena, Berkenbaum, and several other towns and fortresses. By continuing his operations, he forced the elector out of his winter-quarters again into the field, chased him from post to post, until he obliged him to quit Westphalia, repass the Weser, and retire with precipitation into the bishopric of Hildesheim. After taking possession of the elector's towns in Westphalia, he pursued him into the bishopric of Hildesheim; and at length, by mere dint of superior genius, forced him to seek shelter in his hereditary dominions. All this was effected after Louvois had appointed the marshal's army quarters in Alsace and Lorraine, amidst the rigours of a severe winter, opposed by a superior enemy, by the artifices of Louvois, and seconded only by his own prudence, and the affections of his troops, which he maintained in defiance of all the difficulties, hardships, and dangers, they encountered. It was indeed supposed, that Montecuculi was prevented from giving Turenne battle by the remonstrances of prince Lobkowitz, the emperor's ambassador, influenced by the gold of Louis. Certain indeed it is, that Montecuculi's illness arose from his chagrin at seeing all his projects frustrated by the unsteady dilatory conduct of the court of Vienna. Louis's negotiations disturbed Europe no less than his arms. His tools and creatures swarmed in every court. Leopold could not be prevented from declaring in favour of Holland; but his ministers were bought off from seconding the emperor's intentions. The whole English nation exclaimed against the alliance of their king with France; but Charles stood in need of French gold to supply his extravagance and profligacy. The elector of Bavaria had indeed been compelled by Louis to retire to his capital; but it was by dint of intrigue that he was forced from his alliance with Holland, and constrained to sign a peace with France.

While Turenne was thus employed on the Rhine, Conde having recovered of his wounds, returned to the command of the army in Holland. He besieged and took Maestricht in 13 days. Having repaired the fortifications, he proposed making himself master of several other towns; but the inundations everywhere stopped his course. All his attempts to drain off the waters were in vain; and he was forced to content himself with preserving, without pretending to extend, the king's conquests.

Whatever glory the king might have acquired by land, certain it is that the conduct of his admirals deserved equal praise with that of his generals. In little more than 12 years the French were taught the art of naval war. Before, they fought ship to ship; but understood nothing of those evolutions by which whole fleets imitate the movements of armies. The duke of York, afterwards James II. invented the method of giving all orders at sea by means of signals: these and every other part of the art the French borrowed from the English; and became so apt scholars, that they ventured to give battle to the Hollanders, the great rivals of the English on that element. Their fleet, amounting to 30 sail, besides fire-ships, joined to the English, gave battle three different times to the Dutch. De Ruyter gained additional glory in these engagements; and D'Estrees the French admiral gained the esteem of De Ruyter.

In the mean time, Spain declared in favour of the Dutch; [illegible] the emperor [illegible] in the [illegible] of Holland, [illegible] The prince of Orange [illegible] of the Low Countries. They had concluded a treaty with the States at the Hague, [illegible] reinstated in all his possessions in the Low Countries, previous to the peace of the Pyrenees. Montecuculi was ordered to advance [illegible]; and [illegible] the Maes, and took post in the [illegible] of Mentz. The prince of Orange receiving no impediment from Conde, who was forced on account of the inundations to regain the Meuse, thought this a proper time for action, as the enemy had no considerable forces in the heart of the United Provinces. He ordered some troops to file off secretly to Amsterdam and Muyden; lined with infantry the intrenchments which secured the passage to Holland; and to deceive the duke of Luxembourg, who commanded in Utrecht, sent some forces by sea to attack Bommel. The duke, not penetrating the prince's design, came to succour the place; and William, having his stratagem succeed, marched to Naerden, and with 25,000 men invested and took the place before the duke could provide for its defence. Upon this success, the Dutch took courage, [illegible] in their favour, and in a short time all the horrors of war were removed from the interior parts of the United Provinces to the Spanish Netherlands. Neither the experience nor consummate address of Turenne, the genius of Vauban, or the indefatigable vigilance of Louvois, could repair the error committed in ruining the army to garrison the conquered towns. Even Conde's fire seemed extinguished in the waters with which the Dutch had drowned their country. Instead of penetrating farther, he was obliged to retreat. Turenne could not prevent the junction of Montecuculi and the prince of Orange, nor the loss of Bonn. This junction, and the declaration of Spain, obliged the armies of France to abandon the three provinces with still more rapidity than they had conquered them. The triumphal arch at St Dennis was hardly erected as a monument of Louis's victories, before the fruits of those victories were relinquished. In a word, the parliament of England would no longer suffer Charles to be the mercenary tool of France; the late ill success cooled the elector of Cologne and the bishop of Munster in their friendship; and Louis, forsaken by all his allies, found himself under the necessity of maintaining singly a war against the empire, Spain, and the United Provinces.

From that time the United Provinces have been distinguished among the European nations as a very considerable maritime and commercial power. Their connection with Britain by the Revolution in 1688, when William III. stadtholder of Holland became king of these kingdoms, brought on a much closer connection between the two nations than had ever taken place before. By means of this connection, William formed a plan of humbling his great adversary Louis XIV. who had so lately brought his country to the verge of ruin. For this purpose he renewed the war in 1689, and commanded the army in person. He was, however, overmatched by the abilities of Luxembourg the French general; who opposed him, and obliged him to conclude a peace in 1697. His enmity to the French king, however, was not yet extinguished. The remaining part of his life he employed in forming the most powerful confederacy

United Provinces.

against that monarch; and so much was he wrapped in this project, that even in his dying moments it seemed to prevail over every other consideration*. His measures, however, were adopted by his successor Queen Anne; and the French monarchy had nearly sunk under the united efforts of the forces of Britain, Holland, and Germany headed by the experienced generals Marlborough and Eugene. But at last the whole plan was disconcerted by a revolution in the British ministry; the Dutch were disappointed in the moment of their expectations, and obliged to consent to the peace of Utrecht, which left them exposed to the attempts of France as much as ever. A barrier composed of a great number of fortified towns was indeed granted them; but barriers of this kind are a slender defence against the modern improvements in war. In the war of 1739, these towns were taken one after another by Marshal Saxe, who thus revenged the exploits of the duke of Marlborough: while the Dutch and British army, commanded by the late duke of Cumberland, were driven from place to place, without being able to make one successful effort from the beginning of the war to the end of it. See BRITAIN, n° 342—420.

* See Britain, n° 339—346.

It is probable that the bad success of this war cooled the affections of the Dutch towards Britain so much, that ever since they have acted rather as concealed enemies than friends. In the war of 1755, their attachment to France was evident; and in the last, it proceeded to such an height, as to oblige the British ministry to declare war against them. The issue of this war is still fresh in our memories. A single naval engagement was the only event of consequence that took place, and showed that both were formidable antagonists to each other.

This war was undertaken in opposition to the wishes of the stadtholder, who having been maintained in his prerogatives chiefly by the powerful influence of Britain and Prussia, could have no motive for making a rupture with the court of London. The subsequent transactions of the States-general have been related under other articles (see PRUSSIA and REVOLUTION). Having deserted the grand alliance formed against the disturbers of the peace of Europe, and the office of the stadtholder being abolished, the Dutch republic, under the name of an *ally*, is now in reality little better than a province, of France. The consequence of this alliance is what might have been expected. The British government, obliged to attack its enemies wherever it might find them, commenced hostilities against the United Provinces, and in the compass of a very short period wrested from them their most valuable possessions both in the eastern and in the western world.

85 Climate, &c. of the United Provinces.

The seven United Provinces being in great part surrounded by the sea, lying low, and abounding in marshes, have a damp and unwholesome air. Rains and fogs are frequent; and the gout, scurvy, rheumatism, and agues, very common and difficult of cure. The effects of human industry here are wonderful in the dykes and dams erected for defending the country against the inundations of the sea, and in ditches, canals, mills, and sluices, for draining the marshes. The quantity of grain produced is not sufficient for home consumption; but the pastures in the marshes are so rich, that they can spare a great deal of butter and cheese for exportation. They have also a good breed of sheep, whose wool is highly valued. There is turf, madder, tobacco, some fruit, and iron; but all the pit-coal and timber used in this country, and indeed most of the necessaries of life, are imported. All the provinces either lie upon, or communicate with, the North Sea, by means of that called the *Zuyder*, or *South Sea*; which was formed partly by the Rhine's right branch, then increased by the Vecht, which has now another outlet, overflowing the low swampy grounds thro' which it passed; and partly by the sea, in the 13th century, breaking in, and overflowing a large tract of ground contiguous to that before laid under water by the Rhine. The principal rivers are the Rhine, the Meuse, the Scheld, and the Vecht. The first is divided into several branches, one of which joins the Old Issel, and after that falls into the Zuyder Sea; another named the *Leck*, at the village of Krimpen, mingles with the Meuse; a third, called the *Crooked Rhine*, is branched out at Leyden into canals, of which one runs into the lake of Haerlem, and another loses itself in the sand hills between Catwyk on the Rhine, and Catwyk on the sea; and a fourth, called the *Waal*, falls into the Meuse over-against Workum. The Meuse, after dividing itself into two branches, and again uniting these, falls into the North Sea below Rotterdam. The Scheld below Antwerp divides itself into two branches, called the *Welleren* and *Lagen Scheld*; the first separating Flanders from Zealand; and the other, running north by Bergen-op-Zoom, and afterwards east, between the islands of Beveland and Schowen, falls into the sea a little below. The Vecht runs from east to west through the province of Overyssel, and falls into the Zuyder Sea. There are many smaller rivers that join these, and a vast number of canals; yet there are few good harbours in the provinces. The best are those of Rotterdam, Helvoetsluys, and Flushing. As to the harbour of Amsterdam, it is indeed one of the largest and safest in Europe; but there is a bar at the entrance of it, over which large vessels cannot pass without being lightened or unloaded. There are no mountains in these provinces; and the only lake, properly so called, is that of Haerlem. The provinces are extremely well cultivated, and very populous; especially that of Holland, which, in this respect, perhaps has not its equal in the universe. The towns are very agreeable, being kept clean, and having canals in the middle of the streets, planted with trees. The number of inhabitants is computed at about 2,000,000. The animals here are much the same as in England; but their horses and horned cattle are of a larger size. Storks build and hatch on their chimneys; but, being birds of passage, they leave the country about the middle of August, with their young, and return the February following. It is said there are some wild boars and wolves here; and that neither oysters nor herrings are to be found upon the coast: but of other fish they have the several sorts, both in their seas and rivers, that we have in Britain.

The established religion here before the Revolution was the Presbyterian, or Calvinism: none but Presbyterians were admitted into any office or post in the government, excepting the army; all religions and sects, however, were tolerated, and had their respective meetings or assemblies for public worship, among which the Papists and Jews were very numerous. Since the late alliance with France, no particular religion is established; and the phlegmatic Dutch have drunk deep of the cup of infidelity, mixed by their new and volatile allies. 86 Religion.

There are five universities in the provinces, viz. those of Utrecht, Leyden, Franeker, Groningen, and Harderwic; but the three last are inconsiderable. The dissenters in England often send their children to these universities for education. Before the Reformation there was an archbishop at Utrecht, who had for his suffragans the bishops of Deventer, Groningen, Middleburg, Haerlem, and Lewarden. The language here is a dialect of the German, but French is much spoken by the better sort.

87 Commerce, &c.

With regard to the commerce of this country, their East India company had the monopoly of the fine spices for more than 100 years, and was long the most opulent and powerful of any in the world. Though the country itself produces

duces very few things, yet almoſt all the products and commodities of the globe may be found here, nearly as cheap as in the countries where they are made or produced. A vaſt variety of manufactures are carried on in the provinces, and with extraordinary ſkill and diligence; and a great number of hands are employed, and much wealth acquired, by the herring, cod, and whale fiſheries. No nation has hitherto equalled them in the curing of herrings; thoſe cured at Glaſgow, in Scotland, are thought to come neareſt to them. About 150 ſail were annually employed in the whale-fiſhery, and about 200 in the herring. The profits of the latter, in a good year, after all deductions, were thought to amount to 200,000 Holland guilders. The principal manufactures here are thoſe of linen, paper, and earthen ware of all ſorts. Ship building alſo employs vaſt numbers of hands. The trade of this country, however, upon the whole, has long been declining; owing partly to a decline of their ancient parſimony and induſtry; but chiefly to the improvement of manufactures, trade, and navigation, in other countries; and at preſent (1796) it is almoſt annihilated.

88 Conſtitution. The late conſtitution was ſomewhat ſingular. Moſt of the towns in the ſeveral provinces are little republics, whoſe deputies, with the nobility, compoſed the ſtates thereof; and the deputies of the provinces, in like manner, compoſed the States-general. Every town or province might ſend as many deputies as they pleaſed to the aſſemblies of the provincial ſtates, or States-general; but thoſe of each town or province had but one voice, and preſided by turns. No reſolution taken by the States-general was of any force till confirmed by the ſeveral provinces. The legiſlative power in the towns was veſted in the ſenates; and the executive in the burgomaſters ſyndics, &c. The ſtates of the provinces were ſtyled, Noble and Mighty Lords; but thoſe of Holland, Noble and Moſt Mighty Lords: and the States general, High and Mighty Lords, or the Lords the States general of the United Netherlands, or their High Mightineſſes. Beſides the States-general, there was alſo a council of ſtate, conſiſting of deputies from the ſeveral provinces, making twelve in all; of which Holland ſent three; Guelderland, Zealand, and Utrecht, two a-piece; and Frieſland, Groningen, and Overyſſel, one. In this council every deputy preſided a week by turns, and the ſtadtholder had a deciſive voice when the votes happened to be equal. The principal affairs that came under their deliberation, were thoſe relating to the army and finances. The ſtadtholder was alſo preſident of the ſtates in every province, but had no ſeat in the States general. One diſſenting voice in the provincial ſtates prevented their coming to any reſolution. See STADTHOLDER.

Such was the conſtitution of the ſeven United Provinces. They are now employed in framing for themſelves a new one, upon the plan dictated to them by their maſters the French.

With reſpect to the adminiſtration of juſtice in this country, every province has its tribunal, to which, except in criminal caſes, appeals lie from the petty and country courts; and it is ſaid, that juſtice is nowhere diſtributed with more impartiality.

89 Taxes. The taxes in theſe provinces are ſo many, and ſo heavy, eſpecially in Holland, that it is not without reaſon aſſerted, that the only thing that has eſcaped taxation there is the air they breathe. The ordinary revenues of the republic are computed at between two and three millions Sterling annually. Out of 100 guilders, the province of Holland contributes 58; and conſequently above one half of the whole public expences. For the encouragement of trade, the duties on goods and merchandiſe are ſaid to be exceeding low.

United Provinces Army. With reſpect to their land forces in time of peace, they ſeldom exceed 40,000, and very often fall ſhort of that number. They employ a great many foreigners in their land army, and in time of war hire whole regiments of Germans.

90 Navy and [illegible]. Their navy, were they to enter heartily into any war, could ſoon be made formidable, as they have always vaſt quantities of timber prepared for building ſhips, and great numbers of ſhip carpenters and mariners. It is under the direction of the five admiralty colleges, who, to defray the charges thereof, levy the duties on exports and imports.

91 Character. As to the character of the Dutch, the boors or huſbandmen are induſtrious enough, but heavy, and ſlow of underſtanding. The ſeamen are a plain, blunt, but rough, ſurly, and ill-mannered ſort of people. Their tradeſmen are ſomething ſharper, and make uſe of all their ſkill to take advantage of thoſe they deal with. Every claſs of men is extremely frugal. All appetites and paſſions run lower and cooler here than in other countries, avarice excepted. Quarrels are very rare; revenge is ſeldom heard of; and jealouſy ſcarcely ever known. It is very uncommon for any of them to be really in love, or even to pretend to it; nor do the women ſeem to care whether they are or not. People converſe pretty much upon a level here; nor is it eaſy to diſtinguiſh the man from the maſter, or the maid from the miſtreſs, ſuch liberties do they allow their ſervants, or rather are obliged to allow them; for they may not be ſtruck or corrected by them, but the diſpute muſt be left to the magiſtrate. The Dutch are tall and ſtrong built; but both men and women have the groſſeſt ſhapes that are to be met with anywhere. Their garb, except among the officers of the army and ſome few others, is exceeding plain, and the faſhions change as ſeldom as in Spain. The men are addicted to drinking, which ſome think neceſſary in this foggy air, both for their health and the improvement of their underſtandings. Among their diverſions, that of ſkating in winter is one of the chief. It is amazing to ſee the crowds in a hard froſt upon the ice, and their great dexterity in ſkating; both men and women darting along with inconceivable velocity. The Dutch are remarkable for their cleanlineſs: nothing can exceed the neatneſs of their houſes, towns, and villages. Many of them have diſtinguiſhed themſelves by their learning, and ſome even by their wit and ingenuity; witneſs Eraſmus, Grotius, &c. The Dutch excel alſo in painting and engraving; and ſome of them have been no contemptible ſtatuaries.

UNITY, in poetry. There are three unities to be obſerved, viz. the unity of action, that of time, and that of place. In the epic poem, the great, and almoſt the only, unity, is that of the action. Some regard indeed ought to be had to that of time; for that of place there is no room. The unity of character is not reckoned among the unities. See POETRY, Part II. Sect. 3.

UNIVERSAL, ſomething that is common to many things; or it is one thing belonging to many or all things.

UNIVERSE, a collective name, ſignifying the whole world; or the aſſemblage of heaven and earth, with all things therein. See ASTRONOMY and GEOGRAPHY.

UNIVERSITY, is the name of a corporation formed for the education of youth in the liberal arts and ſciences, and authorized to admit ſuch as have ſtudied in it, to certain degrees in different faculties, which not only ſerved as certificates of proficiency in ſcience, but alſo confer on thoſe who obtain them conſiderable privileges within the univerſity, as well as ſome rank in the ſtate without it. Univerſities generally comprehend within them one or more colleges; but this is not always the caſe; for the univerſity of St Andrew's was in being before either of its colleges was founded, and it would continue in being with all its pri-

University. privileges though both its colleges were levelled with the dust.

In every university with which we are acquainted, there are four faculties, viz. *Theology*, *Law*, *Physic*, and the *Arts and Sciences*, comprehending mathematics, natural and moral philosophy, &c.; and in Oxford, Cambridge, and some other universities, *Music* is considered as a fifth faculty. In each of these there are two degrees, those of *Bachelor* and *Doctor*; for though in the universities of Great Britain and Ireland we have no such degree as *Doctor in Arts and Sciences*, our *Master of Arts* answers to the degree of *Doctor in Philosophy*, which is conferred by many of the universities on the continent.

Universities in their present form, and with their present privileges, are institutions comparatively modern. They sprang from the convents of regular clergy, or from the chapters of cathedrals in the church of Rome, where young men were educated for holy orders, in that dark period when the clergy possessed all the little erudition which was left in Europe. These convents were seminaries of learning probably from their first institution; and we know with certainty, that in Old Aberdeen there was a monastery in which youth were instructed in *theology*, the *canon law*, and the *school philosophy*, at least 200 years before the university and King's College were founded. The same was doubtless the case in Oxford and Cambridge, and probably in every town in Europe where there is now a university, which has any claim to be called ancient; for it was not till the more eminent of the laity began to see the importance of literature and science, that universities distinct from convents were founded, with the privilege of admitting to degrees, which conferred some rank in civil society. These universities have long been considered as lay corporations; but as a proof that they had the ecclesiastical origin which we have assigned to them, it will be sufficient to observe, that the Pope arrogated to himself the right of vesting them with all their privileges; and that, prior to the Reformation, every university in Europe conferred its degrees in all the faculties by authority derived from a papal bull.

It is perhaps no improbable conjecture, that the church of Rome derived her idea of academical honours from the Jews, among whom literary distinctions extremely similar subsisted before the nativity of our Saviour. Among them, the young student, with respect to his learning, was called a *disciple*; from his minority a *junior*; and the *chosen* or *elected*, on account of his election into the number of disciples. When he had made some progress in knowledge, and was deemed worthy of a degree, he was by imposition of hands made חבר, *a companion* to a *Rabbi*, the person who officiated using this form, *I associate thee*, or, *Be thou associated*; and as soon afterwards as he was thought worthy to teach others, the *companion* was raised to the rank of *Rabbi*. Whether this process suggested the idea or not, it has certainly some resemblance to that by which a young man in our universities passes through the degree of *Bachelor* to that of *Master of Arts* or *Doctor*.

The most ancient universities in Europe are those of Oxford, Cambridge, Paris, Salamanca, and Bologna; and in the two English universities, the first founded colleges are those of *University*, *Baliol*, and *Merton*, in the former, and *St Peter's* in the latter. Oxford and Cambridge, however, were universities, or, as they were then called, *studies*, some hundreds of years before colleges or schools were built in them; for the former flourished as a seminary of learning in the reign of Alfred the Great, and the other, could we believe its partial partizans, at a period still earlier. The universities of Scotland are four, St Andrew's, Glasgow, Aberdeen, and Edinburgh. In Ireland there is but one university, viz. that of Dublin, founded by Queen Elizabeth, and very richly endowed.

An idle controversy has been agitated, whether the constitution of the English or of the Scotch universities be best adapted to answer the ends of their institution; and, as might be expected, it has been differently decided, according to the partialities of those who have written on the subject. Were we to hazard our own opinion, we should say, that each has its advantages and disadvantages; and that while the English universities, aided by their great schools, to which we have nothing that can be compared, are unquestionably fitted to carry their young members farthest in the knowledge of the learned languages, the mode of teaching in our own universities is better adapted to the promotion of arts and sciences, and the communication of that knowledge which is of most importance in active life.

University-Courts, in England. The two universities enjoy the sole jurisdiction, in exclusion of the king's courts, over all civil actions and suits whatsoever, where a scholar or privileged person is one of the parties; excepting in such cases where the right of freehold is concerned. And then by the university charter they are at liberty to try and determine, either according to the common law of the land, or according to their own local customs, at their discretion; which has generally led them to carry on their process in a course much conformed to the civil law.

This privilege, so far as it relates to civil causes, is exercised at Oxford in the chancellor's court; the judge of which is the vice-chancellor, his deputy, or assessor. From his sentence an appeal lies to delegates appointed by the congregation; from thence to other delegates of the house of convocation; and if they all three concur in the same sentence, it is final, at least by the statutes of the university, according to the rule of the civil law. But if there be any discordance or variation in any of the three sentences, an appeal lies in the last resort to judges delegates appointed by the crown, under the great seal in chancery.

As to the jurisdiction of the university courts in criminal matters, the chancellor's court at Oxford, and probably also that of Cambridge, hath authority to try all offences or misdemeanors under the degree of treason, felony, or mayhem; and the trial of treason, felony, and mayhem, by a particular charter, is committed to the university jurisdiction in another court, namely, the court of the lord high steward of the university.

The process of the trial is this. The high steward issues one precept to the sheriff of the county, who thereupon returns a panel of 18 freeholders; and another precept to the bedells of the university, who thereupon return a panel of 18 matriculated laymen, *laicos privilegio universitatis gaudentes*: and by a jury formed *de medietate*, half of freeholders and half matriculated persons, is the indictment to be tried; and that in the guildhall of the city of Oxford. And if execution be necessary to be awarded in consequence of finding the party guilty, the sheriff of the county must execute the university process; to which he is annually bound by an oath.

VOCABULARY, in grammar, denotes the collection of the words of a language, with their significations, otherwise called a *dictionary*, *lexicon*, or *nomenclature*. See Dictionary.

A vocabulary is properly a smaller kind of dictionary, which does not enter so minutely into the origin and different acceptations of words.

VOCAL, something that relates to the voice or speech; thus vocal music is that set to words, especially verses, and

to be performed by the voice; in contradistinction to instrumental music, composed only for instruments, without singing.

VOCATIVE, in grammar, the fifth state or case of nouns. See GRAMMAR.

VOETIUS (Gisbert), an eminent divine of the 17th century, was professor of divinity and the Oriental tongues at Utrecht, where he was also minister. He assisted at the synod of Dort; and died in 1676, aged 87. He wrote a great number of works; and was the declared enemy of Des Cartes and his philosophy. His followers are called *Voetians*.

Voetius had two sons, *Daniel* and *Paul*, who also wrote several works. *John Voetius*, the son of Paul, was doctor and professor of law at Herborn: he wrote a commentary on the Pandects, which is esteemed, and other works on law.

VOICE, a sound produced in the throat and mouth of an animal, by an apparatus of instruments for that purpose.

Voices are either articulate or inarticulate. Articulate voices are those whereof several concur together to form some assemblage or little system of sounds: such are the voices expressing the letters of an alphabet, numbers of which joined together form words. Inarticulate voices are such as are not organized, or assembled into words; such is the barking of dogs, the braying of asses, the hissing of serpents, the singing of birds, &c.

The formation of the human voice, with all the varieties thereof observed in speech, music, &c. makes a very curious article of inquiry; and the apparatus and organization of the parts administering thereto, is something exceedingly surprising. Those parts are the trachea or wind-pipe, through which the air passes and repasses into the lungs; the larynx, which is a short cylindrical canal at the head of the trachea; and the glottis, which is a little oval cleft or chink left between two semicircular membranes stretched horizontally withinside the larynx; which membranes, though capable of joining close together, do generally leave an interval, either greater or less, between them, called the glottis. A particular description of each part may be seen in ANATOMY, Part IV. Sect. 5.

VOICE, in grammar, a circumstance in verbs, whereby they come to be considered as either active or passive, *i. e.* either expressing an action impressed on another subject, as, *I beat*; or receiving it from another, as, *I am beaten*. See GRAMMAR.

VOICE, in matters of election, denotes a vote or suffrage.

VOICE, in oratory. See DECLAMATION; READING, n° 5.; and ORATORY, n° 120—131.

VOLANT, in heraldry, is when a bird, in a coat of arms, is drawn flying, or having its wings spread out.

VOLATILE, in physics, is commonly used to denote a mixed body, whose integrant parts are easily dissipated by fire or heat; but is more properly used for bodies whose parts are easily separated from each other, and dispersed in air.

Volatile alkali, in the new French nomenclature *ammoniac*, one of the three alkaline salts. It consists, as Mr Berthollet and several other chemists have proved, of 807 parts in 1000 of azot, and 193 of hydrogen. Several experiments, published by Dr Priestley, led the way to this analysis, though he himself did not see their result. It is chiefly procurable from animal substances by distillation, during which process the azot and hydrogen necessary to its formation unite in proper proportions: it is not however procured pure by this process, being mixed with oil and water, and mostly saturated with carbonic acid. To separate these substances, it is first combined with an acid, the muriatic for instance, and then disengaged from that combination by the addition of lime or potash. In its present state of purity it can only exist in a gaseous form, at least in the common temperature of the atmosphere. It was at first obtained [illegible] called [illegible]; a [illegible] its name, *sal ammoniac*, "Ammon's salt." See CHEMISTRY-*Index*. [illegible]

VOLATILIZATION, the art of rendering fixed bodies volatile, or of resolving them by fire into a subtile vapour or spirit which easily diffuses and flies away. All bodies, even the most fixed, [illegible] or spirit, [illegible].

VOLCANO, a name given to burning mountains, [illegible] from time to time.

The number of volcanoes with which we are at present acquainted is very considerable, yet probably less than [illegible]. In Europe there are Ætna, Vesuvius, Hecla, Stromboli, Volcano; in Asia, one in Mount Taurus, three in the Moluccas, five in Japan, two in the Philippines, and a great many more scattered through the islands in the South Sea; in Africa, one in Fez, one in the island Bourbon, one at Fuego, one on the Cape Verd islands; and in America several in the Andes. There is one [illegible] discovered by Captain Cook on the western coast of North America. There are others, but these are the best known.

It is remarkable that all the volcanoes with which we are acquainted, four or five perhaps excepted, are situated at a small distance from the sea. Most of them have been burning from time immemorial; some few however have broke out in our time. Volcanoes all occupy the tops of mountains; we find none of them in plains; some of them indeed, which are situated in the ocean, do not rise much above the surface; but even these volcanoes seem to be the tops of mountains, the greater part of which are covered by the sea. The substances ejected by volcanoes are fixed and inflammable air, water, ashes, pumice stones, stones that have undergone no fusion, and lava. The phenomena which take place during the eruptions of volcanoes have been so fully described already in the articles ÆTNA, HECLA, LAVA, and VESUVIUS, that any repetition here would be unnecessary and improper. All that remains, therefore, is to examine the causes of volcanoes, or, to speak more properly, to examine the opinions of philosophers concerning the causes of volcanoes; for the real cause, we are afraid, after all that has been written, remains still unknown. The most elaborate theory that has yet appeared is that of M. Houel *.

* Voyage Pittoresque.

Houel's supposed method of their formation.

According to him, water is necessary for the formation of volcanoes. All volcanoes are near the sea: they are even extinguished when the sea retires from them; for we can still perceive the craters of volcanoes in several long isolated mountains, which discover what they have been formerly. He supposes that a long series of ages was necessary for the formation of a volcano, and that they were all formed under the surface of the sea. The first explosion which laid open the foundations of the deep, would possibly be preceded by an earthquake. The waters would be parted by a vast globe of burning air, which would issue forth with a tremendous noise, opening at the same time a large and wide vent for the immense flame that was to follow, and which, as it issued from the bottom of the sea, would be spread over its surface by the first gusts of wind which followed. A fire which was to burn through thousands of years, could not be faint or feeble when it was first kindled up. Its first eruptions therefore have undoubtedly been very violent, and the ejected matter very copious. For a long series of ages it would continue to discharge torrents of lava from the

bottom

Volcano. bosom of its native earth; and its first crater would be composed of the fragments of the same earth.

Thus, according to our author, the foundations of the burning mountain would be laid in the bottom of the sea; and even then it would have an hollow cup or crater on the top similar to that which is to be found on all volcanoes at

2 Why the fire is not extinguished by the waters of the ocean. present. But the question now very naturally occurs, by what means was the internal fire preserved from extinction by the waters of the ocean, which must thus have been incumbent upon it? To this he replies, that "The fire, having disposed the substances in fusion to make an eruption, next laid open the earth, and emitted as much matter as it could discharge, with force sufficient to overcome the resistance of the column of water which would oppose its ascent; but as the strength of the fire diminished, the matter discharged was no longer expelled beyond the mouth; but, by accumulating there, soon closed up the orifice. Thus only small orifices would be left sufficient for giving vent to the vapours of the volcano, and from which only small bubbles of air could ascend to the surface of the water, until new circumstances, such as originally gave occasion to the eruption of the volcano, again took place in the bowels of the earth and produced new eruptions either through the same

3 Ebullition of the fire by the formation of a volcano. or other mouths. The appearance of the sea over the new formed volcano, in its state of tranquillity, would then be similar to what it is betwixt the islands of Basilizzo and Pariarin. Columns of air bubbles are there ascending at the depth of more than 30 feet, and burst on their arriving at the surface. This air would continue to disengage itself with little disturbance as long as it issues forth only in small quantity, until, at the very instant of explosion, when prodigious quantities, generated in the burning focus, would make their way all at once, and the same phenomena which originally took place would again make their appearance."

4 Action of submarine volcanoes. A volcano, while under water, cannot act precisely as it does in the open air. Its eruptions, though equally strong, cannot extend to so great a distance. The lava accumulates in greater quantity round the crater; the sands, ashes, and pozzolano are not carried away by the winds, but are deposited around its edges, and prevent the marine substances which are driven that way by the waters from entering. Thus they agglomerate with these bodies, and thus a pyramidal mount is formed of all the materials together.

In this manner Mr Houel supposes that the mountain was gradually raised out of the sea by the accumulation of lava, &c. at every eruption, and that the cavern of the volcano was gradually enlarged, being driven down into the bottom of the cavern by the continued action of the stones which the volcano is constantly throwing up; that it was there fused, and at last thrown out at the top of the mountain to accumulate on its sides. Mr Houel's opinion about the volcanic fire we shall give in his own words.

"We cannot form any idea of fire subsisting alone, without any pabulum, and unconnected with any other principle. We never behold it but in conjunction with some other body, which nourishes and is consumed by it. The matter in fusion, which issues from the focus, is but the incombustible part of that which nourishes the fire, and into the bosom of which that active principle penetrates in search of pabulum. But as the fire acts only in proportion to the facility with which it can dissolve and evaporate, I am of opinion, that it is only the bottom of the volcano on which it acts; and that its action extends no farther than to keep these substances which it has melted in a constant state of ebullition.

5 Formation of lavas. That fusible matter being discharged from the mouth of the volcano, and hardening as it is gradually cooled by the action of the air, produces that species of stones which are distinguished by the name of *lavas*. This lava, even when in the focus, and in a state of fluidity, must also possess a certain degree of solidity, on account of the gravity and density of its particles. It therefore opposes the fire with a degree of resistance which irritates it, and requires, to put it into a state of ebullition, a power proportioned to the bulk of the mass.

"That quantity of matter, when dissolved by the action of the fire, must constantly resemble any other thick substance in a state of ebullition. Small explosions are produced in various parts over the surface of every such substance while in a state of ebullition; and, by the bursting of these bubbles, a great number of small particles are scattered around. This is the very process carried on in the focus of a volcano, though on a scale immensely more large; and the vast explosions there produced expel every body which lies in their way with the utmost violence; nor is there any piece of lava which falls down from the upper part of the arch of weight sufficient to resist this violent centrifugal force.

"No estimate can be made of the power of these explosions, but by observing the obstacles they overcome, and what enormous bodies are raised up and thrown to an immense height and distance. Such vast pieces of lava are to be seen on the top of Vesuvius and Lipari, that the projectile force by which they have been thrown out appears altogether incredible. No person can harbour the least suspicion of their having been laid there by any human power; and the appearance of them demonstrates that they have been ejected from the bottom of the volcano, not in a state of fusion, but coherent and solid. A piece of lava lies on the top of Ætna of more than a cubic fathom in bulk, and whose weight therefore cannot be less than 16 tons. What an amazing force then must it have required, not only to raise this enormous mass from the volcanic focus, but to make it describe a parabola of about a league in diameter after it had come out of the crater? Incredible force of volcanic explosions.

"When we consider how much the volcanic focus is sunk below the base of the mountain, that the mountain itself is 10,000 feet high, and that consequently there must have been a power sufficient to raise such a mass 12,000 feet perpendicular, the boldest imagination must be lost in amazement.—This may serve to give us some idea of the nature of that power which operates in the foci of volcanoes; a power which is unknown and inconceivable, and may justly be reckoned among the mysteries of nature."

The pabulum by which the internal fire is supported, Mr Houel thinks to be substances contained in the mountain itself, together with bitumen, sulphur, and other inflammable materials which may from time to time flow into the focus of the volcano in a melted state through subterraneous ducts, and the explosions he ascribes to water making its way in the same manner. The water is converted into steam, which fills the cavern and pushes the melted lava out at the crater; this opinion is corroborated by the copious smoke which always precedes an eruption. But, combined with the water, there is always a quantity of other substances, whose effects precede, accompany, or follow the eruptions, and produce all the various phenomena which they display. The eruption of water from Ætna in the 7 Eruption of water from Ætna explained. year 1775 proceeded undoubtedly from this cause. The sea, or some of the reservoirs in Ætna or the adjacent mountains, by some means discharged a vast quantity of water into the focus of the volcano. That water was instantly resolved into vapour, which instantly filled the whole cavern, and issued from the mouth of the crater. As soon as it made its way into the open atmosphere, it was condensed again into water, which streamed down the sides of the mountain in a dreadful and destructive torrent.

Thus

Thus we have given a view of Mr Houel's theory, according to which volcanoes originally began at the bottom of the sea; and not only the mountain, but all the adjoining country, was formed by successive eruptions. It is rather a theory of mountains raised by subterraneous heat than of volcanoes, and does not attempt to explain the origin of the fire, which is the principal difficulty; neither does his theory account for the immense height to which matters are sometimes thrown during eruptions. This indeed it is impossible to account for, without supposing that the resistance of the air is diminished. The excessive opposition of the atmosphere to bodies moving with very great degrees of velocity has been taken notice of under the article GUNNERY. If it has so much effect then upon solid and round globes of iron, what ought it to be on irregular masses of rock, or streams of liquid lava? Nevertheless, in the great eruption of Vesuvius in 1779, Sir William Hamilton informs us, that a vast stream of lava was projected to the height of at least 10,000 feet above the top of the mountain. Had the air resisted this liquid matter as it does a cannon ball, it must have been dashed in pieces almost as soon as it issued from the crater. Either the extreme heat of the lava, therefore, or some other cause, must have contributed very much to diminish, or rather, in a manner to annihilate the resistance of the atmosphere at that time. As for the lighter materials, though they may be supposed to be carried to a vast distance by the wind, after being projected to a great height in the air, it is inconceivable how their motion was not suddenly stopped, and they scattered all around the top of the volcano by the violence of the blast. Substances of this kind, when quietly carried up with smoke, will indeed fly to a great distance; for we are assured, that the ashes of the great fire at London in 1666 were carried by the wind to the distance of 16 miles. It is therefore the less incredible, that those of the great eruption of Vesuvius in 1779 should be carried to the distance of 100 miles, as we are informed was the case.

To account for the volcanic fire, Dr Woodward and others have had recourse to the hypothesis of a central fire, to which the volcanoes are only so many chimneys or spiracles. Dr Hutton, in his theory of the earth, adopts the same opinion; but as it did not immediately concern the subject of which he treated, he evades any question concerning its origin, by declaring himself satisfied of its existence without any inquiry into its origin.

Others, as Dr Lister, have had recourse to the well known experiment of the fermentation of sulphur and iron, which will take fire when mixed in considerable quantity, and moistened with water. Pyrites, therefore, which are a natural mixture of these two substances, it is supposed may naturally give rise to volcanoes. Instances are indeed adduced, which undeniably prove that these substances will spontaneously take fire when thrown together in large heaps. Of this we have a remarkable example in the following anecdote. —"A covetous copperas maker at Deptford having bought up all the pyrites he could find, in order to ruin the trade of his neighbours, collected a vast quantity below a shade in order to secure them from the rain. He was soon, however, punished for his avarice; for the pyrites began to smoke, glowed like red-hot coals, and melted into a kind of vitrified and partly metallic substance, grievously annoying the neighbourhood for a long time with the sulphureous steam they emitted." Beds of pyrites, therefore, taking fire in the earth by means of a fermentation occasioned by water, are now generally supposed to be the cause of volcanoes; and the observation, that volcanoes are generally near the sea, is thought to confirm this hypothesis.

When the matter is properly considered, however, it must be evident, that neither of these hypotheses can answer the purpose. The central fire of Dr Woodward and others is a cause too magnificent even for volcanoes. If a central fire is supposed, we must imagine a burning globe in the centre of the earth, whose heat is sufficient to vitrify the most solid and refractory terrestrial substances. But of what dimensions are we to suppose this globe? Is it one, two, three, four, or more thousands of miles in diameter? Very large indeed it must be; for we could scarce suppose that stones could be projected even from the depth of 500 miles into the air. But even this supposition is inadmissible; for as the fire of volcanoes is at times exceedingly augmented from some cause or other, were this cause general, as it must be in case of a burning central globe, the whole number of volcanoes existing on earth would be in a state of eruption at once. Besides, if we were to suppose a burning globe of 7000 miles in diameter to exist, the least effect it would have throughout its vast bulk, which must be the ... of an immense ... heat from any ... the volcanoes in the world would not be ... it, though they should spout forth ... for centuries together. A dissolution of the whole globe must therefore undoubtedly take place; and though we should lessen the diameter of our burning globe by ... miles, our difficulties will be as far from being removed as before.

Volcanic fire, therefore, cannot originate from any general collection of burning materials dispersed throughout the vast mass of solid earth which lies betwixt the surface and the centre; and the volcanoes at present in an active state would not be such a vent for that fire as a tobacco-pipe would be to a glass house furnace. We must have recourse then to some operation by which we know that nature can kindle and extinguish fires occasionally; and if we can suppose such an operation to take place in the bowels of the earth, we may then reasonably conclude, that we have discovered a cause adequate to the production of volcanoes. Such a cause, however, cannot be pyrites, sulphur, or nitre, in any quantity under the surface of the earth. It is incredible that beds of pyrites can remain for thousands of years under the same part of the surface of the earth, be occasionally inflamed and quenched, and afterwards undergo a renovation, in order to enable them to go through a similar operation. Nitre is never found in a solid state; nor can it be inflamed in such a manner as to make any considerable explosion without a thorough mixture with sulphur and charcoal; neither would all the quantity which we can suppose to exist under the base of any mountain in the world be sufficient to give birth to one of those dreadful ... which are ... by volcanoes an hundred times in a day. Besides, neither pyrites nor sulphur can be inflamed without access of air; which cannot take place in the bowels of the earth; for it must be remembered, that the first question is concerning the means by which the fire was originally kindled. Most writers, however, seem to overlook this difficulty, and to be solicitous only about the immediate cause of the explosive force, which is generally ascribed to steam of one kind or other. Mr Houel in general calls it the force of fire, or of steam; though he does not enter very particularly into its nature. Mr Whitehurst says, that it is the force of fire and water, which is the primary agent in all such operations of nature. He also gives a figure, showing how, by means of confined steam, a jet, either of hot water or of liquid lava, may be produced. But this applies only to a particular case, which we cannot suppose always to happen; for volcanoes are constantly attended with explosions; and so great is the tendency of volcanic matters to this violent operation, that many stones have been observed to burst in the air like bombs.

Volcano bombs, after they were thrown out of the volcano; and Mr Houel even informs us, that such have burst three times during their flight. Water therefore cannot be always the cause of volcanic explosions. When thrown upon melted lead, tin, or especially copper, it explodes indeed with vast force. With the last mentioned metal it is peculiarly and remarkably violent; so much, that it is said that furnaces have been burst, and buildings thrown down, by the mere circumstance of some of the workmen spitting among the melted metal; and Mr Whitehurst calculates the force of aqueous steam, when thus suddenly and violently heated, to be no less than 28 times stronger than inflamed gunpowder.

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Many philosophers attempt to account for the origin and continuance of volcanoes by the agency of the electric fluid; but their theory is so ill supported by facts, that we think it would be improper at present to take up room with detailing it. It is certain that volcanoes exhibit many electrical appearances, and that great quantities of the electrical fluid are discharged at every eruption. But our knowledge of electricity is still too limited to draw any certain conclusion from their appearances.

VOLERY, a great bird-cage, so large that the birds have room to fly up and down in it.

VOLGA, the largest river in Europe, rises in the forest of Volkonski, about 80 miles from Tver, a town in Russia. This noble river waters some of the finest provinces in the Russian empire, and at last falls into the Caspian sea by several mouths, below Astracan.

VOLITION, the act of willing. See METAPHYSICS.

VOLLEY, a military salute, made by discharging a great number of fire arms at the same time.

VOLONES, in Roman antiquity, slaves who in the Punic war voluntarily offered their service to the state, which is the reason of the appellation; upon which they were admitted to citizenship, as none but freemen could be soldiers.

VOLT, in the manege, a round or circular tread; and hence, by the phrase *to make volts*, is understood a gait of two treads, made by a horse going sidewise round a centre, in such a manner that these two treads make parallel tracts; one larger, made by the fore-feet, and another smaller made by the hind-feet; the croup approaching towards the centre, and the shoulders bearing out.

VOLTAIRE (Francis Arouet de), a celebrated French author, was born at Paris, February 20. 1694. His father, Francis Arouet, was *ancien notaire au Chatelet*, and treasurer of the chamber of accounts; his mother, Mary-Margaret Draumart. At the birth of this extraordinary man, who lived to the age of 84 years and some months, there was little probability of his being reared, and for a considerable time he continued remarkably feeble. In his earliest years he displayed a ready wit and a sprightly imagination; and, as he said of himself, made verses before he was out of his cradle. He was educated, under Father Poré, in the college of Louis the Great; and such was his proficiency, that many of his essays are now existing, which, though written when he was between 12 and 14, show no marks of infancy. The famous Ninon de l'Enclos, to whom the ingenious boy was introduced, left him a legacy of 2000 livres to buy him a library. Having been sent to the equity schools on his quitting college, he was so disgusted with the dryness of the law, that he devoted himself entirely to the muses. He was admitted into the company of the Abbé Cheaulieu, the marquis de la Fare, the duke de Sully, the grand Prior of Vendôme, marshal Villars, and the chevalier du Bouillon; and caught from them that easy taste and delicate humour which distinguished the court of Louis XIV. Voltaire had early imbibed a turn for satire; and, for some Philippics against the government, was imprisoned almost a year in the Bastile. He had before this period produced the tragedy of *Oedipus*, which was represented in 1718 with great success; and the duke of Orleans happening to see it performed, was so delighted, that he obtained his release from prison. The poet waited on the duke to return thanks; "Be wise (said the duke) and I will take care of you." "I am infinitely obliged (replied the young man); but I intreat your royal highness not to trouble yourself any further about my lodging or board."

He began his *Henriade* before he was 18. Having one day read several cantos of this poem when on a visit to his intimate friend, the young president de Maisons, he was so teased with objections, that he lost patience, and threw his manuscript into the fire. The president, Henaut, with difficulty rescued it. "Remember (said Mr Henaut to him, in one of his letters) it was I that saved the Henriade, and that it cost me a handsome pair of ruffles." Some years after, several copies of this poem having got abroad, while it was only a sketch, an edition of it was published, with many chasms, under the title of *The League*. Instead of fame and friends, the author gained only enemies and mortification, by this first edition. The bigots took fire at it, and the poet was considered as highly criminal for praising admiral Coligny and queen Elizabith. Endeavours were even used to get the piece suppressed; but this strange design proved abortive. His chagrin, on this occasion, first inspired him with the thought of visiting England, in order to finish the work, and republish it in a land of liberty. He was right; for king George I. and more particularly the princess of Wales, afterwards queen of England, raised an immense subscription for him. Their liberality laid the foundation of his fortune; for on his return to France in 1728, he put his money into a lottery established by M. Desfortes, comptroller-general of the finances. The adventurers received a rent charge on the *Hotel-de-Ville* for their tickets; and the prizes were paid in ready money; so that if a society had taken all the tickets, it would have gained a million of livres. He joined with a numerous company of adventurers, and was fortunate.

His *Lettres Philosophiques*, abounding in bold expressions and indecent witticisms against religion, having been burnt by a decree of the parliament of Paris, and a warrant being issued for apprehending the author in 1733, Voltaire very prudently withdrew; and was sheltered by the marchioness du Chatelet, in her castle of Cirey, on the borders of Champagne and Lorraine, who entered with him on the study of the system of Leibnitz, and the principia of Newton. A gallery was built, in which Voltaire formed a good collection of natural history, and made an infinite number of experiments on light and electricity. He laboured in the mean time on his Elements of the Newtonian Philosophy, then totally unknown in France, and which the numerous admirers of Des Cartes were very little desirous should be known. In the midst of these philosophic pursuits he produced the tragedy of *Alzira*. He was now in the meridian of his age and genius, as was evident from the tragedy of *Mahomet*, first acted in 1741; but it was represented to the procureur-general as a performance offensive to religion; and the author, by order of cardinal Fleury, withdrew it from the stage. *Merope*, played two years after, 1743, gave an idea of a species of tragedy, of which few models had existed. It was at the representation of this tragedy that the pit and boxes were clamorous for a sight of the author; yet it was severely criticised when it came

from

ire. from the preſs. He now became a favourite at court, through the intereſt of madam d'Etiole, afterwards marchioneſs of Pompadour. He was appointed a gentleman of the bed-chamber in ordinary, and hiſtoriographer of France. He had frequently attempted to gain admittance into the Academy of Sciences, but could not obtain his wiſh till 1746, when he was the firſt who broke through the abſurd cuſtom of filling an inaugural ſpeech with the fulſome adulation of Richelieu; an example ſoon followed by other academicians. From the ſatires occaſioned by this innovation he felt ſo much uneaſineſs, that he was glad to retire with the marchioneſs du Chatelet to Luneville, in the neighbourhood of king Staniſlaus. The marchioneſs dying in 1749, Voltaire returned to Paris, where his ſtay was but ſhort. The king of Pruſſia now gave Voltaire an invitation to live with him, which he accepted towards the end of Auguſt 1750. On his arrival at Berlin, he was immediately preſented with the *Order of Merit*, the *key of chamberlain*, and a *penſion* of 20,000 livres. From the particular reſpect that was paid to him, his time was now ſpent in the moſt agreeable manner; his apartments were under thoſe of the king, whom he was allowed to viſit at ſtated hours, to read with him the beſt works of either ancient or modern authors, and to aſſiſt his majeſty in the literary productions by which he relieved the cares of government. But a diſpute which aroſe between him and Maupertuis ſoon brought on his diſgrace. Maupertuis was at ſome pains to have it reported at court, that one day while general Manſtein happened to be in the apartments of M. de Voltaire, who was then tranſlating into French, The Memoirs of Ruſſia, compoſed by that officer, the king, in his uſual manner, ſent a copy of verſes to be examined, when Voltaire ſaid to Manſtein, "Let us leave off for the preſent, my friend; you ſee the king has ſent me his dirty linen to waſh, I will waſh your's another time." A ſingle word is ſometimes ſufficient to ruin a man at court; Maupertuis imputed ſuch a word to Voltaire, and ſucceeded. It was about this very time that Maupertuis publiſhed his very ſtrange Philoſophical Letters; and M. de Voltaire did not fail to heighten, with his utmoſt powers of raillery, every thing which he found, or could make, ridiculous, in the projects of M. Maupertuis, who was careful to unite his own cauſe with that of the king; Voltaire was conſidered as having failed in reſpect to his majeſty; and therefore, in the moſt reſpectful manner, he returned to the king his chamberlain's key, and the croſs of his Order of Merit: accompanied with four lines of verſe; in which he, with great delicacy, compares his ſituation to that of a jealous lover, who ſends back the picture of his miſtreſs. The king returned the key and the ribbon; but they were not followed by an immediate reconciliation. Voltaire ſet out to pay a viſit to her highneſs the ducheſs of Gotha, who honoured him with her friendſhip as long as ſhe lived. While he remained at Gotha, Maupertuis employed all his batteries againſt him: Voltaire was arreſted by the king's orders, but afterwards releaſed.

He now ſettled near Geneva; but afterward being obliged to quit that republic, he purchaſed the caſtle of Ferney in France, about a league from the lake of Geneva. It was here that he undertook the defence of the celebrated family of Calas; and it was not long before he had a ſecond opportunity of vindicating the innocence of another condemned family of the name of *Sirven*. It is ſomewhat remarkable, that in the year 1774, he had the third time a ſingular opportunity of employing that ſame zeal which he had the good fortune to diſplay in the fatal cataſtrophe of the families of Calas and Sirven.

In this retreat M. Voltaire continued long to enjoy the pleaſures of a rural life, accompanied with the admiration of a vaſt number of wits and philoſophers throughout all Europe. Wearied at length, however, with his ſituation, or yielding to the importunities of friends, he came to Paris about the beginning of the year 1778, where he wrote a new tragedy called *Irene*. By this time his underſtanding ſeems to have been impaired, either through the infirmities of age, or continued intoxication by the flattery of others; and he ridiculouſly ſuffered himſelf to be crowned in public with laurel, in teſtimony of his great poetical merit. He did not long ſurvive this farce: for having overheated himſelf with receiving viſits, and exhauſted his ſpirits by ſupplying a perpetual fund of converſation, he was firſt ſeized with a ſpitting of blood; and at laſt becoming reſtleſs in the night time, he was obliged to uſe a ſoporific medicine. Of this he unluckily one night took ſo large a doſe, that he ſlept 36 hours, and expired a very ſhort time after awakening from it.

Volume || Voluta.

VOLUME, in matters of literature, a book or writing of a juſt bulk to be bound by itſelf. The name is derived from the Latin *volvere*, "to roll up;" the ancient manner of making up books being in rolls of bark or parchment. See Book.

VOLUNTARY, in muſic, a piece played by a muſician extempore, according to his fancy. This is often uſed before he begins to ſet himſelf to play any particular compoſition, to try the inſtrument, and to lead him into the key of the piece he intends to perform.

VOLUNTEERS, perſons who, of their own accord, either for the ſervice of their prince, or out of the eſteem they have for their general, ſerve in the army without being inliſted, to gain honour and preferment, by expoſing themſelves in the ſervice.

Such are the volunteers who have been long known in the army; but the preſent age has witneſſed whole regiments of volunteers arming themſelves for a ſtill more laudable purpoſe. In conſequence of thoſe democratical principles which, in 1793, had been imported into Scotland from the Jacobins of France, a number of gentleman in Edinburgh, eminent for their rank and reſpectability of character, aſſociated themſelves for the purpoſe of preſerving the internal peace of the city. Making their object known to government, they were, in 1794, embodied in a regiment, called The Royal Edinburgh Volunteers, with officers appointed by his majeſty; and ſo aſſiduous were they in learning the exerciſe of the army, that, without incurring the imputation of national prejudice, we may venture to affirm, that there is not in the king's ſervice a regiment better diſciplined or more alert in their evolutions than the Edinburgh Volunteers, who conſiſt of lawyers, phyſicians, and opulent tradeſmen, attached to their king and the conſtitution of their country. They amount at preſent (1796) to 850. The example of the metropolis was quickly followed by many of the other towns in Scotland; and in Glaſgow, Aberdeen, Stirling, and Perth, &c. there are now volunteer regiments, which have certainly contributed to preſerve the internal peace of the country, and are prepared to repel any foreign invaſion ſhould an enterprize ſo daring be ever attempted. Similar armaments have been formed, we believe, in many of the towns in England; and Great Britain, at preſent, can boaſt a mighty force, which, without receiving the pay of ſoldiers, is ready to fight *pro aris et focis*.

VOLVOX, in zoology; a genus of animals belonging to the order of *vermes infuſoria*. The body is round, ſimple, and pellucid. There are ten ſpecies, all of which live in water.

VOLUSENUS. See Wilson.

VOLUTA, in natural hiſtory; a genus of animals be-

longing to the class and order of *vermes testacea*. There are 144 species. The animals are of the slug kind; the shell is unilocular and spiral; the aperture narrow and without a beak: the columella plaited.

VOLUTE, in architecture, a kind of spiral scroll used in the Ionic and Composite capitals, whereof it makes the principal characteristic and ornament.

VOMICA, in medicine, an abscess of the lungs. See MEDICINE, n° 186.

Nux VOMICA, in pharmacy, a flat compressed round fruit, of the breadth of a shilling, or somewhat more, and of about the thickness of a crown piece.

It is the nucleus of a fruit of an East-Indian tree, the wood of which is the *lignum columbrinum* of the shops.

Some have prescribed small doses of the nux vomica as a specific against a gonorrhœa, and others against quartan agues. But we have so many good and safe medicines for all these purposes, that there seems no occasion for our having recourse to such as these, which show so many signs of mischief.

VOMIT. See EMETIC.

VOMITING, a retrograde spasmodic motion of the muscular fibres of the œsophagus, stomach, and intestines, attended with strong convulsions of the muscles of the abdomen and diaphragm; which, when gentle, create a nausea; when violent, a vomiting.

VOORN, one of the islands of Holland, bounded by the river Maes, which divides it from the continent and the island of Issemunde, on the north; by the sea called the *Bies-bosch*, on the east; by another branch of the Maes, which divides it from the islands of Goree and Overflackee, on the south; and by the German sea on the west; being about 24 miles long, and 5 broad.

VORTEX, in meteorology, a whirlwind, or sudden, rapid, and violent motion of the air in gyres, or circles.

Vortex is also used for an eddy or whirlpool; or a body of water, in certain seas or rivers, which run rapidly around, forming a sort of cavity in the middle.

VORTEX, in the Cartesian philosophy, is a system or collection of particles of matter moving the same way, and round the same axis.

VORTICELLO. See MICROSCOPE, Vol. XI. page 745.

VOSSIUS (John Gerard), one of the most learned and laborious writers of the 17th century, was of a considerable family in the Netherlands; and was born in 1577, in the Palatinate, near Heidelberg, at a place where his father, John Vossius, was minister. He became well skilled in polite literature, history, and sacred and profane antiquities, and was made director of the college of Dort. He was at length made professor of eloquence and chronology at Leyden, from whence he was called in 1633 to Amsterdam, to fill the chair of a professor of history. He died in 1649. He wrote many learned works, of which a complete edition has been printed at Amsterdam, in 9 vols folio.

VOSSIUS (Isaac), a man of great parts and learning, the son of John Gerard Vossius, was born at Leyden in 1618. He had no other tutor but his father, and employed his whole life in studying: his merit recommended him to a correspondence with queen Christina of Sweden; he made several journeys into Sweden by her order, and had the honour to teach her the Greek language. In 1670 he came over to England, where king Charles made him canon of Windsor; though he knew his character well enough to say, That there was nothing that Vossius refused to believe, excepting the Bible. He appears indeed by his publications, which are neither so useful nor so numerous as his father's, to have been a most credulous man, while he afforded many circumstances to bring his religious faith in question. He died at Windsor castle in 1688.

VOTE, the suffrage or resolve of each of the members of an assembly, where any affair is to be carried by a majority; but more particularly used for the resolves of the members of either house of parliament.

VOTIVE MEDALS, those on which are expressed the vows of the people for the emperors or empresses. See MEDAL.

VOW, a solemn and religious promise or oath. See OATH.

The use of vows is found in most religions. They make up a considerable part of the Pagan worship, being made either in consequence of some deliverance, under some pressing necessity, or for the success of some enterprize. Among the Jews, all vows were to be voluntary, and made by persons wholly in their own power; and if such person made a vow in any thing lawful and possible, he was obliged to fulfil it. If he appointed no particular time for accomplishing his vow, he was bound to do it instantly, lest by delay he should prove less able, or be unwilling, to execute his promise. Among the Romanists, a person is constituted a religious by taking three vows; that of poverty, chastity, and obedience.

Vows, among the Romans, signified sacrifices, offerings, presents, and prayers made for the Cæsars, and emperors, particulary for their prosperity and the continuance of their empire. These were at first made every 5 years, then every 15, and afterwards every 20, and were called *quinquennalia*, *decennalia*, and *vincennalia*.

VOWEL, in grammar, a letter which affords a complete sound of itself, or a letter so simple as only to need a bare opening of the mouth to make it heard, and to form a distinct voice. The vowels are six in number, *viz.* A, E, I, O, U, Y.

VOWEL (John). See HOOKER.

UPHOLSTER, UPHOLSTERER, or *Upholder*, a tradesman that makes beds, and all sorts of furniture thereunto belonging, &c.

UPLAND, denotes high ground, or, as some call it, *terra firma*, by which it stands opposed to such as is moorish, marshy, or low.

UPLAND, a province of Sweden, bounded on the north-east by the Baltic Sea, on the south by the sea of Sudermania, and on the west by Westmania and Gestricia, from which it is separated by the river Dela. It is about 70 miles in length and 45 in breadth, and contains mines of iron and lead. Stockholm is the capital.

UPSAL, a rich and considerable city of Sweden, in Upland, with a famous university, and an archbishop's see. The town is pretty large, and as straight as a line; but most of the houses are of wood, covered with birch-bark, with turf on the top. On an eminence, to the south of the town, is a ruined castle. Those that view the town from hence would take it to be a garden, whose streets represent the alleys; and the houses, which are covered with turf, the grass-plats. It was formerly the residence of the kings, and is now the usual place where they are crowned. It is seated on the river Sala, over which there are two bridges. It is 27 miles north-west of Stockholm. E. Long. 17. 48. N. Lat. 59. 52.

UPUPA, in ornithology; a genus belonging to the order of *picæ*. The beak is arcuated, convex, and something blunt; the tongue is obtuse, triangular, entire, and very short; and the feet are fitted for walking. There are ten species; one of which, the *epops*, hoopoe, or dung-bird, is frequently seen in Britain. It may be readily distinguished from all others that visit this island by its beautiful crest, which it can erect

or

Upupa, Uranium.

or depress at pleasure. It is in length 15 inches; the bill is black, two inches and a half long, slender, and incurvated; the irides are hazel: the crest consists of a double row of feathers; the highest about two inches long; the tips are black, their lower part of a pale orange colour: the neck is of a pale reddish brown; the breast and belly white; the lesser coverts of the wings are of a light brown; the back, scapulars, and wings, crossed with broad bars of white and black; the rump is white; the tail consists of only 10 feathers, white marked with black, in form of a crescent, the horns pointing towards the end of the feathers. The legs are short and black; the exterior toe is closely united at the bottom to the middle toe.

According to Linnæus, it takes its name from its note, which has a sound similar to the word; or it may be derived from the French *huppe*, or "crested:" it breeds in hollow trees, and lays two ash coloured eggs: it feeds on insects, which it picks out of ordure of all kinds. Dr Pallas affirms, that it breeds in preference in putrid carcases; and that he had seen the nest of one in the privy of an uninhabited house, in the suburbs of Tzaritsyn.

Ovid says that Tereus was changed into this bird:

Vertitur in volucrem, cui stant in vertice cristæ,
Prominet immodicum pro longa cuspidæ rostrum:
Nomen epops volucri. Metam. lib. vi. l. 672.

Tereus, through grief and haste to be reveng'd,
Shares the like fate, and to a bird is chang'd.
Fix'd on his head the crested plumes appear.
Long is his beak, and sharpen'd as a spear. *Croxall.*

UR (anc. geog.), a citadel of Mesopotamia, situated between the Tigris and Nisibis; taken by some for Ur of the Chaldees, the residence of Abraham. What seems to confirm this is, that from Ur to Haran, the other residence of the patriarch, the road lies directly for Palestine. And it is no objection that Ur is said to be in Mesopotamia; because the parts next the Tigris were occupied by the Chaldeans, as seems to be confirmed from Acts vii. 2, 4. It is called *Orche*, in Strabo; *Orchoe*, in Ptolemy.

URALLIAN CHAIN, a range of mountains which form part of the boundaries of Asia, and anciently known by the name of *Riphæi Montes*. See *RIPHÆI Montes*, &c.

URANIA, in fabulous history, one of the nine Muses, was supposed to preside over astronomy. She is commonly represented in an azure robe, crowned with stars, and supporting a large globe with both hands.

URANIUM, a fossil found at Johangeorgenstad in Saxony, and at Joachimstal in Bohemia, and is, by the miners, called *Pechblend*. M. Werner, a German mineralogist, being convinced that it was not a blend, gave it the name of *Ferrum Ochraceum Piceum*, and thought it contained the tungstic acid combined with iron: but M. Klaproth is of a contrary opinion, and maintains that it is very different from wolfram. There are (he says) two varieties of pechblend: the one is of a dark grey colour, with very little brilliancy, the particles of which have the form of a flattened conchoid; it is not very hard, and, when triturated, becomes a black powder: its mean specific gravity is 7, 5. The other is distinguished by its black colour, though it sometimes assumes a reddish tint: its surface is more brilliant than that of the former, and resembles pit-coal; it is also less hard; and the black powder, to which it is reduced by trituration, has a greenish hue. This kind is generally discovered in compact masses, lying between strata of a micaceous schist, which is found to be decompounded. In the internal parts of this stone, it is not uncommon to meet with veins of a peculiar yellow metallic earth. The pechblend is soluble in the nitric and in the nitro-muriatic acids, partially so in the muriatic, but not at all in the sulphuric. From these solutions, the unsaturated ferruginous prussiat of potash, or phlogisticated alkali, precipitates the metallic substance, which then resembles kermes mineral in colour. This, when it does not unite in flakes, but is uniformly diffused in the solution, may be considered as one of the most distinguishing characters of the pechblend; another is, that the precipitates, effected by the volatile and fixed alkalis, are yellow; the fixed caustic alkalis giving it a lemon colour, the aerated alike yellow. This yellow oxyd, or calx, cannot be fused with alkalis. As this fossil cannot be classed either among the zinc or iron ores, and is very different from tungstein, M. Klaproth proposes to give to it the appellation of *Uranium*; and he distributes it into the following species:

1. *Uranium sulphuratum.* (*a*) Dark gray, often exhibiting traces of Galena. (*b*) Black, resembling pit coal.

2. *Uranium Ochraceum.* Brimstone colour, lemon colour, deep yellow, reddish brown.

3. *Uranium Spathosum.* (*a*) Tinged with green by copper. (*b*) Yellow. This is the green mica or chalcolithe.

Uranoscopus, Urinal.

URANOSCOPUS, in ichthyology, a genus of fishes belonging to the order of *jugulares*. The head is large, rough, and depressed, the upper jaw being shorter than the under one; there are six dentated rays in the membrane of the gills; and the anus is in the middle of the body. There are two species, one of which is found in the Mediterranean Sea.

RAFHAEL D'URBINO. See RAPHAEL.

URCHIN, in zoology. See ECHINUS.

URETERS, in anatomy. See ANATOMY, n° 101.

URETHRA, in anatomy. See ANATOMY, n° 107.

URIM *and* THUMMIM, among the ancient Hebrews, a certain oracular manner of consulting God, which was done by the high priest dressed in his robes, and having on his pectoral or breast plate.

Various have been the sentiments of commentators concerning the urim and thummim. Josephus, and several others, maintain, that it meant the precious stones set in the high-priest's breast-plate, which by extraordinary lustre made known the will of God to those who consulted him. Spencer believes that the urim and thummim were two little golden figures shut up in the pectoral as in a purse, which gave responses with an articulate voice. In short, there are as many opinions concerning the urim and thummim as there are particular authors that wrote about them. The safest opinion, according to Broughton, seems to be, that the words *urim* and *thummim* signify some divine virtue and power annexed to the breast-plate of the high priest, by which an oraculous answer was obtained from God when he was consulted by the high-priest; and that this was called *urim* and *thummim*, to express the clearness and perfection which these oracular answers always carried with them; for urim signifies "light," and thummim "perfection:" these answers not being imperfect and ambiguous, like the heathen oracles, but clear and evident. The use made of the urim and thummim was to consult God in difficult cases relating to the whole state of Israel; and sometimes in cases relating to the king, the sanhedrim, the general of the army, or some other great personage.

URINAL, in medicine, a vessel fit to receive and hold urine, and used accordingly for the convenience of sick persons. It is usually of glass, and crooked; and sometimes it is filled with milk, to assuage the pain of the gravel.

URINAL, in chemistry, is an oblong glass vessel, closed for making solutions, and so called from its resemblance to the glasses in which urine is set to settle for the inspection of the physician.

URINE, a ferous and faline fluid, feparated from the blood, and carried by the emulgent arteries to the kidneys, from whence it defcends to the bladder by the ureters, and is from time to time emitted thence by the canal of the urethra. See ANATOMY, n° 107. For the analyfis of urine, fee CHEMISTRY.

URN, a kind of vafe, of a roundifh form, but biggeft in the middle, like the common pitchers, now feldom ufed but in the way of ornament over chimney-pieces, in buffets, &c. The great ufe of urns among the ancients, was to preferve the afhes of the dead after they were burnt; for which reafon they were called *cineraria*, and *urnæ cinerariæ*, and were placed fometimes under the tomb-ftone whereon the epitaph was cut; and fometimes in vaults in their own houfes. Urns were alfo ufed at their facrifices to put liquid things in.

UROGALLUS, in ornithology. See TETRAO.

URSA, in aftronomy, the name of two conftellations in the northern hemifphere.

URSULINES, is church hiftory, an order of nuns, founded originally by St Angela of Brefcia, in the year 1537; and fo called from St Urfula, to whom they were dedicated.

URSUS, the BEAR; a genus of quadrupeds belonging to the order of *feræ*. There are fix fore-teeth in the upper jaw, alternately hollow in the infide, and fix in the under jaw, the two lateral ones being lobated. The dog-teeth are folitary and conical; the eyes are furnifhed with a nictitating membrane; the nofe is prominent; and there is a crooked bone in the penis. There are eight fpecies; the principal of which are,

1. *Arctos*, the black bear, has ftrong, thick, and clumfy limbs; very fhort tail; large feet; body covered with very long and fhaggy hair, various in its colour: the largeft are of a rufty brown; the fmalleft of a deep black: fome from the confines of Ruffia black, mixed with white hairs, called by the Germans, *filver bear;* and fome (but rarely) are found in Tartary of a pure white. It inhabits the north parts of Europe and Afia; the Alps of Switzerland, and Dauphine; Japan and Ceylon; North America and Peru. The brown bears are fometimes carnivorous, and will deftroy cattle, and eat carrion; but their general food is roots, fruits, and vegetables: they will robe the fields of peafe; and when they are ripe, pluck great quantities up, beat the peafe out of the hufks on fome hard place, eat them, and carry off the ftraw: they will alfo, during winter, break into the farmer's yard, and make great havock among his ftock of oats; they are alfo particularly fond of honey. The flefh of a bear in autumn, when they are exceffively fat, by feeding on acorns, and other maft, is delicate food; and that of the cubs ftill finer; but the paws of the old bears are reckoned the moft exquifite morfel; the fat white, and very fweet; the oil excellent for ftrains and old pains. The latter end of autumn, after they have fattened themfelves to the greateft degree, the bears withdraw to their dens, where they continue for a great number of days in total inactivity and abftinence from food, having no other nourifhment than what they get by fucking their feet, where the fat lodges in great abundance; their retreats are either in cliffs of rocks, in the deepeft receffes of the thickeft woods, or in the hollows of ancient trees, which they afcend and defcend with furprifing agility: as they lay in no winter-provifions, they are in a certain fpace of time forced from their retreats by hunger, and come out extremely lean: multitudes are killed annually in America, for the fake of their flefh or fkin; which laft makes a confiderable article of commerce.

2. *Maritimus*, the polar or white bear, has a long head and neck; fhort round ears; great teeth; the hair long, foft, and white, tinged in fome parts with yellow: growing to a vaft fize; the fkins of fome being 13 feet long. See Plate DX. fig. 3.

This animal is confined to the coldeft part of the globe; it has been found as far as navigators have penetrated northwards, above lat. 80. The frigid climes only feem adapted to its nature; for we do not learn from any authority that it is met with farther fouth than Newfoundland. Its bounds in refpect to longitude are alfo very limited; being an animal unknown except on the fhores of Hudfon's Bay, Greenland, and Spitzbergen, on one fide, and thofe of Nova Zembla on the other; for fuch as have appeared in other parts have been brought there involuntarily on floating iflands of ice; fo that the intermediate countries of Norway and Iceland are acquainted with them but by accident. We cannot trace them farther eaft than Nova Zembla; though the frozen fea, that is continued from thence as far as the land of Tfchukfchi, that lies above Kamtfchatka, is equally fuited to their nature. The late hiftories of thofe countries are filent in refpect to them.

During fummer, the white bears are either refident on iflands of ice, or paffing from one to another: they fwim admirably, and can continue that exercife fix or feven leagues, and dive with great agility. They bring two young at a time: the affection between the parents and them is fo ftrong, that they would die rather than defert one another. Their winter retreats are under the fnow, in which they form deep dens, fupported by pillars of the fame. They feed on fifh, feals, and the carcafes of whales, and on human bodies, which they will greedily tear up: they feem very fond of human blood; and are fo fearlefs as to attack companies of armed men, and even to board fmall veffels. When on land, they live on birds and their eggs; and allured by the fcent of feals flefh, often break into and plunder the houfes of the Greenlanders: their greateft enemy in the brute creation is the morfe, with whom they have terrible conflicts, but are generally worfted, the vaft teeth of the former giving it a fuperiority. The flefh is white, and faid to tafte like mutton: the fat is melted for train-oil, and that of the feet ufed in medicine: but the liver is very unwholefome, as three of Barentz's failors experienced, who fell dangeroufly ill on eating fome of it boiled. One of this fpecies was brought over to England a few years ago; it was very furious, almoft always in motion, roared loud, and feemed very uneafy, except when cooled by having pailfulls of water poured on it.

3. The *lufcus*, or wolverene, has a black fharp pointed vifage; fhort rounded ears, almoft hid in the hairs; the fides of a yellowifh brown, which paffes in form of a band quite over the hind-part of the back, above the tail; the legs are very ftrong, thick and fhort, of a deep black: the whole body is covered with very long and thick hair, which varies in colour according to the feafon. It inhabits Hudfon's Bay and Canada, as far as the ftraits of Michilimakinac; is found under the name of the *glutton* in the north parts of Europe and Afia, being a native of the moft rigorous climates.

It is a moft voracious animal, and flow of foot; fo is obliged to take its prey by furprife. In America it is called the *beaver-eater*, watching thofe animals as they come out of their houfes, and fometimes breaking into their habitations, and devouring them. It often lurks on trees, and falls on the quadrupeds that pafs under; will faften on the horfe, elk, or ftag, and continue eating a hole into its body, till the animal falls down with the pain; or elfe will tear out its eyes: no force can difengage it; yet fometimes the deer in their agony have been known to deftroy it, by running their

their head violently againſt a tree. It devours the iſatis, or white fox; ſearches for the traps laid for the ſables and other animals; and is often beforehand with the huntſmen, who ſuſtain great loſſes by the glutton: authors have pretended that it feeds ſo voraciouſly, that at length it is in danger of burſting; and that it is obliged to eaſe itſelf of its load, by ſqueezing it out between two trees.

In a wild ſtate, it is vaſtly fierce; a terror to both wolf and bear, which will not prey on it when they find it dead, perhaps on account of its being ſo very fetid, ſmelling like a pole-cat: it makes a ſtrong reſiſtance when attacked; will tear the ſtock from the gun, and pull the traps it is caught in to pieces. Notwithſtanding this, it is capable of being tamed, and of learning ſeveral tricks. It burrows, and has its den under ground. The ſkin is ſold in Siberia for 4s. or 6s.; at Jakutſk for 12s.: and ſtill dearer at Kamtſchatka, where the women dreſs their hair with its white paws, which they eſteem a great ornament. The fur is greatly eſteemed in Europe: that of the north of Europe and Aſia, whoſe ſkins are ſometimes to be ſeen in the furriers ſhops, is much finer, blacker, and more gloſſy than that of the wolverene, or American kind. The glutton has by ſome authors been confounded with the hyæna.

4. The *lotor*, or raccoon, has the upper part of the body covered with hair, aſh-coloured at the root, whitiſh in the middle, and tipped with black; tail very buſhy, annulated with black; toes black, and quite divided.—It inhabits the warm and temperate parts of America: is found alſo in the mountains of Jamaica, and in the iſles of Maria, between the ſouth point of California and Cape Corientes, in the South Sea: is eaſily made tame, very good natured, and ſportive; but as unlucky as a monkey. It is almoſt always in motion; and very inquiſitive, examining every thing with its paws. It makes uſe of them as hands; ſits up to eat; is extremely fond of ſweet things, and ſtrong liquors, and will get exceſſively drunk. It has all the cunning of a fox; and is very deſtructive to poultry; but will eat all ſorts of fruits, green corn, &c. At low water it feeds much on oyſters, and will watch their opening, and with its paw ſnatch out the fiſh: it ſometimes is caught in the ſhell, and kept there till drowned by the coming in of the tide: it is alſo fond of crabs. It climbs very nimbly up trees. It is hunted-for its ſkin; the fur is next to that of the beaver for making hats.

5. The *meles*, or common badger, is an animal of a very clumſy make, with ſhort thick legs, long claws on the fore feet, and a fetid white matter exuding from the orifice below the tail. It inhabits moſt parts of Europe, as far north as Norway and Ruſſia, and the ſtep or deſert beyond Orenburgh, in the Ruſſian Aſiatic dominions, north of the Caſpian Sea: inhabits alſo China, and is often found in the butchers ſhops in Pekin, the Chineſe being fond of them; but a ſcarce animal in moſt countries. It ſeldom appears in the day; confines itſelf much to its hole; is indolent and ſleepy; generally very fat; feeds by night; eats roots, fruits, graſs, inſects, and frogs; but is not carnivorous: it runs ſlowly; when overtaken, it comes to bay, and defends itſelf vigorouſly: its bite is dangerous. It burrows under ground; makes ſeveral apartments, but forms only one entrance from the ſurface. It is hunted during night for the ſkin, which ſerves for piſtol furniture; the hairs for making bruſhes to ſoften the ſhades in painting. Its fleſh makes good bacon.

URTICA, in botany: A genus of plants of the claſs of *monœcia*, and order of *tetrandria*; and in the natural ſyſtem claſſed under the 53d order, *Scabridæ*. The ſmall flower has a calyx of four leaves; no corolla; a nectarium minute, central, urn-faſhioned. The female a bivalve calyx; and a ſingle, oval, gloſſy ſeed. There are 26 ſpecies; three of which are Britiſh plants.

1. The *pilulifera*, Roman nettle, has a ſtalk branched, two or three feet high. Leaves oppoſite, oval, ſerrated, ſtinging. Fruit globule.

2. The *urens*, ſmall ſtinging nettle, has a ſtem a foot high. Leaves roundiſh, deeply ſerrated, oppoſite, burning. The ſtings are very curious microſcopic objects: they conſiſt of an exceedingly fine pointed, tapering, hollow ſubſtance, with a perforation at the point, and a bag at the baſe. When the ſpring is preſſed upon, it readily perforates the ſkin, and at the ſame time forces up ſome of the acrimonious liquor contained in the bag into the wound.

3. The *dioica*, common nettle, has a ſquare firm ſtem, three or four feet high. Leaves heart-ſhaped, long pointed, ſerrated, beſet with ſtings. Flowers in long catkins. The aculei, or ſtings of the nettle, have a ſmall bladder at their baſe full of a burning corroſive liquor: when touched, they excite a bliſter, attended with a violent itching pain, though the ſting does not appear to be tubular, or perforated at the top, nor any viſible liquor to be infuſed into the puncture made by it in the fleſh. It ſeems certain, however, that ſome of this liquor is inſinuated into the wound, though inviſibly, ſince the ſtings of the dried plant excite no pain.

Nettle-tops in the ſpring are often boiled and eaten by the common people inſtead of cabbage-greens.

In Arran, and other iſlands, a rennet is made of a ſtrong decoction of nettles: a quart of ſalt is put to three pints of the decoction, and bottled up for uſe. A common ſpoonful of this liquor will coagulate a large bowl of milk very readily and agreeably. The ſtalks of nettles are ſo like in quality to hemp, that in ſome parts of Europe and Siberia they have been manufactured into cloth, and paper has been made of them. The whole plant, particularly the root, is eſteemed to be diuretic, and has been recommended in the jaundice and nephritic complaints. It is alſo reckoned aſtringent; and of ſervice in all kinds of hæmorrhagies, but is at preſent but little in practice. The roots boiled will dye yarn of a yellow colour. The larvæ, or caterpillars of many ſpecies of butterflies, feed on the green plant; and ſheep and oxen will readily eat the dried.

Urtica Marina. See *Animal-Flower*.

USANCE, in commerce, is a determined time fixed for the payment of bills of exchange, reckoned either from the day of the bills being accepted, or from the day of their date; and thus called becauſe regulated by the uſage and cuſtom of the places whereon they are drawn.

USE, in law, the profit or benefit of lands and tenements; or a truſt and confidence repoſed in a perſon for the holding of lands, &c. that he to whoſe uſe the truſt is made ſhall receive the profits.

USHANT, an iſland of France, 15 miles weſt of the coaſt of Britanny, at the entrance of the Britiſh Channel.

USHER (James), archbiſhop of Armagh, one of the moſt illuſtrious prelates in the 17th century, as well with reſpect to his piety and other virtues, as his uncommon erudition, was born in Dublin in 1580, and it is ſaid that two of his aunts taught him to read, though they were both born blind. Dublin college being finiſhed in 1593, he was one of the three firſt ſtudents admitted into it. He made ſo ſwift a progreſs in his ſtudies, that at 18 years of age he was able to diſpute with Henry Fitz-Simons, a famous Jeſuit, who challenged all the Proteſtant clergy; and defended his cauſe ſo well in the caſtle of Dublin, that he made him repent his challenge. He was ordained prieſt in 1601, and ſoon after was appointed to preach conſtantly before the court at Chriſt-church in Dublin, on Sundays in the afternoon. In 1603, he was ſent over to England with Dr Luke Challoner;

Usher, Usk.

Challoner, in order to purchase books for the library of Dublin. In 1607, he took the degree of bachelor of divinity; soon after, he was made chancellor of St Patrick's cathedral, and the same year was chosen professor of divinity, when he made choice of Bellarmine's controversies for the subject of his lectures. Some years after, he made it a constant custom to come over to England once in three years, spending one month of the summer at Oxford, another at Cambridge, and the rest of the time at London. In 1612, he took the degree of doctor of divinity; at the latter end of the year 1620, he was promoted to the bishopric of Meath, and in 1625 was made archbishop of Armagh. In the administration of his archbishopric he acted in a very exemplary manner, and endeavoured to reform the clergy and officers in the ecclesiastical courts. In 1640, he came over to England with his family, with an intention soon to return to Ireland; but was prevented by the rebellion which broke out there in 1641; and in that rebellion he was plundered of every thing, except his library, which was in England, and some furniture in his house at Drogheda. His majesty, therefore, conferred on him the bishopric of Carlisle, to be held *in commendam*: the revenues of which were greatly lessened by the Scots and Irish armies quartering upon it; but when all the lands belonging to the bishoprics in England were seized by the parliament, they voted him a pension of 400 l. *per annum*, though he never received it above once or twice. He afterwards removed to Oxford; and, in 1643, was nominated one of the assembly of divines at Westminster, but refused to sit amongst them; which, together with some of his sermons at Oxford, giving offence to the parliament, they ordered his study of books, of considerable value, to be seized; but by the care of Dr Featly, one of the assembly, they were secured for the primate's use. The king's affairs declined; and Oxford being threatened with a siege, he left that city, and retired to Cardiff in Wales, to the house of Sir Timothy Tyrrel, who had married his only daughter, and was then governor and general of the ordnance. He was afterwards invited to London by the countess of Peterborough. In 1647, he was chosen preacher in Lincoln's-Inn; and during the treaty in the Isle of Wight, he was sent for by the king, who consulted him about the government of the church. The death of his majesty struck him with great horror. The countess of Peterborough's house, where the primate then lived, being just over-against Charing Cross, several of her gentlemen and servants went up to the leads of the house, whence they could plainly see what was acting before Whitehall. As soon as his majesty came upon the scaffold, some of the household told the primate of it; and asked him, whether he would see the king once more before he was put to death. He was at first unwilling, but at last went up: where, as the ceremonial advanced, the primate grew more and more affected; and, when the executioners in vizards began to put up the king's hair, he swooned away. He died of a pleurisy in 1655; and was solemnly buried at Westminster, in St Erasmus's chapel. He published, 1. *Britannicarum Ecclesiarum Antiquitates.* 2. *Polycarpi et Ignatii Epistolæ, Græce Latine*, &c. 3. Annals of the Old and New Testament, in Latin. 4. *De Græce Septuaginta interpretum Versione Syntagma*; and many other books which are esteemed. A considerable number of his works still remain in manuscript.

USHER, an officer or servant who has the care and direction of the door of a court, hall, chamber, or the like.

Usher of the Black Rod, the eldest of the gentlemen ushers, daily waiters at court, whose duty is to bear the rod before the king at the feast of St George, and other solemnities.

USK, a river of Wales, which rises on the west of Brecknockshire, and runs south-east through that county and Monmouthshire, falling into the mouth of the Severn.

USQUEBAUGH, a strong compound liquor, chiefly taken by way of dram.

There are several different methods of making this liquor; but the following is esteemed one of the best: To two gallons of brandy, or other spirits, put a pound of Spanish liquorice, half a pound of raisins of the sun, four ounces of currants, and three of sliced dates; the tops of baum, mint, savory, thyme, and the tops of the flowers of rosemary, of each two ounces; cinnamon and mace, well bruised, nutmegs, aniseeds, and coriander seeds, bruised likewise, of each four ounces; of citron or lemon, and orange-peel, scraped, of each an ounce: let all these infuse 48 hours in a warm place, often shaking them together; then let them stand in a cool place for a week: after which the clear liquor is to be decanted off, and to it is to be put an equal quantity of neat white port, and a gallon of canary; after which it is to be sweetened with a sufficient quantity of double-refined sugar.

USTION, in pharmacy, the preparing of certain substances by burning them.

USUFRUIT, in the civil law, the use or enjoyment of any lands or tenements; or the right of receiving the fruits and profits of an inheritance, or other thing, without a power of alienating or changing the property thereof.

USURER, a person charged with a habit or act of usury.

USURIOUS CONTRACT, is any bargain or contract whereby a man is obliged to pay more interest for money than the statute allows.

USURPATION, in law, is an injurious using or enjoyment of a thing for continuance of time, that belongs of right to another.

USURY, an unlawful contract upon the loan of money, to receive the same again with exorbitant increase. Under the article INTEREST, it was observed, that by statute 37 Hen. VIII. c. 9. the rate of interest was fixed at 10 l. *per cent. per annum:* which the statute 13 Eliz. c. 8. confirms, and ordains, that all brokers shall be guilty of a *præmunire* that transact any contracts for more, and the securities themselves shall be void. The statute 21 Jac. I. c. 17. reduced interest to 8 l. *per cent.*; and it having been lowered in 1650, during the usurpation, to 6 *per cent.* the same reduction was re-enacted after the Restoration by statute 12 Car. II. c. 13. and, lastly, the statute 12 Annæ, st. 2. c. 16. has reduced it to 5 *per cent.* Wherefore not only all contracts for taking more are in themselves totally void, but also the lender shall forfeit treble the money borrowed. Also if any scrivener or broker takes more than 5 s. *per cent.* procuration-money, or more than 12 d. for making a bond, he shall forfeit 20 l. with costs, and shall suffer imprisonment for half a year.

UTERUS, in anatomy. See there, n° 108.

UTICA (anc. geog.), a town of Africa Propria, on the Mediterranean: a Tyrian colony, and older than Carthage, (Sil. Italicus); its name, according to Bochart, denoting *old:* reckoned second to it; but after the destruction of Carthage, became the capital and centre of all the Roman transactions in Africa, according to Strabo; who adds, that it stood on the same bay with Carthage, at one of the promontories called *Apollonium*, bounding the bay on the west side, the other to the east called *Hermeia*, being at Carthage. It became famous by the death of Cato, who thence was called *Uticensis*.

UTRECHT, one of the seven United Provinces, or States of Holland, wholly surrounded by Holland and Guelderland, excepting a small part of it that borders on the Zuyder-

Zuyder-Zee. Its greateſt length is about 32 miles, and breadth about 22. It enjoys a good air; and in moſt places the ſoil is fruitful, but in ſome ſandy, or what is called *turf-ground*, and in others over-run with wood. It is watered by the Leck, Rhine, Vecht, and other ſmaller rivers, beſides ſeveral canals: of which that extending from the village of Vreeſwyk to Utrecht is one of the chief.

UTRECHT, or, Latin, *Ultrajectum*, *Trajectum vetus* or *inferius*, or *Trajectum Rheni*, capital of a province of the ſame name, ſo called from its ancient ferry or paſſage here over the Rhine; the word being compounded of *trecht*, which in Dutch ſignifies "a ferry," and *oud* or *olt*, i. e. "old." It is a fair, large, and populous city, ſituated 19 miles from Amſterdam, 25 from Rotterdam, and 27 from Leyden. Here is a ſtately town-houſe, with a commandery of the Teutonic order, and a celebrated univerſity, which was founded in 1630, ſince which it hath flouriſhed greatly, though it has not all the privileges of moſt other univerſities; being wholly ſubject to the magiſtrates of the city. The mall without the town, having five rows of lofty limes on each ſide, is very pleaſant; and the phyſic-garden belonging to the univerſity is extremely curious. There are five churches here that have chapters; but the members of theſe purchaſe the places, of which ſome coſt 6000 or 7000 guilders. The ſtreams which run through ſeveral of the ſtreets, contribute much to the beauty and cleanlineſs of the town; and the canal that is cut from the Leck, and paſſes through it to Amſterdam, will carry ſhips of any burden. Pope Adrian VI. was a native of this city. Here, in 1579, the memorable union was formed between the ſeven provinces; and, in 1713, the celebrated peace concluded between France on the one part, and the allies on the other. The Papiſts have a nominal archbiſhop of this city; and there is a ſilk manufactory carried on in it, which employs a number of hands. The inhabitants are ſuppoſed to amount to 30,000. E. Long. 5. 8. N. Lat. 52. 7.

UTRICULARIA, in botany: A genus of plants of the claſs of *diandria*, and order of *monogynia*; and in the natural ſyſtem arranged under the 24th order, *Corydales*. The calyx is ringent, with a nectarium reſembling a ſpur; the corolla diphyllous and equal: the capſule unilocular. There are nine ſpecies; two of which are natives of Britain. They have been applied to no particular uſe.

UVA URSI. See ARBUTUS.

VULCAN, in Pagan worſhip, the god of ſubterraneous fire and metals, was the ſon of Jupiter and Juno; and was ſaid to be ſo remarkably deformed, that his father threw him down from heaven to the iſle of Lemnos, in which fall he broke his leg, and there he ſet up his forge, and taught men how to ſoften and poliſh braſs and iron. Thence he removed to the Liparian iſles, near Sicily, where, by the aſſiſtance of the Cyclops, he made Jupiter's thunderbolts, and armour for the other gods. Notwithſtanding the deformity of his perſon, he had a paſſion for Minerva, and by Jupiter's conſent made his addreſſes to her, but without ſucceſs. He was, however, more fortunate in his ſuit to Venus; who, after her marriage, choſe Mars for her gallant; when Vulcan expoſed them to the ridicule of the other gods, by taking them in a net.

VULGATE, a very ancient Latin tranſlation of the Bible, and the only one acknowledged by the church of Rome to be authentic. See BIBLE.

VULNERARY, in medicine, an epithet formerly given to remedies ſuppoſed to poſſeſs virtues for the cure of wounds and ulcers.

VULTUR, a genus of birds belonging to the order of *Accipitres*. The beak is ſtraight and crooked at the point; the head has no feathers; on the forepart being only naked ſkin; and the tongue is generally bifid. There are 21 ſpecies. The moſt remarkable are,

Vultur.

1. *Gryphus*, the condor, which is not only the largeſt of this genus, but perhaps of all others which are able to fly. The accounts of authors in regard to its extent of wing are various, viz. from 9 to 18 feet from the tip of one wing to that of the other. One gives it ſtrength ſufficient to carry off ſheep, and boys of 10 years old; while another ventures to affirm, that it can lift an elephant from the ground high enough to kill it by the fall! M. de Salerne ſays, that one of this kind was ſhot in France in the year 1719, which weighed 18 lib. and whoſe extent of wing was 18 feet. But to come nearer the truth, perhaps it is better to abide by deſcriptions which bear a moderate proportion. In Hawkeſworth's Voyages, mention is made of one of theſe birds ſhot at Port Deſire, off Penguin Iſland, of which he gives the following deſcription: "The head of this bird reſembled that of an eagle, except that it had a large comb upon it. Round the neck it had a white ruff, exactly reſembling a lady's tippet; the feathers on the back were as black as jet, and as bright as the fineſt poliſh could render that mineral; the legs were remarkably ſtrong and large, and the talons like thoſe of an eagle, except that they were not ſo ſharp; and the wings, when they were extended, meaſured, from point to point, no leſs than 12 feet." This laſt account ſeems by no means to exceed the natural ſize, ſince we have an account in the Philoſophical Tranſactions of one of the quill-feathers of this bird, brought from Chili, which meaſured 2 feet 4 inches; the diameter of the quill half an inch; and the extent of wing 16 feet. This bird was met in latitude 33 ſouth, not far from the iſland Mocha, in the South Sea, in the year 1691. The ſeamen ſhot it on a cliff by the ſea-ſide; and taking it for a kind of turkey, made a meal of it. In this account we are told that the colour was black and white, like a magpie, and the creſt or comb ſharp like a razor.

It ſeems now certain, that the account given by the editor of Cook's Voyage is very nearly, if not preciſely, the truth, as two birds of this kind are now in the muſeum of Mr Parkinſon, and are probably male and female. The firſt of theſe has an extent of wing ſomewhat under 11 feet. The bill is ſtrong, moderately hooked, and blunt at the tip, which is white, the reſt of it being of a duſky colour. On the top of the head runs a kind of carunculated ſubſtance, ſtanding up like the comb of a cock. The head and neck are ſlightly covered with brown down, in ſome parts nearly bare, and here and there a carunculated part, as in the neck of a turkey. The lower part of the neck is ſurrounded with a ruff of a pure white and hairy kind of feathers. The upper parts of the body, wing, and tail, are black, except that the middle wing coverts have whitiſh ends, and the greater coverts half black half white. The nine or ten firſt quills are black, the reſt white, with the tips only black; and when the wings are cloſed, produce an appearance of the bird having the back white; giving occaſion to Molina, in his Hiſtory of Chili, to ſay, that the back was white. The under parts of the body are rather ſlightly covered with feathers; but thoſe of the thighs are pretty long. The legs are ſtout and brown; claws black and blunt.

The ſecond bird in Mr Parkinſon's collection, chiefly differs from the firſt, in having not the leaſt appearance of a comb or creſt, but ſmooth for the moſt part, except where the head and neck are covered with down. The ruff on the lower part of the neck is not ſo full and conſpicuous; but as to the colour of the plumage, the difference is not worth noticing. It is not impoſſible but this laſt may prove to be

a

Vultur. a young male, for Molina expresly says, that the female is smaller than the male, of a brown colour, and has no ruff about the neck, only a small tuft at the back part.

These birds are said to make the nest among the inaccessible rocks, and to lay two white eggs, larger than those of a turkey; are very destructive to sheep, and will in troops often attempt calves; in which case, some of them first pick out the eyes, whilst others attack the poor animal on all sides, and soon tear him to pieces. This gives rise to the following stratagem, used by the peasants of Chili: One of them wraps himself up in the hide of a fresh killed sheep or ox, and lies still on the ground; the condor, supposing it to be lawful prey, flies down to secure it, when the person concealed lays hold of the legs of the bird, his hands being well covered with gloves; and immediately his comrades, who are concealed at a distance, run in, and assist to secure the depredator, by falling on him with sticks till they have killed him. See Plate DX. fig. 4.

2. The *Percnopterus*, or Egyptian vultur. The appearance of this bird is as horrid as can well be imagined, viz. the face is naked and wrinkled; the eyes are large and black; the beak black and hooked; the talons large, and extending ready for prey; and the whole body polluted with filth: these are qualities enough to make the beholder shudder with horror. Notwithstanding this, the inhabitants of Egypt cannot be enough thankful to Providence for this bird. All the places round Cairo are filled with the dead bodies of asses and camels; and thousands of these birds fly about, and devour the carcases before they putrify and fill the air with noxious exhalations. The inhabitants of Egypt, and after them Maillet in his Description of Egypt, say, that they yearly follow the caravan to Mecca, and devour the filth of the slaughtered beasts, and the carcases of the camels which die on the journey. They do not fly high, nor are they afraid of men. If one is killed, all the rest surround him in the same manner as do the royston crows; they do not quit the places they frequent, though frightened by the explosion of a gun, but immediately return thither. Maillet imagines this bird to be the ibis of the ancients: but it is scarcely to be imagined, that a wise nation should pay such honours to an unclean, impure, and rapacious bird, which was not perhaps so common before the Egyptians filled the streets with carcases. If the ibis is to be found, it must certainly be looked for in the ordo of grallæ of Linnæus; and we imagine it to be the white stork (*Ardea cicona*), which is so common in Egypt. The Arabians call it *rochæme*; the French living in Egypt, give it the name of *chapon de Pharaon*, or *de Mahometh*.

3. The *aura*, or carrion vulture, according to Mr Latham, is about the size of a turkey, though it varies in size in different parts. The bill is white; the end black; irides bluish saffron-colour. The head, and part of the neck, are bare of feathers; and of a red, or rather rufous colour. The sides of the head warted, not unlike that of a turkey. The whole plumage is brown black, with a purple and green gloss in different reflections; but in some birds, especially young ones, greatly verging to dirty brown. The feathers of the quills and tail are blacker than the rest of the body. The legs are flesh-colour; the claws black.

This bird is very common in the West Indies, and both in North and South America. It feeds on dead carcases, snakes, &c. like most of this genus; which makes the smell of it very offensive. In general, it is very tame in its wild state, but particularly so when trained up from being young. This our author experienced in two birds sent home from Jamaica. They were suffered to run wild about the garden, and were alert and brisk during the summer months; but impatient of the least cold; for a rainy day, with the slightest degree of cold, obliged them to creep for shelter. In the West Indies, they roost together of nights, in vast numbers, like rooks in this country. They are reckoned a most useful animal in the places where they resort; which secures their safety, added to a penalty for killing one, which is in force in Jamaica, and other islands of the West Indies.

4. The *sagittarius*, or secretary, is a most singular species, being particularly remarkable from the great length of its legs; which at first sight would induce one to think it belonged to waders: but the characters of the vultur are so strongly marked throughout, as to leave no doubt to which class it belongs.

The bird, when standing erect, is full three feet from the top of the head to the ground. The bill is black, sharp, and crooked, like that of an eagle; the head, neck, breast, and upper parts of the body, are of a bluish ash colour: the legs are very long, stouter than those of a heron, and of a brown colour; claws shortish, but crooked, not very sharp, and of a black colour; from the hind-head springs a number of long feathers, which hang loose behind like a pendent crest; these feathers arise by pairs, and are longer as they are lower down on the neck; this crest the bird can erect or depress at pleasure; it is of a dark colour, almost black; the webs are equal on both sides, and rather curled; and the feathers, when erected, somewhat incline towards the neck; the two middle feathers of the tail twice as long as any of the rest.

This singular species inhabits the internal parts of Africa, and is frequently seen at the Cape of Good Hope. It is also met with in the Philippine islands.

The description was taken by Mr Latham from three that were alike, which he saw in England alive some years since; two of which are now in the Leverian museum. From confinement they had lost their two long tail feathers; but this want was supplied by some accurate drawings by Sir Joseph Banks, taken from the life at the Cape.

As to the manners of this bird, it is on all hands allowed that it principally feeds on rats, lizards, snakes, and the like; and that it will become familiar: whence Sonnerat is of opinion, that it might be made useful in some of our colonies, if encouraged, towards the destruction of those pests. They call it at the Cape of Good Hope *slangeater*, i. e. snake eater. A great peculiarity belongs to it, perhaps observed in no other; which is, the faculty of striking forwards with its legs, never backwards. Dr Solander has seen one of these birds take up a snake, small tortoise, or such like, in its claws; when dashing it from thence against the ground with great violence, if the victim was not killed at first, it repeated the operation till that end was answered; after which it ate it up quietly. Dr J. R. Forster mentioned a further circumstance, which he says was supposed to be peculiar to this bird; that should it by any accident break the leg, the bone would never unite again.

VULVA, in anatomy. See there, n° 132.

UVULA, in anatomy. See there, n° 102.

UZ, or Utz, the country and place of residence of Job. In the genealogy of the patriarchs there are three persons called *Uz*, either of which might give this district its name. The first was the grandson of Sem, by his son Aram (Gen. xxii. 23.), who, according to Josephus, occupied the Trachonitis, and Damascus, to the north of Palestine: but Job was among the sons of the East. Another *Uz* was the son of Nahor, Abraham's brother (Gen. x. 21.), who appears to have removed, after passing the Euphrates, from Haran of Mesopotamia to Arabia Deserta. The third *Uz* was a Horite, from mount Seir (Gen. xxxvi. 28.), and thus not of Eber's posterity. Now the question is, from which of these Job's

Job's country, Uz, took its name? Not from the firſt, as is already ſhown; nor from the ſecond, becauſe his country is always called *Seir*, or *Edom*, never *Uz*; and then called a *ſouth*, not an *eaſt*, country, in Scripture. It therefore remains, that we look for the country and place of reſidence of Job in Arabia Deſerta; for which there was very probable reaſons. The plunderers of Job are called *Chaldeans* and *Sabeans*, next neighbours to him. These Sabeans came not from Arabia Felix, but from a nearer Sabe in Arabia Deſerta (Ptolemy); and his friends, except Eliphaz the Themanite, were of Arabia Deſerta.

UZBECK Tartary. See Tartary.

W.

W, or w, is the 21ſt letter of our alphabet; and is compoſed, as its name implies, of two v's. It was not in uſe among the Hebrews, Greeks, or Romans; but chiefly peculiar to the northern nations, the Teutones, Saxons, Britons, &c. But ſtill it is not uſed by the French, Italians, Spaniards, or Portugueſe, except in proper names, and other terms borrowed from languages in which it is originally uſed, and even then it is ſounded like the ſingle v. This letter is of an ambiguous nature; being a conſonant at the beginning of words, and a vowel at the end. It may ſtand before all the vowels except *u*; as *water*, *wedge*, *winter*, *wonder*: it may alſo follow the vowels *a*, *e*, *o*, and unites with them into a kind of double vowel, or diphthong; as in *ſaw*, *few*, *cow*, &c. It alſo goes before *r*, and follows *ſ* and *th*; as in *wrath*, *ſwear*, *thwart*: it goes before *h* alſo, though in reality it is ſounded after it; as in *when*, *what*, &c. In ſome words it is obſcure, as in *ſhadow*, *widow*, &c.

WAAG, a river of Hungary, which riſes in the Carpathian mountains, and falls into the Danube oppoſite to the iſland of Schut.

WAAL, a river of the United Netherlands, being one of the branches of the Rhine, which runs from eaſt to weſt, thro' Guelderland, paſſing by Nimeguen, Tiel, Bommel, and Gorcum; and, uniting with the Maes, falls into the German Sea below the Briel.

WACHENDORFIA, in botany: A genus of plants of the claſs of *triandria*, and order of *monogynia*; and arranged in Linnæus's Natural Method of Claſſification under the 6th order, *Enſatæ*. The corolla is hexapetalous, unequal, and ſituated below the germen; the capſule trilocular and ſuperior. There are four ſpecies; none of which are natives of Britain.

WADD, or Wadding, is a ſtopple of paper, hay, ſtraw, or the like, forced into a gun upon the powder, to keep it cloſe in the chamber; or to put up cloſe to the ſhot, to keep it from rolling out.

WADSET, in Scots law. See Law, n° clxix. 1.

WAFERS, or *Sealing Wafers*, are made thus: Take very fine flour, mix it with glair of eggs, iſinglaſs, and a little yeaſt; mingle the materials; beat them well together; ſpread the batter, being made thin with gum-water, on even tin plates, and dry them in a ſtove; then cut them out for uſe.

You may make them of what colour you pleaſe, by tinging the paſte with braſil or vermilion for red; indigo or verditer, &c. for blue; ſaffron, turmerics, or gamboge, &c. for bellow.

WAGER *of Law*. See (*Wager of*) Law.

Wager of Battel. See (*Wager of*) Battel.

WAGGON, a wheel carriage, of which there are various forms, accommodated to the different uſes they are intended for. The common waggon conſiſts of the ſhafts or rods, being the two pieces which the hind horſe bears up; the welds; the flotes, or croſs pieces, which hold the ſhafts together; the bolſter, being that part on which the forewheels and the axle-tree turn in wheeling the waggon acroſs the road; the cheſt or body of the waggon, having the ſtaves or rails fixed thereon; the bales, or hoops which compoſe the top; the tilt, the place covered with cloth, at the end of the waggon. See Mechanics, Sect. iv.

WAGTAIL, in ornithology. See Motacilla.

WAIFS, bona waviata, are goods ſtolen, and waived or thrown away by the thief in his flight, for fear of being apprehended. Theſe are given to the king by the law, as a puniſhment upon the owner for not himſelf purſuing the felon, and taking away his goods from him. And therefore if the party robbed do his diligence immediately to follow and apprehend the thief (which is called *making freſh ſuit*), or do convict him afterwards, or procure evidence to convict him, he ſhall have his goods again. Waived goods do alſo not belong to the king till ſeized by ſomebody for his uſe; for if the party robbed can ſeize them firſt, though at the diſtance of 20 years, the king ſhall never have them. If the goods are hid by the thief, or left anywhere by him, ſo that he had them not about him when he fled, and therefore did not throw them away in his flight; theſe alſo are not *bona waviata*, but the owner may have them again when he pleaſes. The goods of a foreign merchant, though ſtolen and thrown away in flight, ſhall never be waifs: the reaſon whereof may be, not only for the encouragement of trade, but alſo becauſe there is no wilful default in the foreign merchant's not purſuing the thief, he being generally a ſtranger to our laws, our uſages, and our language.

WAIGATS straits, ſituated between Nova Zembla and Ruſſia, through which the Dutch ſailed to the north, as high as 75°, in order to diſcover a north-eaſt paſſage to China and the Eaſt Indies.

WAINSCOT, in building, the timber-work that ſerves to line the walls of a room, being uſually made in pannels, and painted, to ſerve inſtead of hangings.

WAIVE, in law, a woman that is put out of the protection of the law. She is called *waive*, as being forſaken of the law; and not *outlaw* as a man is; by reaſon women cannot be of the decenna, and are not ſworn in leets to the king, nor to the law, as men are; who are therefore within the law; whereas women are not, and ſo cannot be outlawed, ſince they never were within it.

WAKE, the print or track impreſſed by the courſe of a ſhip on the ſurface of the water. It is formed by the reunion of the body of water which was ſeparated by the ſhip's bottom whilſt moving through it; and may be ſeen to a conſiderable diſtance behind the ſtern, as ſmoother than the reſt of the ſea. Hence it is uſually obſerved by the compaſs, to diſcover the angle of lee-way.

Wake.

A ſhip is ſaid to be in the wake of another when ſhe follows her on the ſame track, or a line ſuppoſed to be formed on the continuation of her keel.

Two diſtant objects obſerved at ſea are called in the wake of each other, when the view of the fartheſt is intercepted by the neareſt; ſo that the obſerver's eye and the two objects are all placed upon the ſame right line.

Wake is the eve feaſt of the dedication of churches, which is kept with feaſting and rural diverſions.

The learned Mr Whitaker, in his Hiſtory of Mancheſter, hath given a particular account of the origin of wakes and fairs. He obſerves, that every church at its conſecration received the name of ſome particular ſaint: this cuſtom was practiſed among the Roman Britons, and continued among the Saxons; and in the council of Cealchythe, in 816, the name of the denominating ſaint was expreſsly required to be inſcribed on the altars, and alſo on the walls of the church, or a tablet within it. The feaſt of this ſaint became of courſe the feſtival of the church. Thus Chriſtian feſtivals were ſubſtituted in the room of the idolatrous anniverſaries of heatheniſm: accordingly, at the firſt introduction of Chriſtianity among the Jutes of Kent, pope Gregory the Great adviſed what had been previouſly done among the Britons, viz. Chriſtian feſtivals to be inſtituted in the room of the idolatrous, and the ſuffering day of the martyr whoſe relics were repoſited in the church, or the day on which the building was actually dedicated, to be the eſtabliſhed feaſt of the pariſh. Both were appointed and obſerved; and they were clearly diſtinguiſhed at firſt among the Saxons, as appears from the laws of the Confeſſor, where the *dies dedicationis*, or *dedicatio*, is repeatedly diſcriminated from the *propria feſtivitas ſancti*, or *celebratio ſancti*. They remained equally diſtinct to the Reformation; the dedication-day in 1536 being ordered for the future to be kept on the firſt Sunday in October, and the feſtival of the patron ſaint to be celebrated no longer. The latter was, by way of pre eminence, denominated the *church's holiday*, or its peculiar feſtival; and while this remains in many pariſhes at preſent, the other is ſo utterly annihilated in all, that biſhop Kennet (ſays Mr Whitaker) knew nothing of its diſtinct exiſtence, and has attributed to the day of dedication what is true only concerning the ſaint's day. Thus inſtituted at firſt, the day of the tutelar ſaint was obſerved, most probably by the Britons, and certainly by the Saxons, with great devotion. And the evening before every ſaint's day, in the Saxon Jewiſh method of reckoning the hours, being an actual hour of the day, and therefore like that appropriated to the duties of public religion, as they reckoned Sunday from the firſt to commence at the ſun-ſet of Saturday; the evening preceding the church's holiday would be obſerved with all the devotion of the feſtival. The people actually repaired to the church, and joined in the ſervices of it; and they thus ſpent the evening of their greater feſtivities in the monaſteries of the North, as early as the concluſion of the ſeventh century.

These ſervices were naturally denominated from their late hours *waeccan* or *wakes*, and *vigils* or *eves*. That of the anniverſary at Rippon, as early as the commencement of the eighth century, is expreſsly denominated the *vigil*. But that of the church's holiday was named *cyric waeccan*, or church-wake, the church vigil, or church eve. And it was this commencement of both with a wake, which has now cauſed the days to be generally preceded with vigils, and the church-holiday particularly to be denominated the *church-wake*. So religiouſly was the eve and feſtival of the patron ſaint obſerved for many ages by the Saxons even as late as the reign of Edgar, the former being ſpent in the church, and employed in prayer. And the wakes, and all the other holidays in the year, were put upon the ſame footing with the octaves of Chriſtmas, Eaſter, and of Pentecoſt. When Gregory recommended the feſtival of the patron ſaint, he adviſed the people to erect booths of branches about the church on the day of the feſtival, and to feaſt and be merry in them with innocence. Accordingly, in every pariſh, on the returning anniverſary of the ſaint, little pavilions were conſtructed of boughs, and the people indulged in them to hoſpitality and mirth. The feaſting of the ſaint's day, however, was ſoon abuſed; and even in the body of the church, when the people were aſſembled for devotion, they began to mind diverſions, and to introduce drinking. The growing intemperance gradually ſtained the ſervice of the vigil, till the feſtivity of it was converted, as it now is, into the rigour of a faſt. At length they too juſtly ſcandalized the Puritans of the laſt century, and numbers of the wakes were diſuſed entirely, eſpecially in the eaſt and ſome weſtern parts of England; but they are commonly obſerved in the north, and in the midland counties.

This cuſtom of celebrity in the neighbourhood of the church, on the days of particular ſaints, was introduced into England from the continent, and muſt have been familiar equally to the Britons and Saxons; being obſerved among the churches of Aſia in the ſixth century, and by thoſe of the weſt of Europe in the ſeventh. And equally in Aſia and Europe on the continent, and in the iſlands, theſe celebrities were the cauſes of thoſe commercial marts which we denominate *fairs*. The people reſorted in crowds to the feſtival, and a conſiderable proviſion would be wanted for their entertainment. The proſpect of intereſt invited the little traders of the country to come and offer their wares; and thus, among the many pavilions for hoſpitality in the neighbourhood of the church, various booths were erected for the ſale of different commodities. In larger towns, ſurrounded with populous diſtricts, the reſort of the people to the wakes would be great, and the attendance of traders numerous; and this reſort and attendance conſtitute a fair.— Baſil expreſsly mentions the numerous appearance of traders at theſe feſtivals in Aſia, and Gregory notes the ſame cuſtom to be common in Europe. And as the feſtival was obſerved on a feria or holiday, it naturally aſſumed to itſelf, and as naturally communicated to the mart, the appellation of *feria* or fair. Indeed ſeveral of our moſt ancient fairs appear to have been uſually held, and have been continued to our time, on the original church-holidays of the places: beſides, it is obſervable, that fairs were generally kept in church yards, and even in the churches, and alſo on Sundays, till the indecency and ſcandal were ſo great as to need reformation.

Wake-Robin. See Arum.

WALACHIA, a province of Turkey in Europe, bounded on the north by Moldavia and Tranſylvania, on the eaſt and ſouth by the river Danube, and on the weſt by Tranſylvania. It is 225 miles in length, and 125 in breadth; and was ceded to the Turks by the treaty of Belgrade, in 1739. It abounds in good horſes and cattle; and there are mines of ſeveral kinds. The ſoil is ſo fertile, that it is capable of producing any thing; and there are good paſtures, with wine, oil, and all manner of European fruits. The inhabitants are chiefly of the Greek church.

WALCHEREN, an iſland of the Low Countries, and one of the principal of thoſe of Zealand; ſeparated from Dutch Flanders by the mouth of the Scheld. It is about nine miles in length, and eight in breadth; and though it lies low, has good arable and paſture land. The chief town of this iſland and the whole province is Middleburg.

WALDEN, a town of Essex, commonly called *Saffron Walden*, with a market on Saturdays, and two fairs on Mid-lent Saturday for horses, and November 1st for cows. It is remarkable for the plenty of saffron that grows about it. This town was incorporated by Edward VI. and is governed by a mayor and 24 aldermen. It is 27 miles north-west-by-north of Chelmsford, and 43 north-east of London. E. Long. 0. 20. N. Lat. 52. 4.

WALDENSES. See WALDO.

WALDO, a merchant of Lyons in the latter part of the 12th century, who applying himself to the study of the Scriptures, and finding no warrant there for several of the Romish doctrines, particularly that of transubstantiation, publicly opposed them. His followers, who from him were called *Waldenses*, being chased from Lyons, spread over Dauphine and Provence; upon which Philip II. is said to have razed 300 gentlemens seats, and destroyed several walled towns to stop their growth: but this, instead of suppressing, spread them over a great part of Europe. The articles of their faith, which they drew up and dedicated to the king of France, agreed in most points with those of the present Protestants. In the year 1200, those of them who dwelt in the province of Albigeois in Languedoc, from whence they were called *Albigenses*, stood upon their defence; upon which Philip drove them into Bohemia, Savoy, and England. The crusade against them is said to have consisted of 500,000 men, who wore their crosses on their breasts, to distinguish themselves from those who went to the Holy Land, and wore them on their shoulders.

WALES, a county situated in the south-west part of Britain, into which the ancient Britons retired from the persecution of the Saxons. Anciently it was of greater extent than it is at present, and comprehended all the country beyond the Severn, that is, besides the 12 counties included in it at present, those of Herefordshire and Monmouthshire, which now are reckoned a part of England, were then inhabited by three different tribes of the Britons, namely, the Silures, the Dimetæ, and the Ordovices. The Romans were never able to subdue them, till the reign of Vespasian, when they were reduced by Julius Frontinus, who placed garrisons in their country to keep them in awe. Though the Saxons made themselves masters of all England, they never could get possession of Wales, except the counties of Monmouthshire and Herefordshire, formerly a part of Wales. About the year 870, Roderic king of Wales divided it among his three sons; and the names of these divisions were, *Demetia*, or *South-Wales*; *Povesia*, or *Powis-Land*; and *Venedotia*, or *North-Wales*. Another division is mentioned afterwards in the records, viz. North Wales, South Wales, and West Wales: the last comprehending the counties of Monmouth and Hereford. The country derived the name of *Wales*, and the inhabitants that of *Welsh*, from the Saxons, who by those terms denote a country and people to which they are strangers; for the Welsh, in their own language, call their country *Cymry*, and their language *Cymraeg*. They continued under their own princes and laws from the above-mentioned period, and were never entirely subjected to the crown of England till the reign of Edward I. when Llewellin ap Gryffith, prince of Wales, lost both his life and dominions. Edward, the better to secure his conquest, and to reconcile the Welsh to a foreign yoke, sent his queen to lie in at Caernarvon, where she was delivered of a prince; to whom the Welsh, on that account, the more readily submitted. Ever since that time, the eldest sons of the kings of England have commonly been created princes of Wales, and as such enjoy certain revenues from that country.

As to the character of the Welsh, they are said to be a brave, hospitable people; and though very jealous of affronts, passionate, and hasty, yet are easily reconciled. The common people look with a jealous eye on the English, and bear an hereditary grudge to the English nation, by whom their ancestors were expelled from the finest parts of the island. The gentlemen are apt to value themselves upon the antiquity of their families; and with some reason, as they can generally trace them much higher than the inhabitants of most other countries.

All the better sort, both in town and country, can speak English, especially in the counties bordering upon England. The common people, in general, only speak their own language, which is the ancient British; and not only differs entirely from the English, but has very little affinity with any of the western tongues, unless we should accept the Gaelic, Erse, or Irish. It is said to be a dialect of the ancient Celtic, and in many respects to resemble the Hebrew. Most of the clergy are natives of the country, and understand English so well, that they could exercise their functions in any part of Britain. The public worship, however, is as often performed in Welsh as in English, excepting in the towns, where the latter is the prevailing language. The inhabitants are computed at about 300,000.

The country, though mountainous, especially in North Wales, is far from being barren or unfruitful; the hills, besides the metals and minerals they contain, feeding vast herds of small black cattle, deer, sheep, and goats, and their valleys abounding in corn, as their seas and rivers do in fish. Here are also wood, coal, and turf for fuel, in abundance.

Wales is bounded on all sides by the sea and the Severn; except on the east, where it joins to the counties of Chester, Salop, Hereford, and Monmouth. Its length, from the southernmost part of Glamorganshire to the extremity of Flintshire north, is computed at about 113 miles; and its greatest breadth, from the river Way east to St David's in Pembrokeshire west, is nearly of the same dimensions, being about 90 miles.

After the conquest of Wales by Edward I. very material alterations were made in their laws, so as to reduce them nearer to the English standard, especially in the forms of their judicial proceedings: but they still retained very much of their original polity, particularly their rule of inheritance, viz. that their lands were divided equally among all the issue male, and did not descend to the eldest son alone. By other subsequent statutes their provincial immunities were still farther abridged: but the finishing stroke to their independency was given by the statute 27 Hen. VIII. c. 26. which at the same time gave the utmost advancement to their civil prosperity, by admitting them to a thorough communication of laws with the subjects of England.— Thus were this brave people gradually conquered into the enjoyment of true liberty; being insensibly put upon the same footing, and made fellow-citizens, with their conquerors.

It is enacted by the 27 Hen. VIII. 1. That the dominion of Wales shall be for ever united to the kingdom of England. 2. That all Welshmen born shall have the same liberties as other king's subjects. 3. That lands in Wales shall be inheritable according to the English tenures and rules of descent. 4. That the laws of England, and no other, shall be used in Wales: besides many other regulations of the police of this principality. And the 34 and 35 Hen. VIII. c. 26. confirms the same, adds farther regulations, divides it into twelve shires, and, in short, reduces it into the same order in which it stands at this day; differing from the kingdom of England in only a few particulars, and those too of the nature of privileges (such as having courts within itself, independent of the process of Westminster-

Wales || Waller.

minster-hall), and some other immaterial peculiarities, hardly more than are to be found in many counties of England itself.

New Wales. See *New Britain.*

New South-Wales. See *New Holland.*

Prince of Wales. See *Royal Family.*

Walking Leaf. See *Mantis Syciifolia.*

WALL, in architecture, the principal part of a building, as serving both to inclose it, and to support the roof, floors, &c.—Walls are distinguished into various kinds, from the matter whereof they consist; as plastered or mud-walls, brick-walls, stone-walls, flint or boulder-walls, and boarded-walls. See Architecture.

Cob or *Mud Wall.* In those parts of England where stone is scarce, it is usual to make walls and houses of mud, or, as it is called in Devonshire, *cob;* which is a composition of earth and straw, wet up somewhat like mortar, but well beat and trod together. When a wall is making, after being raised to a certain height, it is allowed time to pitch or settle before the work is resumed. Some value themselves on their skill in building with this composition; the price, when materials are found, is generally in Devonshire 3s. per perch of 16½ feet; but a stone foundation costs more. Houses built with this, being covered with thatch, are very dry and warm; a cob wall, if in a good situation, will last 50 or 60 years or more. When pulled down, they are used as manure, and new earth employed to rebuild with.

WALLACE (Sir William), a gallant general of the Scots, who endeavoured to rescue his country from the English yoke; but being taken prisoner, he was unjustly tried by the English laws, condemned, and executed as a traitor to Edward I. in 1304. See Scotland, n° 103, *et seq.*

WALLACHIA. See Walachia.

WALLER (Edmund), a celebrated English poet, was the son of Robert Waller, Esq; of Agmondesham in Buckinghamshire, by Anne, the sister of the great Hamden, who distinguished himself so much in the beginning of the civil wars. He was born in 1605; and his father dying when he was very young, the care of his education fell to his mother, who sent him to Eton school. He was afterwards sent to King's college in Cambridge, where he must have been very assiduous in his studies, since, at sixteen or seventeen years of age, he was chosen into the last parliament of King James I. and served as burgess for Agmondesham. He began to exercise his poetical talent so early as the year 1623; as appears from his verses " upon the danger his majesty (being prince) escaped in the road of St Andero;" for there Prince Charles, returning from Spain that year, had like to have been cast away. It was not, however, Mr Waller's wit, his fine parts, or his poetry, that so much occasioned him to be first publicly known, as his carrying off the daughter and sole heiress of a rich citizen, against a rival whose interest was espoused by the court. It is not known at what time he married his first lady; but he was a widower before he was 25, when he began to have a passion for Sacharissa, which was a fictitious name for the lady Dorothy Sidney, daughter to the earl of Leicester, and afterwards wife to the earl of Sunderland. He was now known at court, caressed by all who had any relish for wit and polite literature; and was one of the famous club of which Lord Falkland, Mr Chillingworth, and other eminent men, were members. He was returned burgess for Agmondesham in the parliament which met in April 1640. An intermission of parliaments having disgusted the nation, and raised jealousies against the designs of the court, which would be sure to discover themselves whenever the king came to ask for a supply, Mr Waller was one of the first who condemned the preceding measures. He showed himself in opposition to the court, and made a speech in the house on this occasion; from which we may gather some notion of his general principles in government; wherein, however, he afterwards proved very variable and inconstant. He opposed the court also in the long parliament which met in November following, and was chosen to impeach Judge Crawley, which he did in a warm and eloquent speech, July 16th 1641. This speech was so highly applauded, that 20,000 copies of it were sold in one day. In 1642, he was one of the commissioners appointed by the parliament to present their propositions of peace to the king at Oxford. In 1643, he was deeply engaged in a design to reduce the city of London and the tower to the service of the king; for which he was tried and condemned, together with Mr Tomkins his brother-in-law, and Mr Challoner. The two latter suffered death; but Mr Waller obtained a reprieve: he was, however, sentenced to suffer a year's imprisonment, and to pay a fine of 10,000 l. After this, he became particularly attached to Oliver Cromwell, upon whom he wrote a very handsome panegyric. He also wrote a noble poem on the death of that great man.

At the Restoration, he was treated with great civility by Charles II. who always made him one of the party in his diversions at the duke of Buckingham's and other places. He wrote a panegyric upon his majesty's return; which being thought to fall much short of that he had before written on Oliver Cromwell, the king one day asked him in raillery, " How is it, Waller, that you wrote a better encomium on Cromwell than on me?" " May it please your majesty," answered he, " we poets generally succeed best in fiction." He sat in several parliaments after the Restoration, and continued in the full vigour of his genius to the end of his life, his natural vivacity bearing him up, and making his company agreeable to the last. He died of a dropsy in 1687, and was interred in the church-yard of Beaconsfield, where a monument is erected to his memory. Mr Waller has been honoured as the most elegant and harmonious versifier of his time, and a great refiner of the English language. The best edition of his works, containing poems, speeches, letters, &c. is that published in quarto by Mr Fenton, in 1730.

WALLIS (Dr John), a celebrated mathematician, was educated at Cambridge; where he became fellow of Queen's college, and continued so till, by his marriage, he vacated his fellowship. In 1640, he received holy orders, and became chaplain to the lady Vere. While he lived in this family, he cultivated the art of deciphering; and it is said, that the elector of Brandenburg, for whom he explained several letters written in ciphers, sent him a gold chain and medal. In 1643 he published, " Truth tried; or, Animadversions on the lord Brooke's treatise, called *The Nature of Truth,* &c". The next year he was chosen one of the scribes or secretaries to the assembly of divines at Westminster. Dr Peter Turner, Savilian professor of geometry in Oxford, being ejected by the parliament-visitors in 1649, Mr Wallis was appointed to succeed him in that place. In 1653 he published at Oxford a Grammar of the English Tongue in Latin. In 1655 he entered the lists with Mr Hobbes; and their controversy lasted a considerable time. In 1657 the Doctor published his Mathematical Works. Upon the death of Dr Langbaine, he was chosen custos archivorum of the university. After the Restoration he met with great respect, the king himself entertaining a favourable opinion of him on account of some services he had done both to his royal father and himself. He was therefore confirmed in his places, admitted one of the king's chaplains in ordinary, and appointed one of the divines empowered to review the

book of common prayer. He complied with the terms of the act of uniformity, and continued a steady conformist till his death. He was one of the first members of the Royal Society, and corresponded with many learned men. In 1697, the curators of the university press at Oxford thought it for the honour of the university to collect the mathematical works of the Doctor, which had been printed separately, some in Latin, some in English, and published them all together in the Latin tongue, in 3 vols, folio. He died in 1703. He speaks of himself thus: "It hath been my endeavour all along to act by moderate principles, being willing, whatever side was uppermost, to promote any good design for the true interest of religion, of learning, and of the public good." Besides the works above-mentioned, he published many others.

WALLOONS, a name for the inhabitants of a considerable part of the Netherlands, viz. Artois, Hainault, Namur, Luxemburgh, and part of Flanders and Brabant.

WALNUT-TREE, in botany. See JUGLANS.

WALPOLE (Sir Robert), earl of Orford, was born at Houghton in Norfolk, September 6th, 1674, and educated on the foundation at Eton school. Thence he was elected to King's College in Cambridge; but, succeeding to the family estate by the death of his elder brother, he resigned his fellowship. In 1700, he was chosen member of parliament for King's Lynn, and represented that borough in several succeeding parliaments. In 1705, he was nominated one of the council to prince George of Denmak, lord high admiral of England; in 1707, appointed secretary at war; and, in 1709, treasurer of the navy. In 1710, upon the change of the ministry, he was removed from all his posts, and held no place afterwards during the queen's reign. In 1711 he was expelled from the house of commons for what they called notorious corruption in his office as secretary at war. The borough of Lynn, however, re-elected him; and, though the house declared the election void, yet they persisted in the choice. In the well-known debate relating to Steele for publishing the Crisis, he greatly distinguished himself in behalf of liberty, and added to the popularity he had before acquired.

On the death of the queen, a revolution of politics took place, and the Whig party prevailed both at court and in the senate. Walpole had before recommended himself to the house of Hanover by his zeal for its cause, when the commons considered the state of the nation with regard to the Protestant succession: and he had now the honour to procure the assurance of the house to the new king (which attended the address of condolence and congratulation), "That the commons would make good all parliamentary funds." It is therefore not to be wondered at, that his promotion soon took place after the king's arrival; and that in a few days he was appointed receiver and paymaster general of all the guards and garrisons, and of all other the land forces in Great Britain, paymaster of the royal hospital at Chelsea, and likewise a privy counsellor. On the opening of a new parliament, a committee of secrecy was chosen to enquire into the conduct of the late ministry, of which Walpole was appointed chairman; and, by his management, articles of impeachment were read against the earl of Oxford, lord Bolingbroke, the duke of Ormond, and the earl of Strafford. The eminent service he was thought to have done the crown, by the vigorous prosecution of those ministers who were deemed the chief instruments of the peace, was soon rewarded by the extraordinary promotions to the offices of first commissioner of the treasury, and chancellor and under treasurer of the exchequer.

Walpole.

In two years time he resigned all his offices on account of a misunderstanding which took place between him and the rest of the ministry about certain supplies demanded for the support of his majesty's German dominions. On the day of his resignation he brought in the famous sinking fund-bill, which he presented as a country-gentleman, saying, that he hoped it would not fare the worse for having two fathers; and that his successor Mr Stanhope would bring it to perfection. His calling himself the father of a project, which hath since been so often employed to other purposes than were at first declared, gave his enemies frequent opportunity for satire and ridicule; and it hath been sarcastically observed, that the father of this fund appeared in a very bad light when viewed in the capacity of a nurse. In the next session of parliament, Walpole opposed the ministry in every thing; and even Wyndham or Shippen did not exceed him in patriotism. Upon a motion in the house for continuing the army, he made a speech of above an hour long, and displayed the danger of a standing army in a free country, with all the powers of eloquence. Early in 1720 the rigour of the patriot began to soften, and the complaisance of the courtier to appear; and he was again appointed paymaster of the forces, and several of his friends were found soon after in the list of promotions. No doubt now remained of his entire conversion to court measures; for, before the end of the year, we find him pleading as strongly for the forces required by the war-office as he had before declaimed against them, even though at this time the same pretences for keeping them on foot did not exist.

It was not long before he acquired full ministerial power, being appointed first lord commissioner of the treasury, and chancellor of the exchequer; and, when the king went abroad in 1723, he was nominated one of the lords justices for the administration of government, and was sworn sole secretary of state. About this time he received another distinguished mark of the royal favour; his eldest son then on his travels being created a peer, by the title of baron Walpole of Walpole. In 1725 he was made knight of the Bath, and the year after knight of the Garter. The measures of his administration, during the long time he remained prime or rather sole minister, have been often canvassed with all the severity of critical inquiry. It is difficult to discern the truth through the exaggerations and misrepresentations of party. He has indeed been accused of employing the sinking fund for the purposes of corruption, of which it was long the fashion to call him the father; but the man who reflects on the transactions of Charles II. and his infamous cabal, will acquit him of the latter part of this charge. He was an enemy to war, and the friend of commerce; and because he did not resent some petty insults of the court of Spain so suddenly as the fiery part of the nation thought he should have done, a formidable opposition was formed against him in the house, which had influence enough to employ in its cause almost all the wit of the nation. Pulteney and Pitt were the great leaders of the party in the house of commons; while Bolingbroke and Pope and Johnson, and almost every man of genius, exerted themselves without doors to enlighten, by pamphlets in prose and verse, the minds of the people, and show the necessity of a Spanish war. This he strenuously opposed, because he knew that the foreign settlements of that power are very remote, and in a climate destructive to Englishmen: and that such of them as we might be able to take, we could not possibly retain. The opposition however prevailed. The nation was indulged in a war, of which it surely had no cause to boast of the success; and it is now universally known, that the greater part of those who with honest intentions had, either in parliament or out of it, been

engaged

Walpole.

engaged to run down the minister, lived to repent of their conduct, and do justice to the man whom they had so pertinaciously vilified.

In order to encourage commerce and improve the revenue, Sir Robert projected a scheme for an extension of the excise, as the only means of putting a stop to the frauds of merchants and illicit traders. This was another ground of clamour to the orators within, and the wits without, doors; and while the opposition represented it as a measure big with public mischief, Swift and Pope occasionally alluded to it as an oppression calculated to deprive private life of all its comforts. The minister was therefore obliged to abandon the scheme; but in a succeeding administration it was partly carried into execution, at the express solicitation of the principal persons concerned in that article of trade which it was suggested would be most affected by it; and afterwards the most popular minister that ever directed the councils of this country declared in full senate, that if a time should ever arrive which was likely to render the project feasible, he would himself recommend an extension of the excise laws as a measure of the greatest advantage to commerce, to the revenue, and to the general interests of the kingdom.

In 1742 the opposition prevailed; and Sir Robert being no longer able to carry a majority in the house of commons, resigned all his places, and fled for shelter behind the throne. He was soon afterwards created earl of Orford; and the king, in consideration of his long and faithful services, granted him a pension of 4000 l. *per annum*. The remainder of his life he spent in tranquillity and retirement, and died, 1745, in the 71st year of his age.

He has been severely, and not unjustly, censured for that system of corruption by which he almost avowed that he governed the nation; but the objects which he had in view are now acknowledged to have been in a high degree praiseworthy. Johnson, who in the earlier part of his life had joined the other wits in writing against his measures, afterwards honoured his memory for the placability of his temper, and for keeping this country in peace for so many years; and Mr Burke has lately * declared, that his only defect as a minister was the want of sufficient firmness to treat with contempt that popular clamour, which, by his yielding to it, hurried the nation into an expensive and unjust war. But his rancorous prosecution of Atterbury bishop of Rochester (see ATTERBURY), by a bill of pains and penalties, may be considered as something worse than a defect: it was a fault for which no apology can be made; because, whether that prelate was innocent or guilty, of his guilt no legal proof ever appeared. In that instance the conduct of the minister was the more extraordinary, that on other occasions he chose to gain over the disaffected by mildness and beneficence, even when he had sufficient proofs of their guilt. Of this the following anecdote, communicated by lord North to Dr Johnson, is a sufficient proof. Sir Robert having got into his hands some treasonable papers of his inveterate enemy Shippen, sent for him, and burnt them before his eyes. Some time afterwards, while Shippen was taking the oaths to the government in the house of commons, Sir Robert, who stood next to him, and knew his principles to be the same as ever, smiled; upon which Shippen, who had observed him, said "Egad, Robin, that's hardly fair."

* *Letters on a Regicide Peace.*

To whatever objections his ministerial conduct may be liable, in his private character he is universally allowed to have had amiable and benevolent qualities. That he was a tender parent, a kind master, a beneficent patron, a firm friend, an agreeable companion, are points that have been seldom disputed; and so calm and equal was his temper, that Pulteney, his great rival and opponent, said, he was sure that Sir Robert Walpole never felt the bitterest invectives against him for half an hour.

Wal || Wall, La

About the end of queen Anne's reign, and the beginning of George I.'s, he wrote the following pamphlets. 1. The Sovereign's Answer to the Gloucestershire Address. The Sovereign meant Charles duke of Somerset, so nicknamed by the Whigs. 2. Answer to the Representation of the House of Lords on the State of the Navy, 1709. 3. The Debts of the Nation stated and considered, in four Papers, 1710. 4. The Thirty-five Millions accounted for, 1710. 5. A Letter from a foreign Minister in England to Monsieur Pettecum, 1710. 6. Four Letters to a Friend in Scotland upon Sacheverell's Trial; falsely attributed in the General Dictionary to Mr Maynwaring. 7. A short History of the Parliament. It is an account of the last Session of the queen. 8. The South-Sea Scheme considered. 9. A Pamphlet against the Peerage Bill, 1719. 10. The Report of the Secret Committee, June 9th, 1715.

WALRUS, in zoology. See TRICHECUS.

WALSH (William), an English critic and poet, the son of Joseph Walsh, Esq; of Abberley in Worcestershire, was born about the year 1660. He became a gentleman-commoner of Wadham college, Oxford, but left the university without taking a degree. His writings are printed among the works of the Minor Poets, printed in 1749. He was made gentleman of the horse in queen Anne's reign; and died in 1708. He was the friend of Mr Dryden and of Mr Pope; the former of whom esteemed him the best critic then living; and Mr Pope has celebrated his character in the Essay on Criticism.

WALSINGHAM, a town of Norfolk, with a market on Fridays, and a fair on Whit-Monday, for horses and pedlar's ware. It is seated not far from the sea; and in former times was famous for its college of canons, and was greatly frequented by pilgrims who went to pay their devotions to the image of the Virgin Mary at the chapel, where there are two fine springs, called the *Virgin Mary's wells*. Not many years ago there were found here 100 urns full of ashes by a husbandman, which were supposed to be those which the Romans filled with the ashes of the dead. It is 22 miles north-west of Norwich, and 117 north-north-east of London. E. Long. 0. 53. N. Lat. 52. 56.

WALSINGHAM (Thomas), an English Benedictine monk of the monastery of St Alban's, about the year 1440. He applied himself to the history and antiquity of his country, in quality of historiographer to the king; and composed the History of King Henry VI. with other works.

WALSINGHAM (Sir Francis), minister and secretary of state during the reign of queen Elizabeth, and one of the greatest politicians of his time, was descended from a noble and ancient family at Chislehurst. After having made great progress in his studies at Cambridge, he was twice sent ambassador to France, and at his return to England was employed in the most important affairs; became secretary of state, and was one of the commissioners for the trial of Mary queen of Scotland. Sir Francis was undoubtedly one of the most refined politicians and most penetrating statesman that any age ever produced. He had an admirable talent, both in discovering and managing the secret recesses of the heart. He had his spies in most courts in Christendom, and allowed them a liberal maintenance; for it was his maxim, That knowledge cannot be bought too dear. In 1587 the king of Spain having made vast preparations, which surprised, and kept all Europe in suspence, Walsingham employed his utmost endeavours for the discovery of that important secret; and accordingly procured intelligence from Madrid, that the king

Walsingham, Waltheria.

king had informed his council of his having dispatched an express to Rome, with a letter written with his own hand to the pope, acquainting him with the true design of his preparations, and begging his blessings upon him; which for some reasons he could not disclose till the return of the courier. The secret being thus lodged with the pope, Walsingham, by means of a Venetian priest, whom he retained at Rome as a spy, got a copy of the original letter, which was stolen out of the pope's cabinet by a gentleman of the bed-chamber, who took the key out of the pope's pocket while he slept. After this, by his dexterous management, he caused the Spaniards bills to be protested at Genoa, which should have supplied them with money for their extraordinary preparations; and by this means he happily retarded this formidable invasion for a whole year. In short, he spent his whole time and faculties in the service of queen Elizabeth; on which account her majesty was heard to say, "That in diligence and sagacity he exceeded her expectations." However, after all his eminent services to his country, this great man gave a remarkable proof at his death, which happened on the 6th of April 1590, how far he preferred the public interest to his own, he being so poor, that excepting his library, which was a very fine one, he had scarcely effects enough to defray the expence of his funeral. His principal works are, 1. Memoirs and Instructions for the use of Ambassadors, with his Letters and Negociations. 2. Political Memoirs.

WALTHERIA, in botany; a genus of plants in the class *monodelphia*, and order *triandria*; and in the natural system arranged under the 37th order, *Columniferæ*. There is only one pistillum, and the capsule is unilocular, bivalved, and monospermous. There are three species, none of which are natives of Britain.

Walton, Wapentake.

WALTON (Bryan), bishop of Chester, a learned English divine, who gained great reputation by his edition of the Polyglot bible, with his Prolegomena in the beginning; which is more exact, says Father Simon, than any other which had been published on that subject. He died in 1661.

WAMPUM, the money used by the North American Indians. It is much used in all their treaties as a symbol of friendship. It is made of a shell of a particular species of Venus.

WAPENTAKE, is all one with what we call a *hundred*; especially used in the north countries beyond the river Trent. The word seems to be of Danish original, and to be so called for this reason: When first this kingdom, or part thereof, was divided into wapentakes, he who was the chief of the wapentake or hundred, and whom we now call a *high constable*, as soon as he entered upon his office, appeared in a field on a certain day on horseback with a pike in his hand, and all the chief men of the hundred met him there with their lances, and touched his pike; which was a sign that they were firmly united to each other by the touching their weapons. But Sir Thomas Smith says, that anciently musters were made of the armour and weapons of the several inhabitants of every wapentake; and from those that could not find sufficient pledges for their good abearing, their weapons were taken away and given to others; from whence he derives the word.

W A R.

WAR is a great evil; but it is inevitable, and oftentimes necessary. If he who first reduced to rules the art of destroying his fellow-creatures, had no end in view but to gratify the passions of princes, he was a monster, whom it would have been a duty to smother at his birth: but if his intention was the defence of persecuted virtue, or the punishment of successful wickedness, to curb ambition, or to oppose the unjust claims of superior power, mankind ought to erect altars to his memory.

War, in the last case, is the most necessary and useful of all the sciences: the various kinds of knowledge which ought to furnish the mind of a soldier are not without great difficulty to be attained. Of most other sciences the principles are fixed, or at least they may be ascertained by the assistance of experience; there needs nothing but diligence to learn them, or a particular turn of mind to practise them. Philosophy, mathematics, architecture, and many others, are all founded upon invariable combinations. Every man, even of a narrow understanding, may remember rules, apply them properly, and sometimes draw just consequences from them: but the science of war branches out into so many particulars; it takes in so many different parts; there are so many reflections necessary to be made, so many circumstances and cases to be brought together; that it is only by a continual application, grounded upon the love of his duty, and an inclination to his profession, that any man can attain it.

To march an army in every sort of country, whether open, woody, or mountainous; to know how to form a camp in all those countries, with which the general must be thoroughly acquainted in order to do it with security; to make a proper disposition for a battle, whether with a view to the posture of the enemy, or to the situation of the country; to foresee events which depend in a manner upon chance; to be capable of making a good retreat on proper occasions; to direct the forages without fatiguing or exposing the troops; to send out detachments with precaution; to conduct the convoys in safety; to know how to canton an army; to establish magazines in places, both safe and within reach of the army, so that it shall never be in want of subsistence — these are the great ends of the military science.

It is commonly thought sufficient for a military man to know how to obey; and it is also supposed that the success of a day cannot be dubious, if a general joins the confidence of the soldiers to personal courage, a cool head, and a knowledge of the country.

It is true that, in cases of perplexity, many generals have in a great measure owed to their own capacity, and the confidence their soldiers have reposed in them, the advantages they have gained over the enemy; and confidence will always be reposed by the soldiers in that general in whom they perceive conduct united with courage. At the battle of Cannæ, when Gisco seemed to be astonished at the superiority of the enemy's number, Hannibal answered him cooly, "There is, Gisco, a thing still more surprising, of which you take no notice." Gisco asking him what it was, "It is (replied Hannibal) that in all that great crowd there is not one man whose name is Gisco." Plutarch observes, that this coolness of Hannibal greatly animated the Carthaginians, who could not imagine that their general would joke at so important a time, without being certain of overcoming his enemies.

Although bravery and courage are the most essential qualifications of a subordinate officer, yet he should not be deficient in those which are requisite in a general, and which have been already mentioned; obedience to the orders

1 [illegible]

livered to him is no longer a virtue than whilſt he comprehends and knows the intention of them. War, ſays a celebrated author, is a buſineſs which, like all others, muſt be learned; it ſuppoſes ſome qualities to be born with us, and demands others which are to be acquired: but ſince all theſe qualities muſt have the original ſource in genius, a man who propoſes war for his profeſſion, ſhould never engage in it without having conſulted his natural bent, or without knowing the particular turn and power of his mind. Ability, whether in a general or an officer, is the effect of his genius, quickened by a natural liking to his buſineſs.

A quick eye, which is of great importance to a ſoldier, is natural to ſome, and in them it is the effect of genius; others acquire it by ſtudy or experience; he who knows how to command himſelf, and has courage enough to keep himſelf cool on the moſt urgent occaſions, has the readieſt and quickeſt eye. A quick, hot-headed man, however brave, ſees nothing; or if he does, it is confuſedly, and generally too late.

It is this quick eye which enables a general to judge of an advantageous poſt, of a manœuvre to be made, and of a good diſpoſition for the troops, whether with reſpect to that of the enemy, or to the ſituation and nature of the country.

The quick eye is no other than that penetrating genius which lets nothing eſcape it. A general who knows how to unite this quality with perpetual coolneſs, never is in want of expedients; he will ſee how thoſe events, which to any other would be the preſage of his own defeat, may end in the overthrow of his enemies.

The choice of the general officers depends upon this genius, which diſcovers every thing; they ought to be the right-hand of the general, and as capable of commanding the army as himſelf. Whatever good diſpoſitions a general may make, they muſt prove ineffectual if not ſeconded by the general officers under his command; he cannot be everywhere, neither can he forſee all exigencies that may ariſe. He is obliged to give only general orders; it is therefore the buſineſs of thoſe who command under him to know how to take the advantage of a wrong movement of the enemy; to take upon them to attack, or ſuſtain the troops which are engaged; and, as circumſtances vary, to make them advance towards the enemy, either to keep him back or to attack him.

But the qualities already mentioned would be uſeleſs, if order and diſcipline were not ſeverely obſerved: the moſt numerous and beſt compoſed army would ſoon become little elſe than a body of rangers, who being only united by the hope of booty, would ſeparate as ſoon as that motive ceaſed; and truſting each to his own head, or indulging his own humour, would be cut in pieces party by party: ſo that if the general does not keep up ſubordination (the ſoul and ſtrength of diſcipline), his army will be nothing more than a troop of Tartars acting more from the hope of plunder than the deſire of glory. What art and what genius is there not requiſite to maintain this ſubordination? Too much ſeverity diſguſts the ſoldier, and renders him mutinous; too much indulgence ſinks him into indolence, and makes him neglect his duty; licentiouſneſs cauſes that ſubordination to ſeem burdenſome, which ſhould never in any degree be given up: he loſes that reſpect, and often that confidence, which he ſhould have with regard to his officer; and indulgence often makes a well-diſciplined body become a ſet of ſluggards, who march againſt their will, and who, on the moſt preſſing emergencies, think only on their own ſafety.

Beſides theſe qualities, which are eſſential to a general, and which all who would attain that rank ought of courſe to have, there are ſtill many others neceſſary to make a great man. A general who would merit the title of a hero, ought to unite in himſelf all civil, military, and political excellence. It is by this that he will eaſily attain to make war with ſucceſs: nothing will eſcape him; he will know without difficulty the genius of every country, and of the nations which compoſe the enemy's army, the abilities of the generals who command, and the nature of the troops under them; he knows that he may venture a motion with ſome troops that he would not dare to attempt with others that are equally brave. One nation is vehement, fiery, and formidable in the firſt onſet; another is not ſo haſty, but of more perſeverance: with the former, a ſingle inſtant determines ſucceſs; with the latter, the action is not ſo rapid, but the event is leſs doubtful.

No man is born a general, although he brings into the world with him the ſeeds of thoſe virtues which makes a great man: Cæſar, Spinola, Turenne, the great Conde, and ſome others, ſhowed, even in their earlieſt years, ſuch qualities as ranked them above other men; they carried within them the principles of thoſe great virtues which they drew forth to action by profound ſtudy, and which they brought to perfection by the help of practice: thoſe who came after them, with perhaps fewer natural talents, have by ſtudy rendered themſelves worthy of being compared to them. Cæſar and all conquerors had this advantage, that they were able to make their own opportunities, and always acted by their own choice. A man may be a good general without being a Marlborough or a Turenne: ſuch geniuſes are ſcarcely ſeen once in an age; but the more they are raiſed above the reſt of mankind, the more they ought to excite emulation. It is by endeavouring to ſurpaſs the intellects of the ſecond rate; it is by ſtriving to equal the moſt ſublime, that the imitation of them is to be attained. This paſſion in a ſoldier is neither pride nor preſumption; it is virtue: and it is by this only that he can hope to be ſerviceable to the ſtate, and add to the glory of his king and country.

How much ſoever the honour of commanding armies may be ſought after, it degrades him who is not worthy of it; this rank, ſo much deſired, borders on the two extremes of glory and ignominy. A military man who labours to make himſelf capable of commanding, is not to be blamed; his ambition is noble: by ſtudying the art of commanding, he learns that of obeying and of executing. But it is aſtoniſhing in the higheſt degree to ſee ſoldiers thinking only on preferment, and neglecting the ſtudy of their buſineſs. It is perhaps leſs ſurpriſing if we ſee others, without having been tried, propoſing to themſelves to command in chief; becauſe ſuch attempts ſuppoſe in the projector an abſurd temerity, founded on a profound ignorance of the talents he ought to have, and the virtues which he has not. Such boldneſs is the character of a man whoſe mind is too narrow to perceive his danger: We ſhould rather approve the timidity that ſuffers itſelf to be dejected by terror, ſince it ſhows at leaſt that he knows to what hazards he is expoſed; both one and the other are blameable: modeſty is the only proper quality of a ſoldier; it gives ſplendour to virtue, it argues diffidence of himſelf, and deſire of arriving at perfection.

The title of general would be leſs tempting, if proper attention was paid to the qualities it requires, and the duties it impoſes; it would then appear a very honourable, but painful burden. The moſt firm and intrepid genius might be diſcouraged, merely by thinking that on the conduct of a general depends the fate of the ſtate, the glory of his prince's arms, and his own reputation.

But yet the reward that follows such irksome labours ought to animate men to undertake them. Obstacles, however numerous they may be, are not insurmountable, since so many great men have got the better of them: difficulties should stir up a soldier's emulation, but should never terrify him; he should endeavour to copy such great originals, though he should not be able to equal them.

This treatise is divided into four parts.

In the first are mentioned all the greater operations of a campaign; and the means of executing those operations, in any kind of country, are endeavoured to be laid down.

In the second, the precautions that are to be taken to attack the enemy in all the forementioned operations, are considered.

The third treats of the *Petite Guerre*, or the operations of detached parties, and the war of posts.

The fourth, of sieges, both with regard to attack and defence.

Part I. Of the GREATER OPERATIONS in DEFENSIVE WAR.

Sect. I. *Of the Knowledge of a Country.*

A Campaign of which the plan is well formed, and the dispositions well concerted, may nevertheless prove unsuccessful, if the general, to whose direction the operations are intrusted, hath not a thorough knowledge of the country in which they are to be carried into execution.

There is one knowledge of a country, which for an officer to be without should be considered as a reproach; that of the situation of cities, towns, villages, forests, streams, rivers, which is to be acquired by studying of geographical maps. There is another branch of knowledge yet more particular, such as, of the passes, or the boundaries of the country, the situation, the nature of the ground, whether it is plain, or divided by hollows, rivulets, hills, &c. which is to be acquired by the assistance of topographical maps. In the study of these last, care must be taken, not blindly to follow the marks they lay down. It very seldom happens, that topographical maps are perfectly exact: for, besides the many circumstances which may sometimes in a year alter a large extent of country, they seldom take notice of fords, bridges over the small rivulets, small hills, and hollows of little importance; neither can they mark whatever may be occasioned by recent inundations and disruptions of the earth, whereas any of these unforeseen circumstances may prove an obstruction to a great design, either by retarding the march of an army, preventing a column of troops from advancing, or leaving the enemy in possession of some passes from which he might have been driven.

In order to avoid the errors into which a general may be drawn by the maps, the safest method is to apply to the inhabitants of the country, go over it with the most intelligent of them, and remark every obstacle, however trifling it may appear.

For marching with greater security, a general ought to form a company of guides of the peasants, be assured of their fidelity, and attach them to him by all possible methods, particularly by unbounded liberality. It is by money only that trusty spies and faithful guides can be secured; the latter are less expensive, but full as necessary as the former. Parsimony should be avoided in war; for, as Vigetius observes, money should never be spared when expence is necessary to secure possession. In proportion as an army advances into a country, great care must be taken to change the guides.

The general should send out detachments along with some of these guides to examine the streams which cross the country, whether or no their mouths are at a distance, into what river they empty themselves, from whence they take their source, whether they may be easily forded, if their banks are steep or sloping, marshy or covered with bushes; other detachments should be employed in examining the woods, in order to find out whether troops can pass through them or not.

A general ought himself to examine into the truth of the reports made to him by these small detachments, or send out others more considerable under the command of general officers: however certain a general may be of the fidelity of his spies and guides, yet he should not always rely upon their reports: mistrust, which in general is accounted a vice, may almost be esteemed a virtue in the business of war.

Furnished with these lights, a general can allot the easiest road to the artillery and baggage, the shortest to the infantry, and longest to the cavalry: he can at once judge, from the nature of the ground, into how many columns the army can be divided in order to expedite the march, and what dispositions will be necessary for the columns with regard to the enemy's position.

By the knowledge of the country, a general is informed of what camps the enemy doth or can occupy, and of those necessary to be taken to oppose his designs; whether the enemy's detachments can easily approach, or how he can himself advance towards him, without being discovered; if there is forage in the neighbourhood of the enemy's camp, or whether he is obliged to draw it from a distance; where he hath fixed his magazines, and whether an attempt to carry them off is practicable or not; in what manner his quarters are disposed, and which of them is most exposed; what distance there is between himself and the enemy; where the enemy hath established posts, and which those are that himself ought to occupy with regard to the situation of his own camp and quarters, and those belonging to the enemy; which is the properest road for the detachments and the patrols to keep, in order to gain intelligence; and lastly, with what degree of ease the enemy can attack the army on its march, and whether in front or flank. This knowledge is essential to a general in every kind of country; but in a woody or mountainous country it would become more particularly dangerous, and even impossible for him to march an army, if unacquainted with it.

In 1702, the duke of Burgundy, being desirous to attack the enemy who were behind Cleves, but not being perfectly acquainted with the forest in his front, he detached the marquis d'Alegre with 500 grenadiers, and 800 horse, to see if it was not possible to find some passage thro' it. M. d'Alegre met with a defile which was occupied by the enemy: he attacked and forced it; but being advanced beyond it, found it was not posible to proceed farther, by reason of the great number of defiles that succeeded to each other: he thereupon turned back, sent, and had another passage surveyed, where there were found still greater obstacles. He gave an account of this to the duke of Burgundy, who, not choosing to miss the opportunity of attacking the enemy, sent him out again with a larger detachment, that he might examine whether, by keeping along the side of the forest, it would not be practicable for him to march up to them by way of the heaths of Mock, on the

Defensive Operations.

the side of Grave and Nimeguen. The marquis d'Alegre discovered a defile which led to these heaths: he took possession of it, and sent notice thereof to the duke of Burgundy; who ordered the army to advance, obliged the enemy to send their infantry into Nimeguen, and cannonaded their cavalry which had taken post on the glacis, but were unable to maintain it; and the consequence was, that the enemy sustained a great loss in men, artillery, waggons, and baggage.

This example tends to prove, that maps are not always to be relied on. There can be no reason to doubt that the duke of Burgundy was furnished with the most exact: but yet it is probable that he might not have succeeded in this enterprise, if he had neglected sending M. d'Alegre to survey the passes, and examine two, before he proceeded to that through which he marched.

The following is a general rule: That it is upon the ground, and not upon maps, that the roads through which an army is to march must be examined, as well as the situation of places where camps are to be fixed, and fields of battle chosen. An army should never move before ways are opened for every column: with regard to a detachment it is different, as there may arise circumstances which will prevent the general from foreseeing what road it may take. The command of a detachment should always be given to an intelligent officer, and one who has made his business his only study; who hath been particularly careful to acquire a knowledge of the country, and of whose genius the general should entertain no doubt. A particular choice stirs up emulation in young men, and induces them to exert their utmost endeavours to deserve so distinguishing a mark of approbation.

Into how many mistakes have even the greatest generals fallen, by not being thoroughly acquainted with a country, and by suffering themselves to be guided by general notions? M. de Feuquieres cites many examples of great enterprises which have miscarried by it.

Toward the end of the year 1673, when a considerable body of infantry, with only few cavalry, was on its return from Holland, under the conduct of M. de Luxemburg, the prince of Orange having assembled the whole force of the Dutch and the Spaniards (under his command), came upon the Maese, with an intention to fight M. de Luxemburg between Maestricht and Charleroy. This march made it necessary for the court to send an order to M. de Schomberg to assemble all the cavalry that were in Hainault and Flanders, and immediately join M. de Luxemburg, who was greatly inferior to the prince of Orange in cavalry. The prince's aim then should have been to prevent the two generals from joining, and to have fought one or other of them before their junction. The prince's being unacquainted with the country, made him mistake for real the feints made by M. de Luxemburg, whilst he was upon the river Ourte; as if his intention was to march by way of the Condros and the Ardennes, in order to gain Sedan and the Mezuris. The prince of Orange drew near Huy and Namur; and by that means was at such a distance from the high-road, that M. de Schomberg had an opportunity of advancing with his cavalry to Tongres; at the same time that M. de Luxemburg, by a forced march, passed the Maese at Maestricht, and arrived at Tongres, where the junction of the two armies was effected without any accident.

If the prince of Orange had made only two reflections upon the nature of the country, he would have avoided the mistake he fell into; the first of which is, that scarcely any body can be ignorant that the Condros and the Ardennes are sterile and mountainous countries; from whence it is evident, that M. de Luxemburg could not have subsisted his army, especially in the month of December: the roads in those parts, very bad in the summer, are almost impassable during the winter; consequently the carriages could not have passed but with the utmost difficulty.

The second reflection is, that if M. de Luxemburg had actually designed to pass through the Ardennes, why did M. de Schomberg advance towards Tongres, and so expose himself to the danger of being beaten, without a possibility of receiving help from M. de Luxemburg, who was on the other side of the Maese? If the prince of Orange had had a thorough knowledge of the country through which M. de Luxemburg pretended he would pass, he would soon have perceived that it was only to throw him into a perplexing uncertainty with regard to the road which the enemy's general should naturally take: in a word, he would not have remained a moment in doubt on the part he had to act.

By this, then, it appears, that the prince ought to have continued on the side of Liege; by which position he would have stopped M. de Schomberg, who would have scarcely dared to advance to Tongres, nor would M. de Luxemburg have attempted the passage of the Maese at Maestricht: by this means, the junction would have been prevented; or, if either of the two armies had advanced, the prince could have attacked and beaten it; neither would it have been in the power of the other to have assisted it.

It hath frequently happened, and will continue to do so, that a general who knows how to take advantage of the knowledge of the country, although inferior in point of force, may change a defensive into an offensive war. In 1671, M. de Créqui, who began the campaign on the defensive, ended it with obliging the duke of Lorrain to pass the Rhine: that prince dispersed his army, and then M. de Créqui formed the siege of Fribourg.

The knowledge of a country is still more essential in retreats: there is more art and more precaution required in a retreat than in any other action; that operation is the conclusion of all preceding ones. If a general, obliged to retreat precipitately, hath but a superficial knowledge of the country, how will he be able to re-assemble his troops, re-establish order, or march with any degree of security?

Xenophon's retreat with the ten thousand Greeks is one of the most useful lessons a commander can study: in that undertaking were united the virtues of a consummate general, and the most intrepid courage of a soldier; and in particular it exhibits the most profound knowledge of the country.

The knowledge of a country is as necessary for a private officer as for the commander in chief, because he is to execute with part what the general performs with all the troops. When an officer, to whose conduct an expedition is intrusted, joins this knowledge, one of the chief branches of military science, to practice and experience, he will with so much the greater ease comprehend and execute the general's intention and plan; and he will be also enabled to take the properest measures for success: if, on the contrary, he begins a march, without being acquainted with the country, his mind misgiving him, will increase the danger, by the very means he takes to avoid it: he will suppose it in places where there is nothing to be feared, and often fall into it where he was least apprehensive of it.

The general who commands in the cantonments and winter-quarters, and each officer who commands a particular quarter, will never be able to take proper measures if they are unacquainted with the country: they will be unable to preserve a proper strength when separated, or to assemble without difficulty on the first order; and for want of knowing

ing the pofts which it is proper to guard, they will occupy fuch as are unneceffary, and leave thofe defencelefs that are moft liable to be attacked; the troops will be greatly fatigued by increafing the number of pofts without occafion, by fuperfluous or too numerous detachments or patroles. In a word, whatever precautions are taken within, the quarters will never be in fecurity, if the country round about them is not perfectly known, and every important pafs between them and the enemy occupied.

SECT. II. *Of the Preparations before taking the Field, and the March of an Army on leaving its Quarters to go into Cantonments.*

THE time for an army to come out of winter-quarters, is always regulated by the plan which the general has formed for the enfuing campaign. But whether by the fituation of the quarters the army is enabled to enter immediately on the campaign, or whether it muft be firft of all cantoned, the magazines fhould be fo fituated as to be always within reach, efpecially in that early feafon of the year, when there can be no forage upon the ground, and confequently the cavalry muft be fubfifted out of the magazines. The magazines ought to be diftributed about in different parts, that the troops may have lefs way to go for their forage. And this diftribution fhould be regulated by the movements which the general forefees the army will make on leaving its quarters, fuppofing it leaves them when there is only dry forage; but if the army is in an enemy's country, and there is forage upon the ground, it is certainly better to referve the magazines entire, by which not only great trouble will be avoided in tranfporting the forage, but alfo a great expence faved to the government.

Of what nature foever the country may be (an enemy's country is fuppofed), it fhould be foraged in front as much as poffible, in order to referve that which is in the rear, that, when the campaign is over, it may be found laid up in the barns: if this precaution is not attended to, the army will be deftitute of forage at its return, and will of courfe be obliged to draw it from home, and confume thofe magazines which were before fpared; confequently there will be nothing faved, the expence will only have been deferred, but it will be increafed by tranfporting the forage from the magazines to the army.

The forming of the magazines fhould never be delayed till the time for opening the campaign approaches. The intendant, purfuant to the general's order fhould lay in the provifions during the winter, and diftribute them in the frontier towns, by which means they can eafily be tranfported to whatever place the general fhall order. By thefe precautions, the general will not only avoid the inconvenience of being obliged to wait till there is forage upon the ground, but he will alfo be enabled to be firft in the field. The fame precautions fhould alfo be taken with refpect to the artillery. It fhould be affembled upon the glacis of the frontier towns, or rather upon that of the conquered places: the more it is within reach or readily joined, the fooner the operations will be commenced.

From prudence in the execution of thefe difpofitions, as well for the magazines and for the artillery, as for every thing that is neceffary to an army, it follows, that a general hath often formed a fiege, or at leaft invefted a place, and completed his lines of circumvallation, before the enemy could be in a condition of coming out of his quarters: he may likewife have made many marches, and will poffefs himfelf of advantageous pofts, without the enemy having it in his power to oppofe him.

A general fhould obferve, that, in order to caufe his army to be cantoned within a march of the country where he defigns to commence the operations, he muft make all the troops leave their quarters together; affemble them in many bodies in different frontier towns; proportion the marching days to the diftance of the quarters and the rendezvous that fhall have been appointed for them, that they may arrive on the day appointed, and that from thence they may march in a body to the place where they are to canton.

All the bodies march, either in the number of columns that the fituation of the country will allow, and arrive at the cantonment together; or elfe they march feparately, and arrive on different days: but, in either of thefe cafes, the cantonments for each regiment ought to have been marked out; and, if poffible, forage for at leaft three or four days diftributed to each quarter.

In the marching-orders which are fent to each commander, the fituation and name of the place where each regiment is to canton, fhould be carefully expreffed; whether on the right, the left, or in the centre: the difcipline to be there obferved, the place where to go and receive orders, and that where to receive forage, fhould alfo be particularly fpecified.

Troops, when upon a march, fhould always obferve the moft exact difcipline; and never be fuffered to advance, but in the fame order, and with the fame precaution, as if they were in danger of being molefted or attacked.

Whenever an army is cantoned, it is generally in an enemy's country; therefore, for the greater fecurity of the cantonments, there fhould at leaft be one place that may ferve for a fupport. If no place of this fort can be found, the army muft then march out together and encamp, inftead of going into cantonments.

As the cantonments are properly nothing more than a halting place, where the troops are to remain till the feafon permits them to take the field, till the proper quantity of forage is collected, or till the neceffary preparations for the intended operations are completed, they fhould be more connected than the winter-quarters. But as foon as the weather permits, and all the neceffary preparations which fhould have been forwarded during the winter are finifhed, there is then no time to be loft; for an army will always find its advantage in encamping early, getting the ftart of the enemy as much as it poffibly can, and beginning the campaign, no matter by what operations, before the enemy can have time to affemble.

If any particular column, upon the march, prefents its flank to any of the enemy's towns, although it is indifpenfably neceffary for every column to obferve all poffible order and difcipline on the march, yet this column is more particularly obliged to it; neceffity makes it become a duty. But that it fhould not be too much expofed, fome huffars ought to be appointed to march upon its flank, who fhould alfo be ordered to advance till they come within fight of thofe towns. This column, whether confifting of infantry or cavalry, muft detach fome troops to fuftain the huffars, in cafe they fhould be attacked and repulfed. By pofting thefe detachments upon the flank, the enemy will be kept at a diftance from the column, and the huffars will be alfo fuftained.

SECT. III. *The March of an Army in an open Country.*

TO direct the march of armies is not the leaft difficult part of a general's duty, and it is only by a thorough knowledge of the country that he can perform this duty; that he can concert the meafures for conducting them in fafety;

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safety; and that he will be enabled to forefee the enemy's motions.

There are but three forts of countries which may become the theatre of war; an open country divided by rivers, a woody, or a mountainous one.

When an army is in an open country, the general may take whatever road he thinks moft convenient, without being under a neceffity of keeping the beaten road. If he chooses to march acrofs the country, it may be done by cutting down the hedges, filling up the ditches, levelling the ridges, filling up the hollow ways, thereby rendering their afcent or defcent eafy, and by building bridges over the ftreams and rivulets which divide the country. But neverthelefs it is very imprudent for a general to fuppofe himfelf entirely free from danger upon a march; for the confequences of felf-fecurity are generally fatal. The effects of negligence in any military operation are pernicious, but more particularly fo upon a march; and although a general fhould never fear his enemy when in prefence of him, he fhould neverthelefs always apprehend the worft from him when he is out of his fight.

The number of columns in which an army can march in an open country is arbitrary, whilft it is advancing, and the enemy at too great a diftance to attack or annoy it upon its march. But if, on the contrary, the enemy is near at hand, and there is a poffibility of his attacking the army, it fhould then be difpofed after fuch a manner as to form in order of battle in a very fhort time, and to be able to take a favourable pofition for action upon the firft fignal.

If the army prefents its flank to the enemy, the difpofitions, without confidering the probability of its being attacked, fhould be changed; for an army upon a march ought to be always prepared againft any accident that may happen.

A general fhould never caufe an army to move without having previoufly confidered and examined the intended march of it, nor without a thorough knowledge of the enemy's pofition, and where he is, or without knowing particularly the ground intended to encamp on. An army ought never to move but with fome defign, either to feize on fome advantageous poft, to prevent an intended march of the enemy's, to draw him into a difadvantageous fituation, to deprive him of fubfiftence, or to procure fome for itfelf.

This maxim being eftablifhed, let it be fuppofed, that a general would caufe his army to march, and the enemy's diftance to be alfo fuch as to fecure him from any danger of attacks; he hath it in his power to open four, fix, or eight roads, in proportion to the number of the troops under his command: for the greater the number of columns, the lefs is the body of troops contained in each; confequently there will be lefs confufion, and the fooner will the army arrive at its deftined camp.

Before the march is planned, and the number of columns determined upon in which the army is to march, notwithftanding the general is acquainted with the country, he fhould fend out a detachment fome days before, to reconnoitre the intended route of the army, as well as the camp it is to occupy. This detachment is to be commanded by the officers of the day appointed for its fetting out: they muft have ftaff-officers and guides with them, to conduct and to inform them of the nature of whatever may prove an obftacle, of the places where the roads begin, and thofe where they terminate: they fhould alfo have labourers with them, to mend the ways, enlarge the roads, and make new ones, if neceffary; to cut down the hedges, fill up the ditches, level the ridges of the hollows, and build or repair bridges.

When the general commanding this detachment is ready to enter the different ways through which the army is to follow, he will divide his detachment into as many feparate bodies as the army is to be divided into upon its march; and diftribute ftaff-officers, guides, and labourers, to each detachment, with orders to meet again at the fame place from whence they feparated.

Each of thefe detachments fhould advance to the extremities of the woods, if they meet with any, and of the roads leading to the camp, intended to be occupied: the commanding and ftaff officers will then advance with an efcort to reconnoitre its fituation, and will leave part of their men in ambufcade in the woods, or concealed behind fome heights, or in fome hollows. The knowledge of the fituation of the camp being attained, each detachment will return by the road it came; but firft, the commanding officer of each detachment will make a report to the general of the roads they have paffed, what difcoveries they have made, and, in fhort, will give him a particular detail of every thing they have met with on their way, whether woods, villages, hollows, bridges, and of every thing they have done to render the road eafy for the column that is to pafs through it. This detachment being affembled at the place appointed for meeting, will take the road to the camp, where being arrived, the lieutenant-general will make his report to the commander in chief of the army.

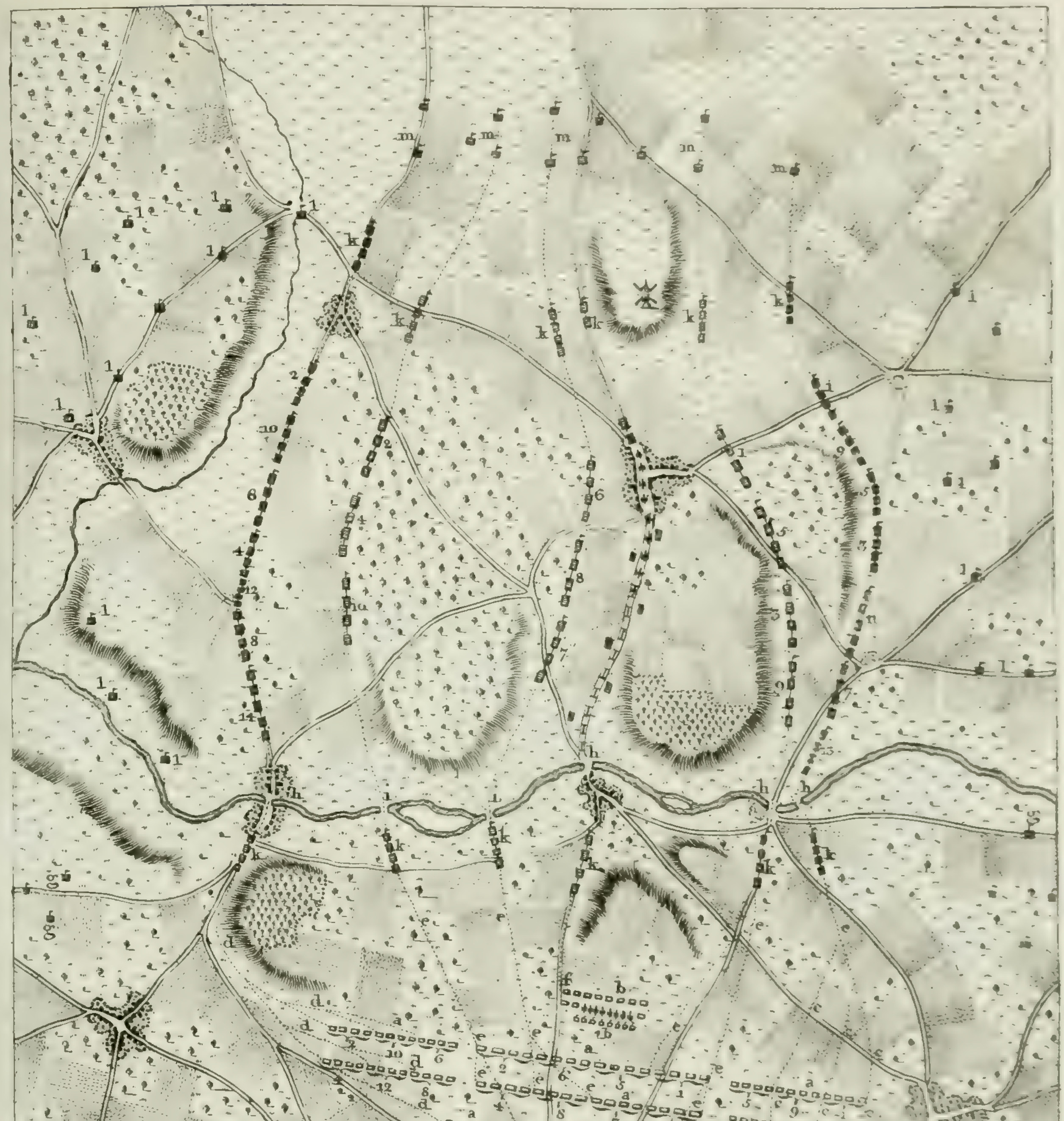
With thefe precautions the army may not only advance in fafety, but the roads alfo for every column having been reconnoitred and repaired, no accident can happen to retard the march of the army.

The general muft take care to have detachments of huffars or dragoons always in the front and upon the flanks, to obferve and clear the march of the army; neither fhould a general fuppofe himfelf to be in abfolute fecurity from the diftance of the enemy: but whilft he fees all clear before him, it would fhow great weaknefs for him to be apprehenfive of a furprife, efpecially when every neceffary precaution for avoiding it hath been taken. It is certainly a mark of prudence to take precautions; but multiplying them without caufe is an undoubted fign of fear and anxiety.

It is proper to make the army march, as near as poffible, in the fame order in which it is to encamp; by which means the troops may enter the camp without confufion. The army being fuppofed to march in fix columns, the infantry will form three, the artillery and baggage the fourth; the cavalry, with the remainder of the corps of huffars that are not detached, and the dragoons, the two laft upon the flanks; fo that the army, on its march, will be in the following difpofition: The column upon the right will confift of cavalry, the one adjoining to it of infantry, and that which comes next will be formed by the artillery and baggage; then two columns of infantry, and the fixth clofing the left, will be compofed of cavalry. It is to be obferved, that, if the baggage-waggons belonging to the army form too long a row, fome of them may be fent into the rear of the columns of infantry, with exprefs orders to the officers to make them march in the column.

There fhould be an advanced and a rear guard to each column, formed from the troops of which the column is compofed; there fhould be alfo detachments of light horfe upon the flanks of the cavalry, in order to keep off any of the enemy's parties that might advance to annoy the army upon its march. The rear-guard to the column of baggage fhould confift of infantry, cavalry, or dragoons, befides the efcort always appointed for it. The general officers who are at the head of the two columns of cavalry fhould not march too faft, left they fhould get too far advanced before the infantry; a matter always to be avoided. The march of

Plan of the March of an Army in Six Columns.



Scale of ½ a League.

The March of an Army through a Mountainous Country.

A. Bell Prin. Mal. Sculpsit.

Defensive operations.

of an army being difpofed after this manner, every column will enter the camp at the fame time, and find itfelf oppofite to its ground. See Plate DXIV, where *a* is the army formed in order of battle, ready to march. *b*, The park of artillery, where the baggage belonging to the army, and their efcorts, alfo are affembled. *c*, March of the cavalry, to form the column on the right. *d*, March of the cavalry, to form the column on the left. *e*, March of the infantry, to form in three columns. *f*, March of the artillery and baggage, to form in a column. *g*, Parties of huffars, covering the flanks of the army, and forming the rear-guards of the column, when the army hath paffed. *h*, Bridges and fords, difcovered by the advanced detachments, who have marked the route of the army, *i*, Bridges built by the fame detachments. *k*, Front and rear guards of the columns drawn from the troops of which the columns are formed. *l*, Parties of huffars, marching upon the flanks of the army. *m*, Parties of huffars marching at the head of the army, to fcour the country through which the army is to pafs, and alfo to examine the routes marked by the advanced detachments.

If, by the enemy's pofition, although at a diftance, the army fhould, on its march, prefent a flank to the enemy, without fearing its being attacked; yet as the enemy may have ftolen one or two marches, as hath happened on many occafions, there muft be only two columns of infantry placed in the centre. The third muft be placed upon that flank which the army prefents to the enemy; fo that the army will find itfelf difpofed upon its march after the following manner: Suppofing it is the right which prefents the flank to the enemy, the firft column will confift of infantry, the fecond of cavalry, the third of artillery, the fourth and fifth of infantry, and the fixth of cavalry. The baggage will then be diftributed to the three columns upon the left; fo that neither the two columns upon the right, or the artillery, will have the leaft embarraffment, in cafe an action enfues. The fame difpofition muft be made upon the left, if it is that which prefents the flank. Particular care muft be taken that the artillery have orders, fuppofing the enemy advancing in full force to attack, to tranfport itfelf to the column of infantry, and to divide itfelf along the front, when it fhall be in order of battle, and to keep up a conftant fire, in order to give the general time to make fuch difpofitions as he fhall find neceffary.

The column of cavalry fhould de divided into two, and be pofted upon the flanks of the infantry that is drawn up in the face of the enemy; the other columns muft follow the orders which have been delivered to them, and execute them with the utmoft difpatch.

If it appears, either from the proximity or pofition of the enemy, that the army is liable to be attacked in front, the difpofition for the march fhould be in the fame order as the army is to form in for action: the artillery muft then be diftributed among the columns of infantry; fo that, following the divifions where it is placed, the brigades will find themfelves fpread over the front of the firft line. In this cafe, the infantry will form four columns, which will march in the centre of the two columns of cavalry upon their flanks; fo that the head of each column, as far as the centre, when placing itfelf in order of battle, fhall make the firft line, and the remainder, from the centre downward, the fecond; and the referve which follows fhall form itfelf behind the other two lines.

It is neceffary that an army difpofed after this manner fhould have orders to draw itfelf into order of battle on the very firft fignal, which fhould be a difcharge of two or three pieces of cannon. The fignal being given, the firft and fecond lines, and the referve, will find themfelves formed in a very fhort time. If, from the proximity and pofition of the enemy, and the facility with which he can attack, the general hath reafon to imagine he will do it, the heavy baggage, with a good guard and efcort, ought to be removed into the rear.

On this occafion the *campement* (A) fhould not be far before the army, the efcort fhould be increafed, and fome detachments of light horfe fhould march in front to cover it, and alfo to make obfervation at a diftance. The remainder of the body of light horfe fhall continue upon the flanks of the army fuftained by dragoons, who, on the fignal being given, fhall immediately go and form themfelves in the place affigned to them during the action.

On the firft fight of the enemy the campement fhould retire; for when fighting becomes neceffary, all thought of encamping muft be laid afide; but the efcort fhall put itfelf in order of battle, and the light horfe fhall approach the enemy as near as poffible, in order to reconnoitre his difpofition and ftrength. The officer commanding them will immediately fend a report of the difcoveries he hath made to the commander in chief, who on every occafion fhould be in the front, and even a little advanced, to furvey the nature of the ground; it being very certain, that in thefe cafes a man can much better rely upon his own than upon the judgment of others. This was marfhal Saxe's method; particularly when he was apprehenfive of being attacked upon a march, or had himfelf an intention of attacking. In proportion as the enemy fhall advance, the efcort of the campement muft retire in good order; at the fame time not neglecting the opportunity, if it offers, of haraffing the enemy's advanced guard, fo as to retard his march, and give more time for the army to form in order of battle, and to the general to make fuch difpofitions as he fhall judge neceffary: after which, the efcort having amufed the enemy, or caufed him to flacken the brifknefs of his march, muft retire in good order; and when it fhall be near the body of the army, each body fhall return to its own brigade.

If, from his knowledge of the country, although an open one, the general knows there are any thickets, hollows, or heights, either on the right or the left, and that this fpot may prove favourable to the enemy, he fhould try to poffefs himfelf of it. If that attempt is not practicable, as the enemy will undoubtedly take advantage of it, and poft infantry either at thefe thickets or heights, the general muft place a brigade of infantry at the head of each column of cavalry, which fhall mix by platoons with that line of cavalry when formed in order of battle. This difpofition was made by M. de Turenne at the action of Sinzheim, and at the battle of Enzheim.

If, by the fituation of the country, the flanks cannot be fheltered

(A) This is a French term, for which we have not a fynonyme equally expreffive in the Englifh language. It is ufed to denote a certain number of troops, who proportion their time of fetting out before the army, by the diftance or proximity of the enemy, in order to trace or mark out the camp. For this purpofe, a quarter-mafter and a trooper is draughted from every troop of every regiment of horfe; and a ferjeant and a corporal, in like manner, from every regiment of infantry, furnifhed with ropes and pickets, to lay out the ground for the tents and the intervals; fo that every regiment will, on its arrival, find its ground properly marked out. A field-officer of every regiment alfo marches with the campement, befides the officers of each corps, who command the detachment.

Defensive Operations. sheltered either by an hollow, a morass, a river, a town, or a village, the hussars and dragoons must be posted upon the wings, but sidewise, so as to be able to take the enemy in flank when he shall come down to charge the first line, or at least to keep back his second: these hussars and dragoons should be sustained by the infantry of the light troops belonging to the army. If the right can be formed next a village, and the left next an hollow, some infantry and artillery must be posted there: if there is only the right or the left that can be sheltered, that which cannot must be properly sustained; and the same disposition must be observed that hath been just now mentioned, with regard to an army whose flanks cannot be covered.

If, on leaving the camp, the army presents a flank to the enemy, who may have it in his power to attack it on the march, it must then march but in two or three columns at most. Each column should be disposed after such a manner, that by a motion to the right or to the left, according to the wing that is liable to be attacked, each battalion and squadron many find itself formed in order of battle before the enemy.

The advanced guard should be composed of light horse, sustained by dragoons: the rear-guard of cavalry sustained by infantry: there should be also some light horse upon the flanks of the cavalry, and some pieces of cannon with the infantry. The artillery should be distributed by brigades in the column of infantry nearest to the enemy; so that, performing the same movement as the troops, it may find itself placed in the front of the first line, ready to fire on the first order. The number of three columns is given to the army, in order that the first and second lines and the reserve shall be formed at the same time, which cannot be done if the army marches only in two columns: for troops must then be taken from these two lines in order to form the reserve, which would require a considerable time, and consequently retard the dispositions; whereas this reserve, forming the third column, is separated from the main body, and in a condition to act with readiness, according to the orders it shall have received. As the baggage, in this manner of marching, must necessarily be an embarrassment, it must be sent into the rear under a good escort, with orders to join the next day at the new camp.

Sect. IV. *The March of an Army in a mountainous and woody Country.*

If the situation of the places in a mountainous country furnishes a general with a greater variety of expedients to conceal his dispositions, it also renders more precautions, and a greater degree of knowledge, necessary to avoid being surprised. If these kind of countries, on the one hand, present greater advantages for the concealment of marches, they also, on the other, offer many difficulties in the transporting of the provisions and the artillery, and require a greater degree of vigilance for the safety of the magazines and the preservation of the communications with the frontier towns.

It is to be feared, that in mountainous countries, in roads that cannot be enlarged, the troops pressed too close together will not be able to move but with great difficulty; and as they will embarrass each other, the front, the rear-guard, and the flanks, must be equally secured; the columns must be unbroken and close, that there be no distance left between them; and halting should be particularly avoided, as that is a circumstance by which an army is most fatigued.

It is again dangerous, as the commentator upon Onosander observes, when troops find themselves straitened of room in a narrow road, for the general, in order to enable them to move with greater ease, to lengthen the columns too much: from whence would arise two inconveniences; the first of which is, that the columns would be weakened, and that in case of a surprise it would not be difficult for the enemy to separate them entirely, and it would also be impossible for them to rally; in the second place, these columns thus lengthened, in going round a mountain and descending into a valley, would take up a prodigious extent; from whence it hath often happened, that the windings of the road hiding the middle of the column, those who march in the front rank can see only those who are in the last, and retard their march, because that, being deceived by distance, they will be scarcely able to distinguish whether they advance or whether they are halted.

In order to avoid these inconveniences, it is not barely sufficient for a general to have a thorough knowledge of the country: he ought immediately to inform himself of ever particular, however minute, relating to it; he should take the same precautions which have been pointed out as necessary for a march in an open country, and send out a detachment, such as hath been supposed in the foregoing section. This detachment will examine the narrow passes, survey and sound the fords, run round the windings of the mountains; and if there are many roads, it will find out which is the most practicable, and that through which the army, the artillery, and baggage, can pass with the greatest ease; what streams cross it, and whether there are bridges over them: it will examine whether they are sufficiently strong, and repair them, or build new ones. It often happens in a mountainous country, that the road which would be very short and commodious proves to be divided, either by the separation of two rocks or by hollows. As these breaches, however deep they may be, cannot be all of a certain breadth, therefore, in order to avoid marching over the unnecessary ground that going round them would take up, bridges should be thrown over, if possible, from one rock to another.

But as in a march, whether in an open or in a mountainous country, occasions for throwing bridges very often present themselves, it is very necessary to say a word or two relative to the manner of their construction.

Six or eight thick pieces of timber are laid across a rivulet, or any other bad place necessary to be passed, at six feet distance from each other; these must be crossed again by other pieces of timber not so thick, at the distance of three feet from each other; which must be fixed to one another by large pegs, and faggots well fastened together must be laid over them. When the bridge shall be thus covered, some earth must be thrown over it, which ought to be well trampled, in order to fill up the vacancies of the faggots; and then, for the greater firmness, new earth should be thrown over it, which ought to be well beaten down. The bridge thus made, the troops, the artillery, and the baggage, will pass over it with great ease.

It must be observed, that the bridges should be of the same breadth with the roads; they should be broader rather than narrower, because, exclusive of the danger the artillery and baggage would run if they were narrower, the ranks being obliged to be straitened and the column to be lengthened, the march would of course be retarded, and it would be difficult to avoid confusion. The labourers that accompany the detachment ought to be furnished with every sort of tool necessary for the removing of earth, the felling of trees, and working and fitting them for use.

On the report of the commanding officer of this detachment to the general, he will order as many detachments as there

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there are columns intended, to ſet out two or three hours before the time appointed for the march of the army. Theſe detachments will march carefully over the ways already examined and prepared: they will ſcour every thing, hedges, narrow paſſes, entrances of paſſes, woods, heights, villages, in ſhort all that may ſerve as ſhelter for troops in ambuſcade; and for greater ſecurity, they will poſt guards in the villages, which guards are not to retire till the rear-guard of the army comes up.

The commanding officer of each detachment ſhould poſſeſs himſelf of the heights on the right and left, and ſhould diſtribute platoons of infantry at proper diſtances from the rocks and narrow paſſes: he ſhould be careful of what may be done to oppoſe him, and be attentive even to the ſmalleſt paths. When the commanding officer of the detachment ſhall be advanced to the end of the paſſes, or to the ground intended for the camp, he will eſtabliſh his infantry in the moſt advantageous poſts; he will place his light horſe or dragoons in the front, but within reach of aſſiſtance; he will ſend out patroles of light horſe advanced before the infantry. If he receives any intelligence of the enemy, he will ſend immediate notice of it to the general; but if, from the report made to him, the enemy does not appear to be ſufficiently ſtrong to annoy the army on its march, or only ſome parties were willing to try if they could enter the paſſes, his detachment will be ſufficient to keep them at a diſtance particularly as he is in poſſeſſion of the heights and the paſſes.

With ſuch precautions as theſe, if the enemy is at too great a diſtance to attack the army, the march will be performed without any trouble: there will be no obſtacle in the roads, or reaſon to fear that the waggons will be mired; and if the wheels or axle-trees of any of them ſhould break, they will be repaired from thoſe which have ſpare ones: if, on the contrary, the enemy ſhould be ſo near as to give cauſe to apprehend an attack, the neceſſary precautions are taken for forming the troops in order of battle, and for the neceſſary diſpoſitions during the action.

It has been already obſerved, that an army on a march ſhould be divided into as many columns as the detachments have found openings or roads leading to the camp the general intends to occupy; ſuppoſe two, the army will conſequently march in two columns. The diſpoſition of the troops in their march differs entirely from what it would be in an open country; the advanced-guard of each column muſt conſiſt of infantry, ſome muſt be diſtributed either in the narrow paſſes or on the heights, and there ſhould be ſome advanced detachments of light horſe to ſcour the narrow paſſes: the rear-guard ſhould conſiſt of infantry only. The remainder of the troops may be diſpoſed after the following manner:

Four or five brigades of infantry, according to the number which compoſes the army, ſhould be placed at the head of each column; the ſame partition ſhould be made with regard to the artillery, which muſt follow the infantry; the cavalry muſt march next, and the baggage of each column, well eſcorted by infantry, muſt follow the cavalry; then the remainder of the corps of light horſe which are not detached; and the dragoons are placed the laſt, in order to diſmount and ſuſtain the rear-guard in caſe it ſhall be attacked.

Each column ſhould conſiſt of the ſame number of troops as well infantry as cavalry. Platoons of infantry ſhould be detached to march on the heights, at proper diſtances, in order to cover the flanks on the right and left. Care muſt be taken to march very leiſurely in the front, otherwiſe the rear will not be able to keep up; then, in order to give the rear time to come up, the front will be forced to halt, by which the march will be much retarded and the troops fatigued.

Defenſive
Operations.

Plate DXV. repreſents the march of an army through a mountainous country. A is the poſition of the army before it begins its march. P is the artillery and baggage, with their eſcorts in the front of the camp. B, Parties of huſſars forming the advanced-guard of the army on its march. C, Parties of infantry of the advanced-guards of the columns. D, The infantry of the army forming the head of the columns. E, The artillery, and waggons belonging to the artillery. F, Battalions of artillery. G, The cavalry. H, The baggage of the army. I, The eſcort of the baggage. K, Parties of huſſars. L, Parties of dragoons. M, The infantry of the reſerve, forming the rear-guard of the army. N, Platoons of infantry marching upon the heights, to cover the flanks of the columns. O, Villages in front of the camp the army is to occupy, and of which the light infantry have taken poſſeſſion.

Theſe diſpoſitions are neceſſary, becauſe, as the enemy in a mountainous country will be able to attack with infantry only, he muſt be oppoſed with troops of the ſame nature: the reaſon why the artillery is poſted behind the infantry is, that in caſe the enemy ſhould attack briſkly in front, and the road through which the columns paſs be broad enough, ſome pieces of cannon may be ſent into the front, which firing with grape-ſhot will ſoon thin the enemy's ranks, and abate ſomething of his ardour: if the road be too narrow to permit the bringing forward of the artillery, reſolution muſt ſupply the want of that aſſiſtance which the cannon would give, and the enemy muſt be charged with bayonets. The cavalry does not follow immediately, becauſe, not being able to act in this ſort of country, it muſt be covered by infantry. The baggage which follows is ſufficiently defended by the columns that cover it, and the infantry that eſcorts it: this infantry ſhould nevertheleſs join as often as circumſtances will permit, without being fearful of expoſing itſelf, that upon the heights being to reinforce it in caſe the head of the army ſhould be attacked.

There are ſome mountainous countries ſo difficult of acceſs, that it is impoſſible for the cavalry to follow, becauſe ſome poſt muſt either be immediately ſeized, or the enemy, being in poſſeſſion of the hills, muſt be driven from them before it can advance; or becauſe it would be difficult for it to be ſubſiſted.

If the army can march in four columns, the diſpoſitions ſhould ſtill be the ſame; but as the heads of the columns will be weaker in infantry, the heights ſhould be guarded accordingly, and the rear-guard ſufficiently ſtrong to reſiſt the enemy: the ſame diſpoſition ſhould be made for one column only.

If the march is to be made through a woody country, the precautions which have been already mentioned in regard to examining the ways through which the army is to paſs, and for the detachments which ſet out in order to be before the army, ſhould ſtill be obſerved; but the diſpoſition and order of the troops muſt be different. If by the ſituation of the country, the army is obliged to march continually through woods till it arrive at the camp, the cavalry and the baggage ſhould be in three columns in the centre; but ſome infantry ſhould be placed at their head and their rear-guard: the infantry ſhould march in two columns, one on the right, the other on the left of the cavalry and baggage; ſome brigades of artillery ſhould be diſtributed to each column of infantry, the remainder muſt march at the head of the columns of baggage; the flanks of the columns muſt be covered by platoons of infantry, placed at proper

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proper distances, which are to follow the columns at 40 or 50 paces distance, without ever losing sight of them.

Plate DXVI. represents the march of an army through a woody country. A, Is the army formed in order of battle previous to the commencement of the march. B, The cavalry, which hath marched some paces in advance, in order to make room for the infantry. C, The infantry, which, by facing to the right, forms the column upon the right. D, The infantry, which, by facing to the left, forms the column upon the left. E, Bodies of infantry, which are to march at the head of the columns of cavalry. F, The park of artillery, where the baggage belonging to the army, and the escorts, also are assembled. G, The march of the infantry, forming in columns. H, The march of the cavalry, forming in columns. I, The march of the artillery and baggage with their escorts, forming in column. K, The army in march. L, Hussars of the advanced guard keeping the roads, marked out by the detachments sent on before. M, Infantry, forming the advanced guard of the columns. N, Small parties of infantry, marching upon the flanks of the columns. O, Parties of hussars, marching upon the flanks of the army. P, Infantry of the reserve forming the rear guard of the army.

If by the knowledge which the general has of the country, or rather from the report of the officers who commanded the detachment sent out to view, open, and repair the roads, he knows that the country is interrupted by woods and little plains, the disposition ought to be wholly changed; it will then be sufficient that the second detachment, which in other cases ought to set out the evening before, sets out only two hours before the campement. This detachment should be composed of infantry, light horse, and dragoons; the infantry to scour the villages and the woods, the light horse to penetrate into the woods wherever they can enter, and clear the march of the infantry, and the dragoons to sustain the whole.

When the disposition for the march of the army is supposed to be in five columns, the infantry should form two, the cavalry two more, and the artillery and baggage the fifth. If it is thought there will be any occasion for artillery, a brigade or two may be distributed to the columns of infantry; and the remainder may march at the head of the escort of the baggage, which is to be defended by the regiment of artillery; to which must be added a detachment of infantry, which will form the advanced guard. The cavalry and dragoons are to keep the open country as much as possible, and the infantry the inclosed; and the best and most accessible road should always be given to the artillery and baggage. In order that the columns may preserve the same length in marching, a brigade of infantry should be placed at the heads of the columns of cavalry; if this precaution, which fixes the head of the columns of cavalry, is neglected, the cavalry will extend a great way before the columns of infantry, which should always be avoided. The rear-guard should consist of infantry, cavalry, or dragoons: the light horse should always march on the flanks on the right and left, and before the army.

It is after this manner that the march of an army may be disposed through a woody and a mountainous country; but an army must always suit its motions to circumstances, and to the situation of the country where the war is carried on. If the general is inferior in point of number, he should make choice of defiles; because in them he can always present a front equal to the enemy's. Who can be ignorant that Leonidas with 8000 Greeks, at the straits of Thermopylæ, stopped the almost innumerable army of Xerxes, who was unable to force him?

A mountainous and woody country, when thoroughly known, becomes a more favourable theatre for practising the wiles and stratagems of war than an open country; it is true that the knowledge of it is more difficult to attain, and that it requires more vigilance and readiness in the general. Hannibal was even drawn into ambuscades by his own guides; an example worthy the notice of a general who takes guides that have either but little regard for him, or are unacquainted with the country: it is impossible to try them too much; and their ignorance is often more fatal than treachery itself.

The marches that require most precaution are those made in the night, those made in sight of the enemy, and those that should be kept secret.

The first should be avoided as much as possible; but if circumstances require and force an army to march over a mountainous country in the night, care should at least have been taken to survey the roads during the day; to make the guides march at the head of the army; to keep the ranks very close together, that the men may not lose sight of each other; and that part of the troops do not mistake one defile for another, which may easily happen in the dark, if the advanced guard has marched a little too fast, and the officers hastened too much. The Greeks, according to Xenophon, on like occasions, gave the heaviest arms to the troops that marched at the head, thereby to oblige them to proceed leisurely.

In those marches that are made in sight of the enemy, beside the precautions necessary to be taken for the safety of the troops, and which have already been mentioned, the general should endeavour to deceive them by false appearances, and by an ostentation, often in such circumstances, necessary: as extensive a front as possible should be given to the army; the intervals of the ranks and columns should be widened, but not so as to weaken them; the general should take advantage of an height, possess himself of it, and post some troops on it, in order to make the enemy suspect there may be still more behind: advantage should be taken of a wood, and, by marches and countermarches, the same troops should be made to pass and repass, in order to make the enemy believe the army stronger than it really is. There have been instances of generals, who, on like occasions, have made such good use of their ground, that, by the arrangement of troops, they have seemed to multiply them in the enemy's eyes; and who, although inferior in strength, appearing to have the advantage of numbers, have kept the enemy in awe.

But still, unless it is to deceive the enemy, a general should conceal his force and management: his force, because, if superior, he will not fail to profit by that advantage; and if inferior, he should avoid a battle: he will conceal his management, because he will prevent the designs of the enemy's general, who will receive as much information from his successes as from his miscarriages. Pyrrhus, who taught the art of war to the Romans, was in the end conquered by them. The Mexicans often turned the arts and wiles of Cortez and the Spaniards against them; and the Czar Peter I. never regretted a defeat when it became the means of instructing him how to conquer in his turn.

It is impossible to lay down fixed rules for secret marches: it is by his address that a general will improve circumstances; it is by art and contrivance that he will evade the enemy's vigilance, and deceive his spies.

General rules only can be given for the dispositions to be made of troops upon a march; particular ones would be merely conjectural, because the general of an army must always depend upon circumstances: it is the situation and nature of the country, the number of troops, the nearness of the enemy, the facility of foraging, and the passes

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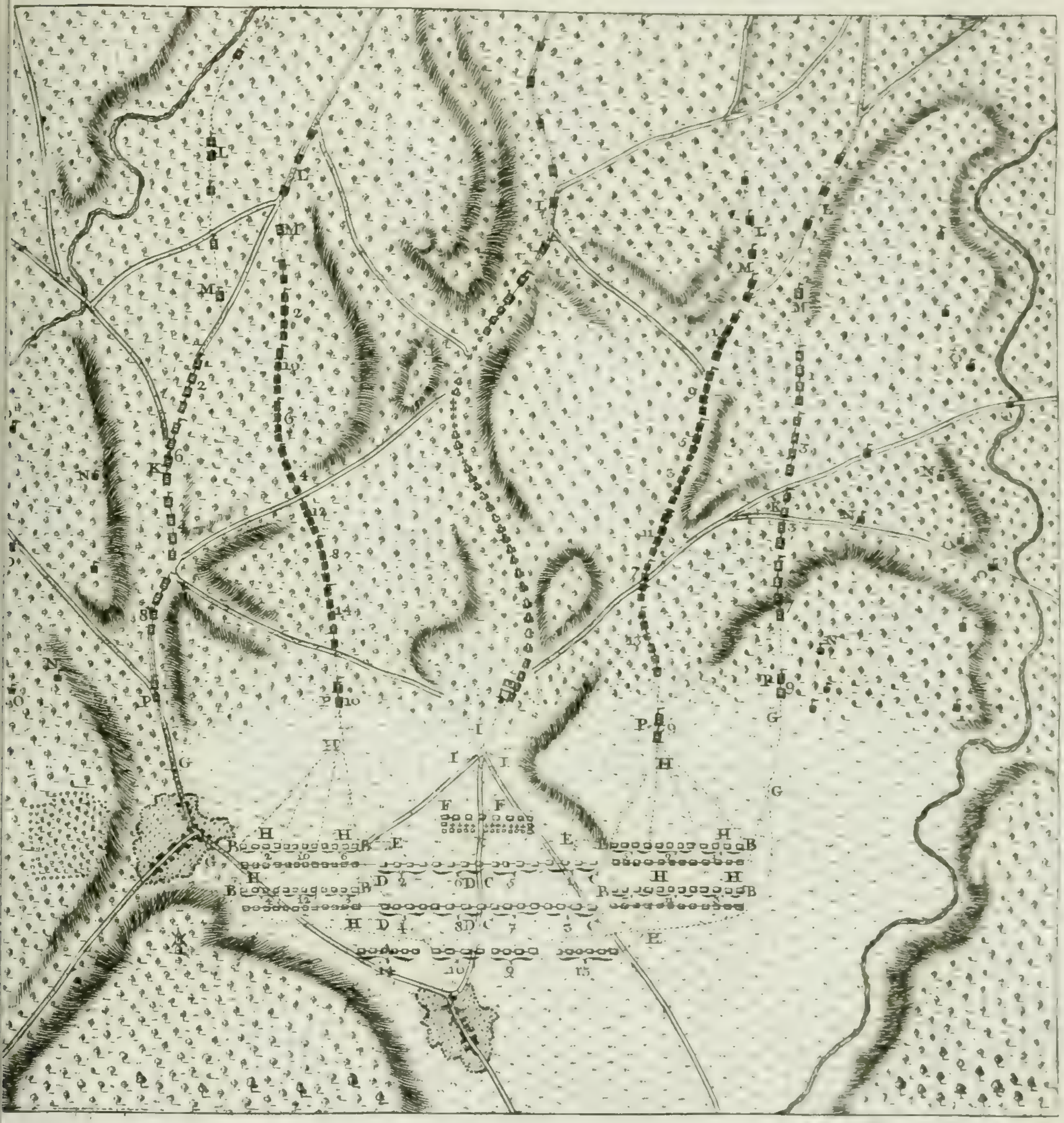
Plan of the March of an Army through a Woody Country.



A. Bell Prin. Wal. Sculptor fecit

Scale of ½ a League.

WAR.
Plan of the Position of an Army in its Camp.

Plate DXVII.

A. Bell. Prin. Wal. Sculptor fecit.

of which the enemy is poffeffed, that ought to determine him.

In a word, whatever is the order and difpofition of the troops, it muft be fuch, that they fhall always be able to fuftain each other; that the flanks fhall be well guarded, and the fronts fecured; the roads muft have been furveyed and opened; and whatever the nature of the country is, all the columns fhould arrive at and enter the camp at the fame time.

Sect. VI. *Of Camps in defenfive War.*

It is in general more difficult to carry on a defenfive than an offenfive war, but more particularly fo in an open than in a mountainous country. In the former, there is nothing to conceal the movements and difpofitions of the army from the enemy; whereas, in the latter, the nature of the places prevents the enemy from difcovering them: but whatever may be the nature of the country, the choice of a camp, when on the defenfive, and the art of pitching upon an advantageous fituation, is what proves the genius and talents of a great officer. Exclufive of a thorough knowledge of the country, this operation requires a quick and penetrating eye in a general, to enable him to feize the pofts which from their fituation may prevent the enemy either from attacking him or penetrating into the country.

A general who acts on the offenfive, takes what ftate or circumftances he pleafes; he may act as he choofes, and is not under a neceffity of regulating himfelf entirely by the enemy's motions: whereas a general that is not fufficiently ftrong to attack, is commonly obliged to continue quiet till the enemy hath acted, and then to regulate his motions according to thofe made by the oppofite army, unlefs his fuperior abilities give him a particular advantage over the enemy's general.

Although it is always neceffary for a general to have a thorough knowledge of the country, this knowledge will yet become more neceffary to him when acting on the defenfive. He ought to prevent the enemy's entering his country, and forming any fiege there (a plan which he cannot execute, unlefs he is poffeffed of the moft advantageous pofts, and alfo of thofe which cover the towns liable to be threatened), by proper difpofitions that fecure his camp; by covering his fronts and rears, and keeping the communication between the camp and the places where the magazines are; by endeavouring to annoy the enemy in his convoys and foragings; by haraffing him in his camp, and perplexing him with fmall detachments, to which he will be obliged to oppofe more confiderable ones: thefe difpofitions, properly managed, may deftroy any enterprifes the enemy may have formed againft the army.

Plate DXVII. reprefents an army properly encamped to ferve thefe purpofes. A, Is the camp of the main body of the army. B, An advanced camp, compofed of dragoons and huffars, in order to cover the right of the army, to guard the paffes by which the enemy might make incurfions upon the flanks and rear of the army, moleft the convoys, and cut off the communications. C, Villages and bridges, guarded by the light infantry. D, Pofts of difmounted dragoons in the front of their camp. E, Pofts of dragoons on horfeback, to fecure the communication between their camp and that of the main body of the army. F, Bridges built, to keep up the communication between the grand and the advanced camp. G, Bridges and villages guarded by detachments of infantry. H, Grand guards of horfe. I, Guards of infantry. K, Bridge, village, and mill, guarded by the infantry belonging to the army. L, Camp of dragoons and huffars covering the left of the army, and fupporting the light infantry. M, Villages and bridges guarded by the light infantry. N, Pofts of difmounted dragoons in the front and on the flanks of their camp. O, Pofts of dragoons on horfeback. P, Pofts and detachments of huffars, to patrole in the front and upon the flanks of the army, and their camp.

Defenfive war.

By the enemy's fuperiority, the nature of the country, and the fuccefs of campaigns, the general fhould determine whether or not his camp fhould be entrenched: the entrenching of camps requires much obfervation. It is eafy (fays Vigetius) to entrench a camp while at a diftance from the enemy; but it becomes a very difficult operation when the enemy is near at hand. The Romans, according to him, ufed to keep all their cavalry and half their infantry drawn up in order of battle, in order to cover thofe troops that were employed in working at the entrenchments. Cæfar, when in Spain, fortified himfelf after this manner under the eyes of Afranius and Petreius, without their having the leaft knowledge of it.

Before a general fortifies a camp in a plain, he muft obferve the pofition in which the ground will permit him to form his camp; whether or no it will be liable to be furrounded; if it will entirely cover the country it is to protect, and the towns for which there is moft reafon to be apprehenfive; if the parts in the rear are open; if forage is in plenty; if provifion can eafily be brought; if there is wood and water; if it is impoffible for the enemy to enter the country without forcing the camp; if all thefe circumftances concur, it is certainly moft advantageous to entrench the camp.

A general fhould never be too fecure by having a fuperiority of numbers; he ought not on that account to neglect fortifying his camp: even when he acts on the offenfive, thefe entrenchments will not hinder him from marching out to the enemy whenever he judges it proper, and his army will by that means be fheltered from the enemy's attempts.

There are many methods of entrenching a camp by lines beginning on the right, and covering the whole front of the camp to the left; thefe lines, in their extent, have redoubts and angles at proper diftances; and the line being continued from one to the other, forms the curtains. In the front of them there is a large and alfo deep ditch; fometimes a covered way is added, which is pallifadoed and ftoccaded throughout the whole front of the lines. To render them yet ftronger and more difficult to be forced, there are pits funk before the covered way. Thefe pits are ranged chequered-wife, about fix feet deep and five broad, and are in form like a reverfed cone. Such were the pits which the duke of Berwick caufed to be made in 1734 to the lines of circumvallation before Philipfburg; only with this difference, there was no covered way. Without doubt thefe lines are formidable, and even very difficult to attack; but a great deal of time is required for conftructing them; and if there is not a fufficient number of peafants in the army to work at them, troops muft be employed to expedite them; which will not only greatly fatigue them, but may alfo coft the lives of many; becaufe the removing of earth often caufes great diforders, particularly where the ground is fwampy or clayey.

The method practifed by marfhal Saxe feems much fuperior to thefe lines. It contained as large an extent of ground, without diminifhing the labour; becaufe, inftead of lines, it confifted of redoubts, which require as much work to form the four faces and the covered way as lines always continued. At the fiege of Maeftricht, in 1748, he ufed thefe redoubts inftead of lines; their diftance from each other was 45 yards; they were fraifed, and the covered

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way pallisadoed. These redoubts presented an angle to the field, and consequently were a mutual protection to each other; they were each of them capable of containing a battalion.

His design, supposing the enemy come to attack the army, was to cause all the redoubts to be occupied; to plant ten pieces of cannon between each, and to draw the army up in order of battle behind them: by this means the enemy would be obliged to force the redoubts before they could attack the army, which could not be done without great loss. But supposing the redoubts to be forced, how would the enemy be able to enter the intervals without dividing? The army behind, in order of battle, would charge him, without giving him time to recover himself, and it is highly probable would beat him.

By following this method of entrenching a camp, if some of the enemy's battalions should, for example, force three or four redoubts, they certainly would not dare to advance as long as the remainder should hold out; so that a general might, by detaching some brigades, and causing them to march to the assistance of the battalions that have been forced, retake the redoubts; or, without disordering the order of battle, drive away the troops which are in possession of them with his cannon. In short, this method seems to be excellent, because it proves that all the redoubts may be forced, and yet the army not be beaten, because it has not suffered in the action, but remained the whole time in order of battle with all its cannon; so that the enemy will be reduced to the necessity of beginning a second battle.—Lines, on the contrary, have not the same advantage; all the troops, or the greatest part of them, must line them; the cannon is planted at proper distances either on the angles of the redans, or those of the redoubts. If one part only is forced, the army is beat, and the cannon taken, because the enemy makes the attack with his whole front.

Lines are indeed never good, unless when there is a large extent of country to be guarded, and some frontier to be covered from the incursions of the enemy; the front of an entrenched camp seldom exceeds six miles, more or less, whereas lines to cover a country have sometimes extended 30 miles in front. By some it is thought, that, in order to cover a country, it is sufficient to have certain holds, which shall be strong and well entrenched, with patroles continually going from one end of the posts to the other, and each post to be provided with signals both for day and night. It is unnecessary that these patroles should be strong, provided they follow, and are continually crossing each other; this will be sufficient to prevent the enemy passing undiscovered. It is certain that the enemy will not dare to pass between these posts, whether he be strong or weak; if he pass in a body, he will be cut off behind, and his convoys intercepted; if he pass only in parties, they will be cut off with the greater ease. However, lines of this nature would require much labour, and also take up years to complete them.

Marshal Saxe's method for entrenching a camp in a woody country interspersed with small plains, seems also to be a very good one. The redoubts are to be erected in the plain; and lines thrown up in the woods according to the usual method, with redans placed on the side of each other, at 24 toises distance; there should be a pallisadoed ditch in the front, and the lines as well as the half-moon should be fraised with pointed stakes; behind these lines, which cannot be very extensive, because they only cover part of the front of the camp, must be placed the troops necessary for defending them; a considerable entrenchment of felled trees must be made behind, with the branches of the trees intangled with each other, and some openings must be left wide enough to permit the troops who guard the lines to pass through, in case they should be overpowered and obliged to retire; the cannon must be planted in the front of these openings; and the remainder of the army must be drawn up in order of battle, 100 paces at most behind the retrenchments of trees and the half moons. The retrenchments of trees are placed about 60 or 80 paces behind the lines, and not before them, because it will be a new and unexpected obstacle to the enemy. These retrenchments, carefully made, and with large trees, can be destroyed by cannon only, which would take up a considerable time; if they were in the front of the lines there would certainly be a rampart more; but that might be useless, and perhaps hurtful, because the fire of the enemy to make a passage would drive the splinters of the trees into the lines, which would do more harm than even the shot itself.

Plate DXVIII. represents an entrenched camp; in which A is the main body of the army encamped behind its entrenchments. B, The camp of the troops of the reserve. C, Camp of the dragoons, to secure the rear of the army. D, Camp of hussars, to cover the ground upon the right of the army. E, Villages and redoubts guarded by the light infantry, to secure the camp of the hussars. F, Bridges built to secure the communication of the army with the ground upon the right, and to favour the retreat of the troops posted on the opposite side. G, Brigades of artillery distributed upon the flanks, and along the whole front of the army. H, The park of artillery. I, A bridge entrenched, to secure the communication between the army and the ground upon the left. K, Villages and farm-houses, guarded by detachments of hussars and light infantry, to patrole in the front of the army.

In a mountainous country the dispositions for entrenchments are different: it is impossible there to find plains sufficiently large to draw up an army in order of battle, and place it beyond redoubts, as in an open country; the avenues and the passes only can be entrenched; the redoubts would not be sufficient, because not only the avenues must be guarded, but the heights also occupied. Now, as it will often happen among mountains that there is not a foot of earth, how can redoubts be erected there? A general must then make use of such assistance as the country can furnish him with, whether by heaping stones upon each other, or by retrenchments of trees well joined; and thus construct lines sufficiently strong to shelter the soldiers from fire and all injury. In an open country, a general in a manner suits the ground to his dispositions; in a mountainous country, he must apply his dispositions to the ground; but in any country whatever, he must use all the assistance of art for entrenching of camps. In mountainous countries there are more inequalities of ground, which render the enemy's approach to the lines difficult; and altho' it is almost impossible for a camp in a mountainous country to be attacked in front, nothing should be neglected for its safety: but all the avenues by which it may be surrounded must be entrenched with care, and all the heights which overlook it secured; because the enemy, without intending to attack in front, will amuse him during the time necessary for troops to take a long round, in order to penetrate to the camp on another side. If Leonidas, with his 8000 Greeks, had been possessed of all the avenues, ways, and heights, by which he could be cut off, in the same manner as he was of the pass of Thermopylæ, Xerxes with his innumerable army could never have forced him in the defiles which he guarded.

The entrenchment should never be more than 250 or 300 toises, which make from 500 to 600 paces, distant from the camp, and which ought to be divided into three parts. This distance should be made, that the troops may be able

to

Plan of an Intrenched Camp.

to judge of the parts that can be carried with greateſt eaſe, and of thoſe which are moſt in need of aſſiſtance, that they may march there with greater order, diſpatch, and facility: whereas, if this diſtance is not obſerved, it will happen, as hath been ſometimes ſeen, that the troops not having ground ſufficient to range themſelves in order of battle, the diſpoſitions will be impeded by confuſion and diſorder, and the enemy will have forced the lines before the troops can be in a condition of oppoſing him.

But in a mountainous country, it is not ſufficient for a general that he cannot be turned; that he hath profited ſo well by the advantages of ground, as to render the enemy's approach to the camp difficult; that the aſſiſtance of art hath been joined to nature; and that the country to be guarded is entirely covered: he muſt alſo be careful that the communication with the neighbouring towns where the magazines of war and proviſion are eſtabliſhed, is ſafe and eaſy. If any one of theſe particulars is neglected, the camp is expoſed, neither can the general continue in it the time that would be neceſſary to retard the march and deſigns of the enemy. As it hath been already obſerved, that there is ſcarcely any poſt that is not liable to be turned or overlooked, the camp ſhould be entrenched only ſo far as the entrenchments may become an obſtacle to the enemy, and as they may be a means of giving the general time to retire to occupy another poſt.

When the enemy undertakes the ſiege of ſome town, and the general, although with an inferior army, is willing to ſuccour it, or cauſe the ſiege of it to be raiſed, he ſhould ſeek out a ſpot naturally ſtrong, and entrench it according to its ſituation: if an open country, according to the method above mentioned; if among mountains, according to the aſſiſtance that the nature of the country may give; and make uſe of theſe entrenchments as a ſure aſylum from whence to make ſallies upon the enemy, to attack his forages and his convoys, and to oblige him to raiſe the ſiege as well by the fatigues of it, when it hath been drawn out to a greater length of time than was deſigned by the enemy, as by the want to which he is reduced by the continual inquietudes that the entrenched army hath given him.

When an army is in an open country, it generally continues in the ſame camp for ſome ſpace of time; becauſe it is certain the enemy cannot conceal his deſigns ſo effectually from the general, but he may be able to circumvent them; but in a mountainous country, it is uncertain whether an army will continue in the ſame poſt till morning that it occupied over-night. A general muſt then encamp in ſuch a poſition, and after ſuch a manner, that in caſe the enemy comes to attack him in force and with advantage, he may be able, without danger, to proceed to another poſt, and evade the enemy's deſigns.

It requires great ſkill in a general to judge when it is proper or improper to make choice of places which have a great many avenues on one ſide; becauſe if he ſhould be attacked in a camp incloſed by rocks, or deep in a valley which hath but one or two paſſes open, it will be very difficult for him to diſengage himſelf from the enemy: on the contrary, if there are many ſmall paſſes or avenues to the ground of which he is poſſeſſed, and by which the enemy may eaſily inveſt his camp, it will require a great number of men to guard them. But on theſe occaſions a general ſhould be ever careful to make a good diſpoſition of his troops, to maintain ſtrict order and diſcipline in his camp, and to ſend out his patroles with the greateſt regularity; by which means he will free himſelf from all apprehenſions of being ſurpriſed.

There ought to be no difference between a well-governed town and a well-ordered camp; the exacteſt order ſhould be obſerved, and the ſtricteſt diſcipline kept up: if a ſoldier is at liberty to quit or enter it at pleaſure, the enemy's ſpies will not fail to make their advantages of it. If the camp is unhealthy, or diſtreſſed for proviſion, water, wood, or forage, and the ſoldier hath real cauſe of complaint, every method ſhould be tried to avoid the danger that will attend his being diſcouraged. It is often owing to the little order exiſting in the camp, that the ſoldiers are ſeized with a panic, occaſioned by the abſurd and groundleſs reports that are diffuſed throughout it; troops thus terrified, are in a manner vanquiſhed before they come to action.

In a mountainous country, ſuch places ſhould be avoided as are ſubject to be overflowed, either by the melting of the ſnow, or by torrents, which at ſome ſeaſons appear no more than trifling rivulets, but which, at others, ſwell and carry off every thing they meet with in their way: of this nature were thoſe mentioned by M. de Feuquieres, which he found near the rock that he attacked and took in 1690 from the Baduais. Situations in the neighbourhood of woods are generally to be feared, becauſe the enemy may ſet them on fire, and the flames be communicated to the camp. The general ought alſo to ſatisfy himſelf with regard to the nature of the ſprings, which may agree very well with the inhabitants, but prove very unwholeſome to ſtrangers: ſuch, according to the reports of the French, is the nature of the ſprings in many parts of Italy. The water belonging to certain ſtreams or rivers will be pernicious, while that belonging to the fountains and wells in the ſame country will be very wholeſome and ſalutary.

SECT. VII. *Of eſcorting Convoys.*

THE conducting of convoys is one of the moſt important and moſt difficult of all military operations. In the eſcort aſſigned them, and the number of horſe and foot of which this eſcort is compoſed, the general ought to be guided by the diſtance of the town from whence they ſet out; the dangers to which they are expoſed from the different parties they may meet; the diſtance and ſtrength of the enemy, and the extent and nature of the country they have to travel over, whether an open or a mountainous one; the number of waggons, and the quality of the convoys, whether they conſiſt of money, or ammunition for war or proviſion; and whether they are extraordinary or daily. When eſcorts are too numerous, the troops are fatigued, and no end anſwered; and when they are too weak, they are liable to be beaten. M. de Puyſégur obſerves, that it is as dangerous to give an eſcort of 2000 men to a convoy where only 1000 are requiſite, as to give but 500 to one where 1000 are abſolutely neceſſary; in the firſt, the troops are unneceſſarily fatigued, and in the ſecond, the convoy is expoſed to the danger of being carried off.

All theſe conſiderations ſuppoſe the general to be a man whoſe natural parts are matured by experience, and who is ſenſible that, without a thorough knowledge of the country, the foundation of all conduct, it will be impoſſible to make a proper diſpoſition of troops. If a general is ignorant of the places moſt proper to form ambuſcades; of thoſe where there are bridges and fords; of the paſſes which are moſt dangerous, and thoſe which will favour the enemy's approach in order to attack, and whether in head, flank, or rear—he acts but as chance directs, and his diſpoſitions will have no meaning, either with reſpect to the ſituation of places, or the nature of the ground; the orders will be ill executed, the evolutions performed without exactneſs, and the diſpoſition of the troops will be faulty; the ſeparate bodies being, conſequently, unable to ſuſtain and aſſiſt each other.

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will soon be beaten and dispersed, and the convoy carried off.

The general officer commanding the convoy ought, for its security, to distribute his troops after such a manner that they may be a mutual assistance to it. The choice of the troops to form the escort is undetermined, as it is by the nature of the country their quality should be decided. In mountainous and woody countries, only infantry, hussars, or dragoons, can be made use of; the hussars or dragoons are to march in the front and on the flanks, to scour the woods, examine the avenues, and make sure of the defiles; in an open country, the escort should be composed of infantry, cavalry, hussars, or dragoons. But whatever may be the nature of the country, the convoy ought never to advance without first sending out detachments to reconnoitre at a distance.

If the convoy marches through a mountainous country, a large body of cavalry would not only be useless, but also an embarrassment, as it would be unable to act, except with great difficulty; whereas, in an open country, cavalry is very serviceable. In any kind of country a convoy can be escorted with infantry, especially when the enemy can only act with his; but as in an open country it is necessary for the infantry to be supported, the cavalry must be used for that purpose. In a mountainous country, infantry can carry on war alone.

In this last case the officer commanding the escort ought to place a body of infantry at the head, another in the centre, and a third at the rear-guard; to distribute small bodies at proper distances on the right and left; and he should be particularly careful to possess himself of the heights. The hussars must be distributed to the advanced and rear-guards, and, in order to be more certain that every part hath been strictly examined, as the convoy advances, notwithstanding the hussars of the advanced guard have already scoured the avenues, woods, valleys, villages, and hollows, the hussars belonging to the rear-guard should again look into those places, to see whether any thing hath escaped the notice of the advanced guard. These precautions are never without their use, and do not in the least retard the march of the convoy.

The small detachments should advance as far as possible into the country, without exposing themselves to the danger of being cut off, the hussars with pistol or musquetoon, and the dragoons with their carbine in hand, in order that, if they should meet the enemy, they may, by firing, give the officer commanding the escort notice of it, so that he may have time to make his dispositions for defending and preserving the convoy. The convoy may continue marching on till the enemy is discovered: but on the first notice of him, it must stop, and the officers belonging to the convoy should park their waggons; or, if the ground will not admit of that, they should cause them to keep very close together, and double them up with the distance of four paces, which should be filled with infantry, between each waggon. By this movement the length of ground taken up by the waggons will be contracted, the troops will be brought closer together, and will form a stronger and heavier body, capable of assisting each other with more ease.

In a mountainous country it is almost impossible for the enemy to attack the advanced and rear guards and the centre at the same time. Nevertheless, if he should find an opportunity of forming these three attacks at once, by following the dispositions above mentioned, he will find troops at every part to receive him: neither will he be able to make himself master of the heights without attacking them, and the troops already in possession of the ground will easily repulse him; and by the assistance which the officer commanding the escort should endeavour to send them, they will be enabled to maintain themselves in them, to protect the convoy, and the enemy will be unable to attack by more than one or two passes.

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If the enemy forms but one attack, only a part of the troops must be opposed to him, because it is to be supposed this attack may be made only with a design to draw the whole strength of the detachment to that part, and which, by being altogether in that one place, will give the enemy concealed in ambush an opportunity of falling with ease upon that part of the convoy that is unprovided with troops, and which will of course be incapable of making any defence. The troops of the centre should never march to the assistance of the advanced guard, if it is that which is attacked, nor those of the rear-guard to the assistance of the centre; but a party from those troops which cover the flanks of the convoy should be collected in a body, and sent to assist the part that is attacked. However narrow and confined the country may be, a convoy may be easily conducted by infantry, when it would be impossible to do it with cavalry.

When any pass or avenue crosses the road on which the convoy marches, it should be covered by a body of infantry, which will remain there till the rear-guard is come up; then it will fall into the post assigned it for conducting the convoy. It is always to be supposed, that this pass hath been examined by the advanced detachments. If the escort is composed of infantry and dragoons, the latter should be dismounted, in order to give an additional strength to the guards, and their horses may be tied to the waggons. The hussars, if the nature of the country renders them unserviceable on horseback, may also be dismounted; by which means, instead of being an embarrassment to the infantry, they will become useful to it. The nature of hussars is such as will admit of their being employed on every occasion; and although the difference of their arms will not permit them to be as serviceable as dragoons, they may nevertheless amuse a party of troops belonging to the enemy in such a manner as to enable the infantry to beat them, or at least to oblige them to retire.

Hussars are more particularly necessary in the escorting of convoys, because they scamper about on all sides, and are very active and ready in scouring a country thoroughly; they leave no place till they have perfectly examined it, unless the thickness of the woods, or any other unavoidable obstacle, should prevent their penetrating as far as they would otherwise do; and even then they protect the infantry, who can with greater ease pass into those places where the hussars cannot. Whatever country the convoy passes through, there should always be hussars with it; otherwise the officer commanding the escort cannot be certain that the country is thoroughly surveyed, because for want of hussars he must employ cavalry on that service. Not that there can be any doubt of the cavalry's exposing itself to danger with as much cheerfulness and courage as the hussars; but as the horses belonging to the cavalry are naturally heavier than those of the hussars, and often encumbered with forage, they cannot venture to a proper distance without running the danger of being taken, because they cannot retire with that expedition which is requisite: On the other hand, the hussar being more active, and more accustomed to reconnoitre, knows how to go over a country with proper caution and care to himself: besides, the trooper who is used always to march in a body, and to be under command, will have a very imperfect idea of the method of scouring a country. Although the disposition of the troops should always be regulated by the nature of the country through which the convoy marches, and by the nature and

number

number of the enemy by which it is liable to be attacked, yet the general ſhould never neglect, whatever his ſituation may be, to ſecure the head, centre, and rear. Before the convoy begins its march, the diſpoſition in caſe of an attack ſhould be ſettled; by which means the commanding officers of different corps will know where to poſt themſelves, and after what manner to act at the time the attack is made. By the knowledge which the commanding officer ought to have of the country, he will form a judgment of thoſe places where it is moſt probable he may be attacked, and of courſe make his diſpoſitions accordingly. In any diſpoſition that may happen, a general ſhould always foreſee in what manner the attack, defence, and retreat, will be conducted.

When a convoy marches through an open country, the advanced and rear guards ſhould conſiſt of cavalry ſuſtained by infantry; the infantry in the centre ſhould be continued on the right and left of the waggons, and the cavalry divided into troops ſhould be diſtributed on the flanks, at 100 or 150 paces from the infantry; ſquadrons of horſe, intermixed with platoons of infantry, ſhould be placed at proper diſtances on the flanks of the remaining part of the convoy. By this poſition, if the convoy ſhould be attacked in head, centre, or rear, theſe ſquadrons and platoons ſhould have orders to march immediately to the aſſiſtance of the party that is attacked.

The advanced detachments of huſſars, and thoſe upon the flanks, by giving notice that the enemy is at hand and coming to attack, will furniſh time for parking the waggons and uniting the troops: in which caſe the infantry muſt form in the park, and the cavalry poſt itſelf on the flank of that front which expects to be attacked, and the huſſars place themſelves upon the flanks of the cavalry.

The attack of a convoy is always ſudden and rapid, and the ſucceſs of it is generally decided in the firſt onſet; and as the enemy, whether he ſucceeds in his attempt or not, muſt retire with great expedition, for fear of any ſuccour that may arrive, it is evident that it can be attacked only by cavalry, huſſars, or dragoons; there have indeed been ſome inſtances where the cavalry have brought infantry behind them. If the convoy has had time to park itſelf, the effort of the infantry can only be turned againſt that which it intrenched behind the waggons. The enemy's cavalry and that belonging to the eſcort attacking each other, will fight upon equal terms: but with regard to the infantry, it will be different: that which is ſheltered by the carriages having a great advantage over that which attacks it. On the contrary, if the enemy's infantry is ſuſtained by huſſars only, they will be briſkly attacked by the cavalry and huſſars belonging to the eſcort, who will take them in flank and rear. The enemy's huſſars being hemmed in, his infantry, for want of being ſuſtained, will be eaſily beaten: part of the cavalry and huſſars belonging to the eſcort ſhould be left in purſuit of the enemy's huſſars, and the remainder ought to take his infantry in flank. If the enemy is beaten, as it is probable he will, his retreat ſeems impracticable, or at leaſt very difficult; becauſe, being deprived of his cavalry, he will be forced to make head againſt the infantry that attacks him in front, and to repulſe the cavalry that attacks him in flank.

If the enemy gives ground, the general ſhould be cautious of purſuing him too far, leſt, if he ſhould receive a reinforcement, the troops in purſuit of him, finding themſelves at too great a diſtance, will not only be beat, but alſo be deprived of every method of retreating.

There are ſome occaſions on which the enemy muſt not be purſued at all; ſuch as when the armies are very cloſe to each other, or the convoy draws near to ſome of the enemy's poſts; becauſe then, by the [illegible] of the army, the enemy's infantry can come to the attack without being under the neceſſity of mounting behind the cavalry. A general, to whom [illegible] a convoy is intruſted, ſhould never ſeek any other advantage than [illegible] in ſafety, even though he ſhould be ſure of beating and taking a detachment belonging to the enemy: a real advantage is often given up by endeavouring to follow an uncertain victory. There is [illegible] when an officer hath done his utmoſt, and acted with prudence, than there is glory acquired in [illegible] when he hath exceeded the limits of his duty. [illegible] than whilſt he acts up to the orders he hath received with exactneſs and diſcretion; whereas he who, depending too much on his own courage, [illegible] himſelf to be drawn on by the appearance of ſucceſs, is not only charged with, but ought to be anſwerable for, the conſequences.

There ſtill remains another diſpoſition to be made in an open country, whether the convoy marches on a cauſeway or in the high road, which is to divide the eſcort into many equal parts, with troops of every [illegible] belonging to each; the firſt body ſhould ſet out an hour before the convoy is to begin its march, the ſecond half an hour after, with orders to the commanding officers to ſcour the adjacent country with great caution, and to be careful not to be cut off by any detachments the enemy may have in the country; for which reaſon theſe two bodies ſhould never be more than three quarters of a league diſtant from each other, by which means they will be within reach of aſſiſting each other. The body which ſets out laſt ſhould never be more than half a league before the advanced guard of the eſcort.

As the convoy is ſuppoſed to march through an open country, the above-mentioned diſtances are allotted between the firſt and ſecond bodies, and between the ſecond body and the advanced guard of the convoy; but if the country ſhould grow rough and unequal, theſe bodies ſhould draw cloſer together, and always keep ſight of each other, ſo as to be able to aſſiſt one another in caſe of an attack.

When theſe bodies are ſet out, the general muſt put the convoy in motion, and form the advanced guard of one of the [illegible] detachments belonging to the eſcort: the infantry of which detachment will remain at the head of the waggons, the cavalry ſhall march in troops [illegible] paces in advance, and the rear-guard muſt be formed equal to the advanced: but beſides this rear-guard, there ſhould be a body of huſſars and dragoons reſerved, to march a quarter of a league or more, according to the nature of the country, in the rear of the convoy; the remainder of the infantry ſhall be diſtributed at proper diſtances on the ſides of the convoy, and the remainder of the cavalry ſhall be placed on the flanks of the convoy, about [illegible] paces diſtance.

When a convoy happens to be of ſuch importance that its being taken [illegible] the remainder of the campaign, the general ſhould not only [illegible] a ſtrong or more [illegible] eſcort to it, but ſhould alſo [illegible] without being obliged to attack the enemy, ſhould keep between him and the road that the convoy keeps, [illegible] the enemy [illegible] he [illegible] of this method.

[illegible] encamped on the [illegible] convoy from Judoigne. As its ſafe arrival in th[illegible] of great conſequence, he cauſed the marqu[illegible] tiere, [illegible] ment in the [illegible]

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was to begin its march, with orders to march on the ſide of Ramillies. At the ſame time, he cauſed another detachment to ſet out from the camp of his ſerene highneſs the prince of Clermont, with orders to march on the ſide of the abbey of Rame: theſe two detachments, by amuſing the enemy on one ſide, and by entirely concealing the march of the convoy on the other, enabled it to proceed in ſecurity, and it arrived in the camp without having been at all moleſted.

In the beginning of the campaign in 1748, the ſame general having a deſign to lay ſiege to Maeſtricht, and conſequently having occaſion for all his troops, was willing to throw a ſupply of proviſions into Bergen-op-Zoom, as he was going to a diſtance from that place, and could no longer be in a ſituation of aſſiſting it. For that purpoſe he ordered a conſiderable convoy, which ſet out from Antwerp for that town under a good eſcort; but in order to prevent an attack, which circumſtance had often happened during the winter, and that with loſs, the allies at that time occupying a chain of quarters from Breda as far as Voude, he detached the count d'Eſtrees with a conſiderable body of cavalry to march on the ſide of Breda, with orders to puſh on detachments almoſt to Voude. This detachment had two objects in view; one of which was to keep the allies in ſuſpenſe with regard to the ſiege that was to be formed, and the other to cauſe them to remain near Breda. This large body of cavalry kept the allies, who were in the neighbourhood of that town, in ſuſpenſe; during which interval marſhal Saxe marched to Maeſtricht, the allies not daring to attack the convoy, becauſe they would have put themſelves between the eſcort and the troops under count d'Eſtrees. From theſe two examples may be concluded the neceſſity of covering convoys of importance by detachments, independent of the eſcort aſſigned them. In ſhort, a general ſhould do every thing that will contribute to the ſecurity of his diſpoſitions; and precautions ought never to be thought ſuperfluous when they are managed with prudence, and have for their end the ſucceſs of a well-concerted plan.

SECT. VIII. *Of Detachments for forming a Chain of green Forage.*

It is very difficult to provide a large army with forage; and a general often expoſes it to inevitable danger, if he is not thoroughly experienced in this operation, or if he is deſtitute of that knowledge which at once preſents all the wants of an army, and the means of ſupplying them, to his view.

Foraging parties, like convoys, are attended with a greater or leſſer degree of danger, according as the country is more or leſs acceſſible, and the forage at a diſtance or near at hand. The diſpoſition for the chain in an open country is different from what it muſt be in a mountainous one. When forage is within reach of the camp, and the enemy at a diſtance, fewer troops and attendants are required; becauſe, in caſe of an attack, there is aſſiſtance near at hand: but in proportion as the forage is farther from the camp and nearer to the enemy, the precautions ſhould be increaſed, and more troops ſhould be allotted to the chain, which ſhould alſo ſometimes be furniſhed with cannon.

A general ſhould never forget that maxim which ſays, The enemy muſt always be oppoſed by troops of the ſame nature as thoſe with which he makes the attack: if the forage, therefore, is in an open country, the chain, as it is certain the enemy will be more numerous in cavalry than infantry, ſhould conſiſt chiefly of cavalry, and only have infantry ſufficient to occupy ſuch poſts as are neceſſary to be guarded: in a mountainous country the diſpoſitions will be quite different; becauſe, as it is impoſſible for cavalry to move eaſily, the chain ſhould be ſtrongeſt in infantry. In ſhort, the number and quality of the troops for the chain ſhould be regulated in the ſame manner as in regard to the convoys; in proportion to the nearneſs or diſtance of the enemy; by the extent of ground to be foraged; and by the nature of the country: and as marſhal Puyſegur obſerves, before the ground to be foraged is examined, there ſhould be a calculation made of the number of horſes to be fed, and of the fertility of the ground that is to be foraged; for if it is a plentiful ſpot, a leſs extent will be ſufficient; if it is not plentiful, a larger muſt be taken; but in either caſe the chain muſt be always proportionable.

Before a forage is undertaken, the ground on which it is to be performed ſhould be always thoroughly known; in order for which the general ſhould ſend out in the evening, or the day before, the officer who is to command it, with a detachment, to ſurvey the ſituation of the country; the places where he muſt poſt his troops of cavalry and dragoons; the poſts which the infantry muſt occupy; the ground neceſſary for the foragers; that where the corps of reſerve muſt be poſted; and what part in the front of the chain it will be neceſſary for the huſſars to ſcour. After having examined all theſe particulars, the officer makes his report to the general, who, from the account given him, will order the troops neceſſary to ſecure the forage, and render the execution of it eaſy. The chain of forage ſhould be in proportion to the number of troops that are to forage, as well as to the quantity of ſown fields and the thickneſs of the grain. Beſides the horſe, dragoons, and infantry, there ſhould be huſſars to ſcour the country in the front of the chain: the number of them is undetermined, as it will be ſufficient for them to cover and protect the front, and give the commanding officer immediate notice of every thing that makes its appearance.

If the forage is to be made at a diſtance from the camp, the troops deſtined for the chain ſhould ſet out at day-break, or the evening of the foregoing night. The commanding officer muſt take care to eſtabliſh the chain before the foragers arrive, and alſo that the huſſars have ſcoured the country; firſt, becauſe the foragers ſhould not, by waiting, fatigue the horſes; and ſecondly, that no trooper or ſervant ſhall paſs; which will undoubtedly be the caſe if there is any vacancy where troops are not placed.

The whole of the troops ſhould be diſpoſed after ſuch a manner as to be able to ſee one another; and the vedets alſo, that are placed between the troops to prevent the foragers from paſſing, ſhould be within hearing. The infantry ſhould be poſted in hollows and villages and behind hedges, with horſe or dragoons to ſuſtain it and ſupport the flanks; and the diſpoſition of the chain will be ſtill better, if theſe troops can be mixed with it, provided the infantry can be ſheltered by any hollows, hedges, or buſhes.

Grenadiers, ſuſtained by horſe and cannon, if there are any, ſhould be poſted on thoſe ſides which, either from the ſituation of the country or the nearneſs of the enemy, are moſt liable to be attacked: but in reinforcing theſe poſts, the commanding officer muſt be careful not to weaken the chain too much in any particular part. When an enemy attacks a foraging party, he generally attempts to penetrate at different parts; but if he forms only one attack, the diſpoſition of the chain becomes uſeleſs, as all the troops muſt be brought to that part where the attack is made. But as it is naturally to be ſuppoſed the enemy will form many attacks, particularly if his general acts like a man underſtanding

underſtanding his buſineſs, he muſt be ſtrong in every part; the reſerve, which is in the centre, will, with expedition and ſpeed, ſend aſſiſtance to the parts which are attacked.

Before the commanding officer fixes the chain, he ſhould detach ſome huſſars to ſurvey and ſcour with great exactneſs the woods, villages, hollows, and all ſuch places, for at leaſt three quarters of a league or a league, in front, as may be capable of containing ambuſcades: and during the time of this ſurveying, the troops deſtined for the chain will remain in order of battle, in the front of the ground that is to be foraged, in order to cover it and protect the huſſars, in caſe they ſhould be attacked.

When this examination is finiſhed, the commanding officer may begin to eſtabliſh his chain, and the huſſars will remain in the front till the foraging is finiſhed; and will detach ſmall bodies to march round about the chain, croſſing each other, halting at times, and ſending ſome huſſars before them to patrole.

If the huſſars gain intelligence of the enemy's being either in march, or placed in ambuſcade, they will ſend immediate notice of it to the commanding officer of the chain, who ſhould always fix himſelf in a particular ſpot, that there may be no time ſpent in ſeeking him; his poſt ſhould be in the rear of that part of the chain that is neareſt to and moſt in front of the enemy, and he will regulate the diſpoſitions for his defence according to the report made to him. When an ambuſcade is diſcovered, and troops marching to attack, a general ſhould always ſuſpect there may be more ambuſcades, and more troops in march, to form different attacks; he muſt therefore, inſtead of weakening the chain in any part, ſtrengthen it as much as he can, by cauſing either the whole reſerve, or part of it, to march where circumſtances ſhall require.

The avenues and the heights in a mountainous country ſhould be occupied by infantry; the avenues, in order to prevent the enemy from penetrating into the valley or plain where the forage is made; the heights, in order to obſerve the enemy at a diſtance, and to prevent his getting poſſeſſion of them, and flanking the troops which guard the avenues. In this caſe there ſhould be a greater number of infantry than cavalry; no more of the latter being requiſite than what is neceſſary to ſuſtain and ſupport the infantry, in caſe it ſhould be attacked, repulſed, and obliged to retire through a valley or plain. Then, if it hath no cavalry to ſupport it, the wings will be entirely expoſed, and the enemy being ſuperior, can at the ſame time atack the front and the flanks; whereas, by the means of horſe, which can act with eaſe in a plain or a valley, this inconvenience will be prevented, and the infantry greatly aſſiſted.

If the forage is made at a diſtance from the camp, and in the neighbourhood of the enemy, the infantry guarding the avenues ſhould throw up ſome entrenchments in its front, which will be ſoon done; and it is then cannon becomes neceſſary, as there ſhould be two or three pieces planted at each avenue. The heights alſo muſt, on every occaſion, be occupied, which ſhould be conſtantly obſerved as a general rule, whether the enemy is at a diſtance or near at hand, in every diſpoſition that is to be executed in a mountainous country.

If the enemy forms one or more attacks, the ſmall eſcorts belonging to each regiment muſt join on the firſt order, and cover the foragers as much as poſſible, who ſhould at the ſame time aſſemble in the centre by regiments. The foragers ſhould always be provided with their carbine or ſword; and although they may not be very formidable againſt troops completely armed, yet there have been inſtances where they have charged with ſucceſs.

If it is in a plain, and the enemy, having formed but one attack, charges the chain in one particular part, the troops of horſe and dragoons which are oppoſite to him ſhould march up reſolutely and ſuſtain his efforts: if they are repulſed, they will be ſupported by the infantry that hath remained in its poſt; the huſſars which were in front will unite, and place themſelves upon the flanks of the troops which are attacked, in order to cover them, and endeavour to defeat the enemy by charging him in flank and rear. If the general is certain that the whole of the enemy's troops are engaged in this one attack, he may then bring up all the troops belonging to the chain, both cavalry and infantry, in order to oblige him to retire the ſooner: which if he does, ſome huſſars, ſuſtained by horſe and dragoons, ſhould be ſent in purſuit of him, till his retreat becomes certain; but with caution not to purſue too far, leſt he ſhould rally upon thoſe troops, who, being too far from the chain, cannot receive aſſiſtance ſo ſoon as would be neceſſary; and beſides, the making and accompliſhing the forage being the grand object, the commanding officer ſhould be contented with ſucceeding in that, without ſeeking for any other advantage unconnected with the original deſtination of the troops.

If the enemy forms more attacks than one, the foragers, who, as hath been already obſerved, muſt be aſſembled in the centre, ſhould have orders to take the road to the camp, and will re-enter it covered by the ſmall eſcorts from the rear-guard: but as a forage ſhould never be abandoned till the laſt extremity, they ſhould be ordered to draw up in order of battle, when they are within a quarter of a league of the camp, in order to return and complete the forage on the firſt order. But if the enemy is in force, and by his ſuperiority all hope of obtaining the forage is deſtroyed; or if it is made at ſo great a diſtance from the camp that the troops belonging to the chain cannot expect to be readily aſſiſted; the commanding officer ought to make a retreat, with every diſpoſition a good officer is capable of, and to join courage and vigilance with knowledge and experience.

If, on the contrary, the enemy is weaker, or of equal force with the chain, he ſhould be charged without heſitation; becauſe the enemy, regulating his attack by his defence, will be obliged to contract himſelf, in order to make his attack heavier and more conſiderable; ſo that the troops being united, will charge the enemy: and if, by the aſſiſtance of the huſſars who are advanced, and act after the manner already mentioned, the enemy is forced to retire, he muſt be purſued in the manner above directed; after which the troops muſt return and complete the forage.

As a commanding officer is, in caſe of a forced retreat after being beat, obliged to ſubmit to circumſtances, and regulate his diſpoſitions by the enemy's, he muſt retire with the greateſt order poſſible, cauſing the infantry to march in the centre, either in columns or in order of battle, as the ſituation of the ground will beſt allow; the horſe and dragoons upon the wings, the huſſars upon the flanks, that they may not confuſe the diſpoſitions, but ſerve as a ſupport for the chain, and prevent its being taken in flank; and the diſpoſition of the troops ſhould be ſo managed, that the enemy ſhall not be able to preſent a larger front than that which is oppoſed to him: and although it is impoſſible for a general to foreſee, for certain, what will be the diſpoſitions for an attack and retreat, becauſe they muſt be changed according as thoſe of the enemy alter, or as the nature of the ground varies; they ſhould nevertheleſs be ſo ordered, that each body ſhall be ſupported, and capable of acting without confuſion. It is only on occaſions thus preſſing, that the commanding officer ſhould ſuffer the forage to be abandoned; and even then it will be ſome ſatisfaction that he hath been able to place the foragers and their horſes in a ſtate of ſecurity.

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If, during the retreat of the chain, it ſhould receive aſſiſtance from the army, it ſhould charge the enemy, notwithſtanding its being too late to go on with the foraging; and if this charge ſhould prove ſucceſsful in either beating or cauſing the enemy to retire, he ſhould be purſued without intermiſſion, in order to deprive him of all deſire for repeating the attack. In order to improve this advantage to the utmoſt, the commanding officer ſhould leave a large detachment, conſiſting of infantry, cavalry, dragoons, and huſſars, to continue all night upon the ſpot, and the next morning betimes, the foragers, properly eſcorted, will come to take away the forage; and as ſoon as the eſcort is arrived in the front of the chain, the detachment which hath remained there all night muſt return to the camp.

There will remain many other precautions to be taken for the ſecurity of foraging parties, but the limits preſcribed to us will not admit of our ſtating them. We ſhall only add, that the foragers, in entering the ground they are to encompaſs, do not occupy more than is abſolutely requiſite, and that they do not ſpoil more grain than they carry away with them; firſt, becauſe by extending the chain it would be weakened, and become eaſier to be forced; and in the ſecond place, every prudent officer ſhould be an economiſt in the article of forage; the officers commanding the ſmall eſcorts which march at the head of each regiment ſhould be charged with the care of this. Theſe officers will cauſe their troops to march as much as poſſible through roads and over grounds which are untilled, till they arrive at the place intended to be foraged. If all the grounds are ſown, the commanding officer muſt cauſe the cavalry to diſmount at the place where the chain halts, and part of the troopers furniſhed with ſcythes muſt go and cut the grain, while the remainder hold the horſes; and when there ſhall be no farther room to fear damaging the forage, the cavalry will remount and take it up. Each place ſhould be marked out for a brigade or a regiment; which diſtribution ſhould be made by the ſtaff officers before the troops arrive.

Sect. IX. *Of the Detachments for forming a Chain of dry Forage.*

If there is great exactneſs and knowledge required in the conducting of parties for green forage, thoſe for dry forage perhaps require more; and, in general, every thing that regards foraging parties, whether green or dry, excites a particular attention in the commander in chief; and, according to the chevalier Folard, all ſucceſs in war depends upon ſecrecy, diligence, activity, and the thorough knowledge of the country.

The diſpoſitions for forming a chain of dry forage, which differ from thoſe for forming one of green, will direct the means for extending the chain in proportion to its ſtrength, and at the ſame time place the foragers in ſecurity; although, in parties of dry forage, the foragers generally take up leſs ground, according to the diſtance of the villages that are to be foraged from each other.

The diſpoſitions for a chain of dry forage are alſo varied according to the nature of the country; but whether it be open or mountainous, each different body ſhould be placed in that part where it can act with the greateſt facility: the infantry therefore ſhould occupy the villages, and the cavalry the plain in front, and ſhould be diſpoſed after ſuch a manner as to be able to retire eaſily to the protection of the infantry. Before the foraging is put in execution, the commander in chief ſhould mark out the villages to the general officer who is to command the foraging party, and regulate their number by the quantity of troops that are to forage. The firſt diſpoſitions will be the ſame with thoſe mentioned in the foregoing ſection in relation to green forage: therefore the general who is to command the forage ought to ſet out with a detachment in order to examine the ground, the poſts neceſſary to be occupied, the villages which are to be foraged, their ſituation, the rivers which cover or run through them, the bridges to be guarded, the diſtance from one village to another, and with what degree of eaſe the communication with them may be ſecured. After having thoroughly examined into theſe particulars, he can with eaſe form a judgment of the number of troops that will be neceſſary to form the chain and ſecure the foragers; after having done this, he will order the bailiff or burgomaſter of every village to come to him, and inquire of them the number of huſbandmen, and how many ploughs each huſbandman hath belonging to him; by which he will be able to calculate the number of ſheafs reaped by each huſbandman.

The general may, for every plough, reckon about 30 acres of ground; and, in proportion to the fertility of the ground, every acre will produce from 120 to 160 ſheafs: by this method may be computed the number of ſheafs reaped by an huſbandman who hath three or four ploughs; and from this calculation the general will judge whether the number of ſheafs, ſuppoſed to be in each village, will be ſufficient for the troops coming to them.

Let every acre of ground be ſuppoſed to yield 144 ſheafs; then a huſbandman who hath three ploughs will have reaped 12,960 ſheafs; ſo by reckoning 12 ſheafs to a truſs, and every truſs to weigh 600 pounds weight, this huſbandman will ſupply ſufficient for 124 truſſes. It is true, that ſome deduction ſhould be made from the number of truſſes that every acre may yield, as the huſbandman or farmer may have preſerved or conſumed ſome either for daily uſe or for ſeed.

It is very neceſſary that the general ſhould take care to leave ſufficient grain, not only to enable the huſbandman to live, but alſo to ſow his grounds; particularly if he foreſees a probability of the next campaign being carried on in the ſame country.

Nevertheleſs, as this manner of reckoning may be attended with inconveniences, becauſe there are ſome villages which keep up a particular trade of forage and grain, and therefore the granaries and barns may ſometimes be found empty, yet the quantity of ſheafs and grain remaining in the village may be calculated by the number of inhabitants to be ſubſiſted. Marſhal de Puyſégur's method, which conſiſts in informing himſelf of the number of horned cattle and horſes, and by deducting the time they graze, is a very good one; but ſtill there muſt be ſome deficiency in this calculation, as it will be impoſſible to fix with certainty the time of their grazing.

When the general ſhall have arrived at a tolerable certainty of the quantity of forage; the ground where to eſtabliſh his chain; the poſts which the infantry are to occupy; and taken a note of the quantity of forage; he will carry away one or two of the bailiffs or burgomaſters, as hoſtages for the ſecurity of the forage: he will alſo direct them to inform the inhabitants, that if they conceal or purloin but even a ſingle ſheaf from the whole, he will cauſe their village to be firſt pillaged, and afterwards ſet on fire; ſo that the peaſants, on whom theſe threats have often great effect, will ſcarcely give the enemy information of the intended forage. The general muſt leave ſome companies of infantry, ſuſtained by a detachment of huſſars in every village, who, by conſtantly patroling on the outſkirts, will ſtop all comers and goers; while the infantry will keep a ſtrict guard on the inſide of the village, and permit no perſon to go out of it; nor ſuffer the bells to be rung,

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colours to be hoisted upon the steeple, or fires to be lighted; and will put a stop to every thing that may be supposed to be a signal agreed on with the enemy. When the general hath completed all these dispositions, he will return and give an account of them to the commander in chief.

The same general shall, upon the day appointed for the forage, set out at day break, with the troops destined for the chain, and the staff-officers. As soon as he shall be got within sight of the villages, he will not fail to have them examined, notwithstanding he left troops in them the foregoing evening. When they are all examined, he will leave them in the rear, march on into the front, and draw up in order of battle; after that, he will form the chain, regulating the dispositions of it by the situation of the ground, and of the villages examined over-night. The hussars will advance three quarters of a league or a league, in order to scour the country; during which time the staff-officers, instructed by the general of the quantity of sheafs contained in each village, will, attended by the bailiffs or burgomasters, make a distribution of the forage by regiment or brigade, and assign a barn to each, or one to two. When this distribution is made, the staff-officers will make a report of it to the general commanding the party.

As all the villages marked out to be foraged are not in the same line, those which are in the rear, and covered by others in which there is infantry, and by the chain of horse and dragoons in the front, require but a small number of troops; and if a detachment of infantry is posted in them, it is more with a view of preventing the troopers and servants from marauding than any thing else.

The escort belonging to each regiment, commanded by a captain, should remain upon the spot where the regiment forages, and, with the assistance of the infantry, prevent disorder among the foragers, and send off those who are loaded. As soon as a regiment is set off, the captain commanding the small escort must report it to the general officer commanding the forage; after which he will follow, and form the rear-guard of it.

As soon as the general shall be apprised by the staff-officers, and the captains commanding the small escorts, that a village is evacuated, he may contract his chain, and draw it nearer together, till the foragers are gone; which when they are, he will assemble his troops, and detach as many platoons of infantry as there are villages: or rather the body of infantry posted in each village during the forage, should leave a party to make a strict search after all stragglers and marauders; the first they should keep with them, and make the others prisoners, and punish them severely on their return to the camp. When all the different bodies shall be re-assembled, and the officers commanding them have made the report, the general will order the hussars to be called in, and form a rear-guard according to the manner directed in the foregoing section, and return to the camp in the same order, and with the same dispositions, as if he expected to be attacked.

PART II. Of the OPERATIONS of OFFENSIVE WAR.

JUSTICE and humanity having been considered, in this article, as the first principles of war, the chief intention of the first part hath therefore been, rather to convey maxims for a just defence, than to lay down rules for attacking. But though defensive war be that alone to which religion and philosophy give their sanction, it does not follow that a nation is bound to wait patiently for the attack of its enemies. When the conduct of other nations is such as evidently to show that they meditate a war, the nation threatened may arm itself, and strike the first blow when it can be struck with advantage. There is only one precaution for avoiding the danger with which it is beset. By observing the various operations of an offensive war, it may indeed be often seen that the whole is nothing more than a series of defence, and that the fear of being attacked is the real source whence these precautions for attacking spring.

SECT. I. *Of Spies.*

It is impossible for a general, or even for an officer charged with the command of a detachment, to act with certainty if he have not spies or secret intelligence dispersed about the enemy's army; for, without the information which they alone can give, he will have the mortification to see all his designs miscarry, and all his precautions become useless, because improperly taken.

No expence therefore should be spared to procure intelligent spies; but care should be taken that they are unacquainted with each other, and particularly that they are not known to any inferior officer: they should be always spoken to alone, and never be suffered to meet each other. The general should study their character, and prove them by repeated trials; he should sound them by degrees, beginning with things not difficult to be explained, and which, if discovered, will not be of great consequence; he should engage them in long conversations, thereby to form a judgement of their parts and comprehension; and he should also employ them often in bringing him intelligence.

Although a general should always be upon his guard with a spy whom he hath cause to suspect of treachery, he may nevertheless draw great advantage from him, provided he knows how to deceive him properly; because he may be very certain he will inform the enemy of all the resolutions which have been taken.

The emperor Leo, in his Tactic, advises a general, who hath reason to imagine his counsels are betrayed to the enemy, to conceal his real designs, by speaking in a manner quite opposite to them: For, says he, in the maxims at the end of his book, an enemy must be deceived who receives intelligence from spies or deserters directly contrary to what is actually resolved upon. But, adds he, should these spies be entrusted with the general's real intention, he should, by some alteration in his operations, endeavour to persuade the enemy that they have deceived him; upon which he will grow mistrustful of them, and be obliged to look out for others, no longer daring to confide in the former.

If a spy employed by the enemy is discovered, and brought to the general, he ought to take him in private, question with mildness, speak to him with a sort of confidence, and, instead of threatening, should promise him a reward if he will discover to him what he knows of the enemy's intentions. If the general finds him intelligent, he should endeavour to engage him in his service; and, provided he can gain him over by force of money, a thing not difficult, he may derive great advantage from him; but he should be careful how he employs him, till he hath very good reason to be assured of his fidelity.

There are many different methods of trying the veracity of a spy: if, for example, the general receives information, that, on such a day, a detachment of the enemy is to set out on some expedition, he should then send out troops to double the number of those detached by the enemy; by

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which means, if the ſpy's intelligence is true, the enemy will not only be baulked in his deſign, but may alſo be beat by the ſuperior detachment. If the enemy's detachment has but a trifling object in view, it will be ſufficient to ſend juſt troops ſufficient to examine into the truth of the ſpy's report. The general may alſo pretend to appoint a foraging within two days, and order but few troops for the chain; in which interval, if the ſpy is falſe, he will find an opportunity of giving the enemy notice of it: but, inſtead of the few troops publicly ordered, the general will privately add another body to them, which will be placed in ambuſcade behind the place where the pretended forage is to be made. If the enemy, in conſequence of this information, ſhould come and attack the chain, it ſhould immediately retire, as if too inferior in number to continue the forage, toward the troops in ambuſcade; when, being joined, they will fall upon the enemy on all ſides. If this attack is made with vivacity and reſolution, there may be great reaſon to expect it will terminate in a complete victory.

If, on the contrary, the ſpy does not appear intelligent, or affects ſtupidity, the general ſhould puniſh him with death, and cauſe him to be hanged in the ſight of the whole army, in order to deter others, which may be diſperſed in the camp, by his fate. It would be needleſs to queſtion him concerning the enemy, becauſe it would appear inhuman to execute a man who had given intelligence of importance, whether extorted from him by fear, force, or perhaps a promiſe of pardon.

Spies are as neceſſary to a general as arms are to an army: but it is money only that can ſecure their fidelity; and if a general finds himſelf ill ſerved, it is becauſe he has been too ſparing of the funds intended by his ſovereign for that purpoſe. Notwithſtanding it is the duty of a good ſubject to manage his maſter's finances as much as it is in his power, yet there are intelligences of ſo great importance, that it is ſcarcely poſſible to pay ſufficiently for them. A man is ſufficiently indemnified when, by means of the intelligence he has received, he has concerted his meaſures in ſuch a manner as to beat the enemy, gain ſome marches over him, or to be beforehand with him in ſome enterpriſe.

Spies, when diſcovered, ſhould not always be puniſhed with death; great advantage may be made of them by pretending ignorance of their real quality, eſpecially if they are not ſufficiently diſguiſed. Tacitus, in his Annals, ſays, that Vitellius's party got information of Otho's deſigns by means of his ſpies, who, by endeavouring to dive too minutely into their enemy's ſecrets, did not ſufficiently conceal their own. Vigetius's method for diſcovering ſpies who are ſuſpected to be ranging about in a camp, is to order all the ſoldiers and ſervants into their tents during the day, and the ſpies will be taken immediately.

When a general is ignorant of the enemy's deſigns he ſhould always affect a knowledge of them; but whenever he is informed of them, he ſhould, on the contrary, pretend to be ignorant of them; by which means the enemy, being eaſy with regard to his ſpies, will not alter his deſigns, or ſuſpect the general of having any knowledge of them.

If the general can procure ſuch ſpies as, by their employment, are near the perſon of the enemy's general; as, for example, a ſecretary, or any others who are near him, and who conſequently can give intelligence more to be relied upon than thoſe who are conſtantly paſſing from one army to another; their ſervice may be turned to a very great account.

If a general diſcovers an enemy's ſpy to be one of thoſe who, by their employment, are near his perſon, he can receive great advantage, by forcing him to write a letter of falſe intelligence, thereby to divert the enemy's attention from the plan he would execute; but he ſhould cauſe him to be hanged immediately after, for it would be very imprudent to uſe him above once. The prince of Orange, when he came to attack M. Luxemburg at Steinkirk, having diſcovered one of his muſicians who gave the enemy intelligence of every thing he intended, made uſe of this ſtratagem; and although it was rendered abortive by the vigilance of M. de Luxemburg, and the courage of his troops, there are nevertheleſs but very few inſtances where it hath failed: and even M. de Luxemburg would have been beaten, if he had not had early notice given him by his advanced detachments; by which means he had time ſufficient to make his diſpoſitions, and to avoid being ſurpriſed.

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There is a ſtratagem which may be made uſe of when ſpies are wanting, and which is leſs expenſive; that is, to ſend ſuppoſititious letters by the firſt peaſant that comes in the way, who will have nothing to fear; and ſo far from concealing himſelf, he muſt take a road where he will be ſure of falling into the enemy's hands: theſe letters ſhould be directed to the general officers commanding a body of troops, or even to the general of the army, ſuppoſing they come from an advanced body. They ſhould contain ſchemes that are good, and practicable in their execution, but quite oppoſite to what is intended and will really be undertaken: it often happens that the enemy, too credulous, abandons his original deſigns to purſue chimerical ones, which to him appear very good, and do not preſent any obſtacle to thoſe which the general deſigns to execute. Prince Eugene ſucceeded, by this ſtratagem, in raiſing the ſiege of Coni, formed by the French in 1691.

But nevertheleſs a general ſhould take care that, through a fear of being deceived by ſuppoſititious letters, he does not himſelf too much neglect the intimations which are given him: a general ought, ſays Onozander, to liſten to every body at all times, and upon all occaſions. Alexander, when at a great diſtance from his own country, not being able to receive his couriers till very late, refuſed to give attention to a peaſant, who came to inform him of a ſhorter route; but ſoon repenting of what he had done, he ſent to ſeek after him, but in vain.

The ſame reaſon that ſhould make a general always have ſpies in the enemy's army, ſhould alſo make him ſuſpect that the enemy has ſome in his; therefore he ſhould endeavour to deceive them, he ſhould keep his intentions ſecret, mention them to very few, and always talk openly, contrary to what is really deſigned. Onozander obſerves, that it ſhows great folly in a general to mention his deſigns publicly, eſpecially when they are on the eve of execution; for deſerters generally go over to the enemy at the time an action is unavoidable.

But if it is diſcovered that the enemy has received information, Vigetius ſays, that the diſpoſitions muſt be immediately changed. Polybius, on like occaſions, particularly recommends ſilence and diſſimulation; he even ſtretches this rule as far as the thoughts themſelves, which he ſays muſt ſometimes be repreſſed, for fear our actions ſhould ſometimes betray and diſcover them. Metellus anſwered one of his friends, who, on an important occaſion, aſked him the reaſon of certain diſpoſitions, "that if his ſhirt knew what he thought, he would burn it."

To avoid the danger of treachery, ſealed orders have been uſed with great ſucceſs, which have been ſent to officers, with expreſs orders not to open them till at ſuch a time and at ſuch a place: this is an eſtabliſhed rule at ſea, and can alſo be practiſed on ſhore when employed in an expedition which it is eſſential to conceal from the enemy.

SECT.

Sect. II. *Of Ambuscades from the Army.*

A general who loses a battle, says Vegetius, may attribute his ill luck to fortune, although these kind of events are generally the effects of art and skill; but he who suffers himself to be surprised, and who falls into the snares laid for him by the enemy, has no excuse to make, because, by his vigilance, and the goodness of his spies, he might have avoided them.

A design should never be formed for an attack upon marches, detachments, convoys, forages, or upon one or many quarters, without knowing the ways which are to be passed, and the places where ambuscades may be formed; whether to avoid, or whether to conceal troops in them, in order to facilitate a retreat, or to draw the enemy into it. A general who receives information from his spies that some enterprises are intended upon some bodies detached from the army, upon one of his convoys, on a forage, or upon his quarters, ought also, on his side, to form ambuscades in the ways leading to it. The number of troops in ambuscade ought to be regulated by that of the detachment intended to be surprised; it should be sufficiently strong to attack the enemy on all sides, that is, in head, flank, and rear. The troops who set out to form an ambuscade should always march by night, unless it be in a country so covered that the enemy cannot perceive them.

A general, according to Santa Cruz, should endeavour to form as many ambuscades as possible; so that if the enemy should not fall into one, he may not escape the others: they ought to be disposed after such a manner, that one can neither attack nor be attacked without being heard, sustained, and assisted by the others: this junction is a stratagem which the enemy could not expect, and which will assure the victory. If, from the fewness of the troops, or the fatigues of the campaign, it is impossible to form many, there should at least be one sufficiently strong to resist the enemy it would attack: but still it is not requisite that it should be as numerous as the enemy, because troops in ambuscade, who charge a detachment that is unprovided on all sides, ought, by this surprise, to have a particular advantage, and consequently supply the place of number; which will certainly be the case, particularly if the enemy falls into the ambuscade during the night, and that care hath been also taken to place a great number of drums and trumpets, that when the troops of ambush charge, they may serve to increase the numbers in appearance, by the terror which noise always raises in the night-time.

In order to deceive the enemy who is in detachment, small bodies should be sent out towards him, with orders to retire to the troops in ambuscade as soon as they meet him.

Ambuscades should always have some object. Before they are undertaken, it should be known whether the enemy is in the field; if he intends either to attack or molest the quarters; whether it is proper to wait for him or to seek him: without these precautions the troops will be fatigued, and no end answered.

Ambuscades may be composed of infantry, hussars, or dragoons; but it is the situation of the country that must determine which. These troops may be mixed together or sent separately; but that must be according to the design intended to be executed, or according to the nature of the troops employed by the enemy in his detachments.

If the design is to attack a convoy, all these troops are necessary, because the escort of it will undoubtedly consist of infantry, cavalry, or dragoons, and also some hussars to clear the march; if a green forage, infantry is very necessary, but it should always be left in the rear to secure the retreat: cavalry, with hussars or dragoons, is sufficient to attack a forage, to beat the escort of it, or at least to prevent the foraging being executed. If a dry forage is to be attacked, it must be done with infantry, because, as it can only be performed in the villages, it is certain they will be occupied by infantry, and that there will be a chain of cavalry in the front, which will be protected by it: if a detachment, it is according to the nature of the country through which it marches; if an open country, horse, hussars, or dragoons, must be employed; but in a woody or mountainous country, infantry must be made use of. After all that can be said, it is impossible to lay down fixed rules for the kind of troops which should be employed: there are some woody countries where hussars and dragoons can act with ease, and be of great service: there are mountains where they can act securely, because very fine plains, divided by woods, are to be found in the bodies of them, where they can place themselves in ambuscade; but care must be taken to secure their retreat. There are, on the other hand, plains so divided by hollows and canals, that infantry only are capable of acting; therefore it is the general's business to discover from which kind of troops, in either country, he may expect the greatest advantage.

There is no country but presents some place proper for forming ambuscades; hollows from which it is easy to sally, the least height, woods, hedges, ruins, vineyards, sometimes corn-fields, marshes covered with reeds, all present expedients to a general who knows how to take advantage of them: he must only be careful to place the ambuscades after such a manner that they shall not be discovered by the enemy's parties; and that they are not themselves discovered by the inattention of any of the soldiers, by noise, or by other accidents.

If the ambuscade consists of hussars or dragoons, the horses must not be together; their neighings may prove very prejudicial. Even a peasant, attracted by the barking of a dog or the neighing of a horse, may go into a wood, discover an ambuscade, and, often induced by the hope of a reward, will go and give the enemy information of the whole. Every person passing near an ambuscade should be stopped, and that without noise; the peasants should be tied to trees, and guarded by sentries. If the ambuscade is formed in an hollow way, behind an high ground, or in any places whatever, the general must cause every body that is taken to be tied together, and well guarded.

The troops in ambuscade must fall on all parties of the enemy that pass near them, unless when the design is to carry off a convoy or to attack a large detachment. It should in that case continue silent, and let them pass: but if these parties, by making a strict examination, discover the ambuscade, as there can no longer remain any hope of attacking the convoy or detachment, it should fall upon and endeavour to surround them, and, if possible, take them prisoners; and if the troops in ambuscade are so lucky as not to let any of the enemy escape, the ambuscade may remain in its first situation, but always pursue its first object, because here will be no reason to apprehend the enemy's having received intelligence of it.

The troops in ambuscade should attack these parties sword in hand, and not with their fire-arms, and, if possible, prevent them from using theirs. From this manner of attacking, there will result two considerable advantages The first is, that a brisk and unexpected attack astonishes, and scarcely gives them time to think of their defence. The second is, that, by firing, it is to be feared that if there are any other parties farther off they will hear it, and send and give notice. In that case, the ambuscade must change situ-

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ation, and place itself in some other part, but not abandon its original project till the last extremity, and till there is no longer any hope of succeeding otherwise.

The least thing, as has already been said, may be the occasion of an ambuscade's being discovered. The fire of a pipe may be seen at a great distance in the night-time: besides, however small the number of soldiers who smoke may be, the wind may carry the smoke and the smell of the tobacco toward that part where the enemy patroles. The ambuscade should not be cumbered with servants, or any thing else that is unnecessary; orders should be given that the horses are tied with care, and that a profound silence is observed by every body. As it is very difficult for hussars or dragoons to march without leaving marks behind them, by which means the road leading to the ambuscade may be discovered, they should try to enter it by some bye-way, or at least by as dry a one as possible. In order to efface the marks of the horses feet, eight or ten hussars or dragoons may tie branches of trees to their horses tails, and, by marching behind the detachment, in as large a front as the whole body, will destroy any marks that are made: as soon as they shall have entered the wood, they will close up the entrance with the same branches, of which they will make a sort of hedge.

If the detachment intended to form an ambuscade, whether infantry or cavalry, is obliged to march upon a high-way, as soon as it comes near the place appointed, the commanding officer should detach a body on before, with orders to take up the same front as the whole detachment. As soon as it shall have proceeded a quarter or half a league, it will return by another way; and it should also make a large circuit, so that the enemy's parties, coming the same way, will not perceive that they shall be stopped by any troops in that place. This body will rejoin the troops which are in ambuscade, by a road the most out of the enemy's view, never in a body, but scattered, so that they may leave fewer marks behind them. Sentries should be concealed behind bushes, in the front of the ambuscade, so that they may be able to see the country and ways about them, without being seen themselves: two or three soldiers should also be made to climb into trees, in order to see at a great distance, and give notice if they perceive any troops; the same method must be observed with regard to hussars or dragoons.

Before the commanding officer enters the wood where he would form his ambuscade, he should detach two or three patroles to scour it, for fear the enemy should happen to be there in ambuscade himself; after every part has been searched, the troops must enter the wood, and range themselves according to the order that shall have been given them. The commanding officer will form three bodies of his detachment, and place them at a distance one from another; one will be destined to attack the advanced guard, the other the centre, and the last the rear-guard. If the detachment consists of cavalry, the half of each corps should be on horseback; no persons should slip or pass the sentries or vedettes under pain of being declared deserters. During the night, the cavalry should be mounted, and the infantry under arms: in the day-time, half those on foot will relieve those on horseback every three hours; and the same should be done with the vedettes, as well as the infantry and sentries.

If the ambuscade is behind an height or small mountain, sentries must be placed on the top, lying on their bellies, and without hats: in other respects the same dispositions ought to be observed, whether on the march or for the conducting of ambuscades, always paying a proper regard to circumstances and the situation of the country.

There are divers methods of drawing the enemy into ambuscades. The general commanding the army or quarters sends out a detachment under the command of an intelligent officer, to form an ambuscade, at the distance of one or two leagues, more or less, according as the country is fitting for those sort of dispositions, or according to the distance of the enemy. The general must acquaint this officer, that two hours after he is set out, he will send out another detachment, of less force, with orders to go on the side where the enemy is, to endeavour to meet him, and at first sight to make a feint of charging him; but, as if finding him too strong, he will begin his retreat, directing it toward the place where the troops are in ambuscade: furnished with these instructions he will set out.

Then the general will send for the officer intended to command the detachment that is to go in search of the enemy, and inform him of that which is set out to form the ambuscade, and of the place where it is; he will order him to advance as near to the enemy as he can, and to draw him by a feigned retreat upon the troops in ambuscade.

These two officers should be the only persons informed of the design: but nevertheless the commandant of the detachment which is to go towards the enemy, may communicate it to the principal officers under his command; so that in case he should be taken or killed in the retreat, he that succeeds in the command may be able to act according to the general's intentions. He must be particularly careful, that no soldier, trooper, hussar, or dragoon, penetrate into the design of the detachment, as it would then be in the power of a single deserter to make the ambuscade miscarry. The detachment which is to go and seek the enemy, in order to draw him into the ambuscade, ought to be composed of hussars, unless the country be of such a nature that infantry only is capable of acting.

During the time that the hussars are gone before, endeavouring to draw on the enemy, the troops in ambush will be on horseback, and waiting in silence for their commander's order to go out and charge. As soon as they shall have charged and beaten the enemy, for fear lest another detachment, at a little distance from that which has been beaten, should come to its assistance, they will take the shortest way, and march leisurely, but with order, towards the camp or the quarters. The detachment which drew the enemy into the ambuscade, must form the rear-guard of it, and will march slowly on, while the rest of the troops will retreat, conducting the prisoners with them. If the enemy sends any succours, as soon as the rear-guard perceives them, it will double its pace, but with order; there will be no reason to apprehend the enemy's coming too briskly upon it, because he will be fearful of falling into another ambuscade: thus the rear-guard will retreat with ease, and the troops who conduct the prisoners have time enough to reach the camp, without any molestation.

It is on these occasions that a man should know how to keep his courage within proper bounds, and be sensible that flight is glorious: the despair of an enemy that is surprised, and even beaten, is always to be feared, when he is not entirely defeated. A man should always be content with one victory, without attempting a second: he may, by pursuing the enemy too eagerly, fall himself into ambuscades more dangerous than that he has just drawn the enemy into.

If there is reason to apprehend that the enemy, having notice from some deserters, are coming in full strength, the ambuscade must then change its situation and draw nearer to the place from whence it set out. This will serve two purposes; for should the enemy appear in force, the ambuscade will have the shorter way to retreat; or it may again happen that

that the enemy, not finding the ambuſcade in the places pointed out by the deſerters, will imagine it to be retired, and, in that belief, will neglect the precautions neceſſary in ſuch a ſituation.

An ambuſcade that is ſucceſsful may cauſe the deſtruction of a whole army. The example cited by M. de Feuquieres, in his Memoirs, on that head, is ſtriking. M. de Luxemburg, ſtill attached to the prince, took all the baggage belonging to M. Turenne's army, becauſe the lieutenant general who commanded the eſcort did not foreſee that the enemy, ſhut up in his lines of circumvallation before Arras, having two armies near his camp with a deſign of attacking him in his lines, could think of ſending out a large detachment of cavalry on an enterpriſe of ſuch a ſort. In the mean time M. Luxemburg, who was in ambuſcade, within reach of the column of baggage, ſeeing that the lieutenant-general was gone on before with the head of the eſcort, imagining the baggage in ſecurity, marched ſpeedily to the head of that column, whoſe march he ſtopped, and turned toward St Pol, where he conducted the whole baggage belonging to M Turenne's army, without his knowing any thing of the matter. It is thus that, by the negligence of an officer, and by an ambuſcade ſeaſonably placed, an army finds itſelf ſtripped of all its baggage, and, as may be ſaid, not in a condition of continuing the campaign.

If this lieutenant-general had been provided with ſpies, detachments in front and on the flanks, theſe detachments would have diſcovered the ambuſcades, and, by the precautions uſual on ſuch occaſions, he would have placed the baggage of the army in ſafety. Again, his ſpies would have given him notice, that a large body of cavalry was detached from the camp before Arras, conſequently he would have been upon his guard; inſtead of which, being full of a falſe confidence, he marched as if in a champaign country, and, by this unpardonable remiſſneſs, occaſioned the loſs of the whole baggage. An officer who commands a detachment for any expedition whatever, cannot poſſibly take too much care to foreſee the checks that may happen to him; if he is beaten, it ſhould be wholly owing to a ſuperiority of force. He who, after having taken all the precautions poſſible, is beaten by an enemy who has the advantage of number, has nothing to reproach himſelf with: but he who, with ability, has nevertheleſs neglected certain precautions, and is beat becauſe they were not taken, is certainly culpable in the eyes of intelligent men.

Sect. III. *Of Camps in offenſive War.*

To take an advantageous poſition for an army; to make choice of a ſpot that by its ſituation is ſtrongly ſecured; to eſtabliſh a camp there, and to be alſo able to have the army within diſtance of marching eaſily to the enemy, without fear of being moleſted; in ſhort, to throw ſuch difficulties in the enemy's way as may prevent his haraſſing the army, is one of the moſt eſſential branches of knowledge for a general. He who is endowed with this talent can, with an inferior army, not only make head againſt the enemy, but alſo cauſe his deſigns to miſcarry; fatigue him the whole campaign by marches and counter-marches, which lead to nothing; oblige him to remain inactive, and at length draw him into a favourable poſition, where he will be morally ſure of beating him. All this was done by M. Turenne in 1675, who, after having exhauſted every expedient wherewith his military knowledge could furniſh him to draw M. de Montecuculi into a diſadvantageous poſt, at length ſucceeded, found an opportunity of attacking him, and gloriouſly fell at the inſtant victory declared itſelf in his favour.

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Before a general takes the field, he ought to be very certain what number of troops he ſhall have, that his magazines both of war and proviſion are ready, as well as the waggons, pontons, and all other implements whatever that are neceſſary for an army; for events may happen that it is almoſt impoſſible to foreſee, and which often alter the beſt concerted deſigns. But when every thing is in order, a general poſſeſſed of the neceſſary talents can foreſee the event even before taking the field: he will know beforehand the marches he is to make, the camps he is to occupy, and thoſe which the enemy will endeavour to ſeize in order to oppoſe his deſigns.

An offenſive war is undoubtedly carried on with greater eaſe in an open than in a mountainous country. But whether in the one or in the other, no ſuperiority of number ſhould make a general neglectful of the ſafety of his troops in their camp; he ſhould always be aſſiduous in preſerving the ſtricteſt order and diſcipline among them; one or two checks are generally ſufficient to diſcourage the ſoldier, and take away that confidence which he ought to have in his general: the advanced poſts ſhould be well guarded, the flanks ſecured, and detachments frequently ſent out towards the enemy; for as ſucceſs is inſured by vigilance and care, ſo negligence and ſlack diſcipline are ruin to the moſt formidable army, and entertaining a contemptible opinion of an enemy renders him more daring.

It is to be obſerved, that a camp ought never to be fixed on the banks of rivers; but a ſufficient ſpace ſhould always be left between them and the camp, to draw out the army in order of battle. If this precaution is not taken, it may happen that the enemy, encamped either near to or at a diſtance from the other ſide of the river, being informed of the poſition of the army, will come in the night to alarm the camp, and by a diſcharge of artillery and ſmall arms throw the whole camp into confuſion, without riſking the loſs of a ſingle man. For this reaſon, a camp ſhould always be placed at leaſt eight or ten hundred yards from a river; ſo that the guards may be advanced without being expoſed, and within the circumference of the camp and compaſs of the guards the army may be ſupplied with forage for at leaſt four days, and more if poſſible.

There are ſome ſituations for a camp which are in appearance ſtrong, but may notwithſtanding prove very dangerous, if care be not taken to examine whether or not the army can with eaſe come out of it, to form itſelf in order of battle: or whether the enemy can prevent it, by blocking up the avenues and outlets. If this precaution be not taken, an army may be the means of ſhutting itſelf up; as was done at Seneff in 1674, and by the allies at Aſchaffenbourg in 1743.

The choice and ſtrength of a camp depend on the poſition of the enemy and ſituation of the country: a general ſhould always avoid encamping the cavalry in a wood, and ſhould be particularly careful that the wings are ſheltered; the woods ſhould be occupied by the infantry, and entrenchments thrown up in front, according to the deſigns intended to be put in execution. If the wings are ſheltered by a village, it ſhould be entrenched, and infantry poſted in it; and the camp ſhould be covered by a river as much as poſſible, unleſs the intention is to march towards the enemy; then all the obſtacles that can prevent the army coming up with him ſhould be avoided: but if, from [illegible] of the enemy, or from his ſuperiority of troops, the general cannot determine upon opening the campaign [illegible], he muſt [illegible] to [illegible]; [illegible] ſhould ſtrengthen himſelf in his camp, [illegible] on the banks of the river, and cover them by continual detachments of light horſe; who, by extending [illegible]

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will prevent parties of the enemy from paſſing to ſeize on the hind parts of the camp, moleſt the convoys, and attack the foragers.

Whatever may be the nature of the country, it is often neceſſary to have corps detached from the body of the army, to cover or keep open a communication with ſome place, in order to prevent the enemy from foraging too near the camp; to preſerve the forage; to raiſe contributions at a diſtance; to occupy ſome advantageous poſt; to oblige the enemy to divide his forces in order to oppoſe that body; to cover the camp either in the front or on the flanks, according to that ſide which is left moſt unguarded and expoſed: in a word, there ſhould always be continual detachments toward the enemy, as hath been the practice of many generals, and particularly of marſhal Saxe. The ſtrength of this body is to be proportioned to the uſe deſigned for it by the general; but it is uſually compoſed of light horſe, ſome regiments of light infantry, and a brigade or two of dragoons. In the end will be ſeen what uſe ſhould be made of this body; but in whatever ſituation it is to be placed, the communication between it and the army muſt always be kept open, that it may at any time be able to join it on the firſt order; and its camp muſt be ſo choſen, that the general may always receive intelligence from it of the leaſt movements made by the enemy. See Plate DXVII.

In every country, and on every occaſion, a camp is always defective if the wings are not ſheltered, or can be eaſily diſtreſſed by the enemy; if the front is not guarded and the rear well covered; if the communications with the frontier towns are not ſecure and eaſy; if there is any want of forage, wood, and water; and if there are not detachments in front, to prevent the enemy from approaching the camp.

A general who joins experience and ſtudy together, ought to ſee into the intention of the enemy's general, and judge of his deſigns by any of his proceedings, however trifling. All thoſe who are deſtined to the command of armies cannot indeed be endowed with this quick and exact eye, that ready power of judging of a good motion or a good poſition upon the ſpot. Some generals have excelled in marches, others in the poſition of camps; theſe in the arrangement of troops in order of battle, thoſe in their conduct in time of action; others in providing ſubſiſtence, others in projecting a campaign. There have nevertheleſs been ſome of theſe great men, whoſe genius and temper have united and carried all theſe qualifications to the greateſt degree of perfection; but the rarer theſe examples are, the more a man ought, by continual ſtudy, to endeavour to augment their number, and ſtrive to merit the honour of being enrolled among thoſe heroes, the ornament of mankind, their country's ſupport, and their maſter's glory.

SECT. IV. *Of the Attack of an Army on its March.*

HOWEVER difficult certain operations in war may appear, they are nevertheleſs not impracticable when a general knows how to take the neceſſary precautions for leſſening thoſe difficulties. The attack of an army on its march ſeems to be above all reach of attempting; whereas the ſucceſs of ſuch an attempt depends only upon knowing how to take proper meaſures, on chooſing the ground, and on ſeizing a favourable opportunity.

When an army would attack another upon its march, it ſhould endeavour to be beforehand with it, and, by the means of ſtolen marches, come up with it before it can know any thing of the matter: ſome parties ſhould be detached, who muſt place themſelves in ambuſcade, in order to ſtop all the comers and goers, ſo that the march and deſigns of the army may be kept ſecret from the enemy. Whenever a general hath determined to attack his enemy, he ſhould ſend off all the baggage, both great or ſmall, belonging to the army; and it ſhould be left in the rear under a good eſcort, near enough to join after victory, without the army's being obliged to wait three or four days for it.

The general ſhould be well aſſured of the day on which the enemy's army ſets out; or the country through which it is to march; whether it is an open, mountainous, or woody country; if it is divided by rivers; whether there are many bridges to paſs; and in how many columns it marches: he ſhould alſo get all poſſible information of the diſpoſition of it. In the third ſection of the firſt part, relative to the march of an army in an open country, the diſpoſition which it ought to make, in caſe it preſents its front or flank to the enemy, hath been laid down. The general deſigning to attack ought to regulate his diſpoſitions by thoſe which the enemy hath taken, and which he can only know from his ſpies; but if he cannot receive any information concerning them, the beſt rule for him is to ſuppoſe them good, and to form his own accordingly.

As in the caſe of a ſurpriſe there cannot be ſignals given, without running the riſk of the enemy's diſcovering that he is going to be attacked; it is therefore neceſſary, that every general officer leading columns ſhould have a watch, regulated by the general's, ſo as to march all at the ſame time, at the hour agreed on and ordered. The ancients, deſtitute of watches, regulated their motions by the courſe of the ſtars; and it is, without doubt, on that account that Polybius, Onozander, Ælian, and many others, exhorted military men to the ſtudy of aſtronomy: but as it is not often that an army marches by night, this knowledge would be very uſeleſs for an attack in the day-time; beſides, the ſun, by which they were alſo regulated, could be no way ſerviceable to them, ſhould the ſky be overcaſt.

If the general's intention is to attack the enemy's army in front, he muſt detach all his light troops, ſuſtained by a large body of cavalry and ſome battalions, with orders to haraſs the flanks, in order to perplex the enemy with regard to the real attack. It is impoſſible to give the enemy too many falſe alarms with regard to what is really deſigned: the huſſars, from their readineſs in retreating, and their quickneſs in paſſing from one ſpot to another, are the fitteſt troops for theſe ſort of expeditions. The ſame rule ought to be obſerved if the real attack is deſigned to be upon the flank; then the falſe attacks ſhould be upon the front. In Santa Cruz may be ſeen the diſpoſitions which he has made to attack an army on its march.

Stratagem, and the means of ſurpriſing an army, are allowable in war, provided treachery is avoided. Whilſt the law of nations is not infringed, ſucceſsful ſtratagems add luſtre to the genius of the general; but there is no profeſſion in which rectitude of mind is more neceſſary than in that of war.

In order to carry on a ſurpriſe by ſtratagem, one of the moſt certain methods is, to calculate what time is neceſſary for the army to arrive at day-break near the road by which the enemy is to paſs, ſo as to be able to examine the country, and make the neceſſary diſpoſitions for the attack. In an open country the army may be concealed behind corn, or behind a riſing ground. Prince Eugene, in 1702, after the battle of Croſtolo, having gained ſome days march of the king of Spain, poſted himſelf between the Zero and the Po. He ſo well concealed his army behind the bank of the Zero, that the combined army of France and Spain, which was on its march, and ready to enter into its camp, was obliged to range itſelf in order of battle, and to fight, without having ſcarcely time to make any diſpoſition.

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A woody country offers more expedients for the concealing of troops: but as it is to be supposed the enemy's advanced guard will be advanced at least a half or three quarters of a league, to scour the country; therefore, if the general's design is to attack the enemy's flank, he must present some cavalry and hussars in the front of the enemy's army, so as to engage his attention. Some infantry should be placed in the woods, in the rear of these troops, in order to sustain them: this cavalry and the hussars should retire in proportion as the advanced guard advances, in order to induce the enemy to believe they are not sufficiently strong, and that the reason of their advancing was only to examine the march of the army. As soon as the enemy shall have reached the place agreed on by the generals leading columns that are to attack, the body of infantry that is in ambuscade in the wood, the number of whose columns should be regulated according to the situation of the country, will march silently, and near enough to the enemy, and will charge him with bayonets, without giving him time to recover himself: during this attack the cavalry, dragoons, and hussars, who keep the enemy's front in awe, will charge the troops who have passed the wood and spread themselves over the plain. These troops of cavalry must be sustained by the infantry which was in their rear in the wood, and which should be furnished with cannon. These two attacks, made one after the other, but at some small distance of time, will render the enemy doubtful with regard to the dispositions he is to make; he will be undetermined where to send assistance, as the cannon which he will hear at the head will induce him to believe that attack the real one: he will fly to that part, and will consequently weaken the flank, which is designed to be attacked by all the infantry. By this diversion the flank will with greater ease be broken through, and the enemy taken in rear: the enemy thus surrounded, and finding himself between two fires, cannot avoid being beaten.

It is more difficult to form ambuscades in an open country, particularly for a whole army, unless it should find a bank like that at Zero; then the general should consider whether or not the attack of the army on its march is practicable. If the general by his superiority can, without weakening himself, divide his army, and find means to conceal it, he will attempt the attack, provided that each detached body is posted before the enemy has begun his march, and that they can all join on the first order, without a possibility of being cut off or finding any obstacle to prevent their marching up to the enemy: but, in order to a greater certainty of success, these first dispositions being made, great exactness in giving, and diligence in the execution of the orders, is necessary; each separate body should charge at the same time, and at different parts. But as the attack may prove unsuccessful, whether owing to the good disposition of the enemy, or whether because the attacks were not made together or executed with equal vivacity, it is necessary that the general should have provided for a retreat, and that the officers commanding different bodies should know after what manner and from what part it is to begin. For the greater security, the general officers ought to communicate their instructions to the commanding officer of each body composing that which they command, so that at the time of the attack or of the retreat, they may instantly comprehend the meaning of whatever they are ordered to perform.

If the army intending to attack the enemy on his march is weaker, or equal, either in number or in the nature of the troops, it is then only the situation of the country, and the facility with which the enemy may be surprised, that should determine the attempt of this grand enterprise: the prudence of the general, his experience; that of the generals who are under his command; the quality of his troops; whether they are well disciplined or not; whether they are composed of one or of many nations; the quality of the troops to be attacked; and, in short, the genius of their general, are circumstances by which the attacking or not attacking should be decided. It is impossible to be decisive upon these circumstances, which depend entirely upon the ground, upon the vigilance of the enemy's general, upon the order which he causes his troops to observe in their march, and in short upon the troops under his command. A general, at the head of a well-disciplined army, composed of veterans and good general officers, will undertake and execute designs which he would not even dare think of with a new-raised army, however numerous: it is also very difficult to surprise a vigilant general, who is besides a good soldier, and who is also assisted by the counsels of able and intelligent officers. Offensive Operations.

A general should also be guided, in attacking the enemy on a march, by the country and the nature of the troops of which his army is composed. If the enemy marches through an open country, and the general is equal to him in infantry but superior in cavalry, he should make no hesitation in attacking him; but if the country is woody or mountainous, and the enemy's army is more numerous in cavalry than infantry, the general has still the same advantage with a superiority of infantry; because the enemy's cavalry in those kind of countries is unable to act against infantry; and the infantry also which the enemy may have will never be sufficiently strong to maintain itself upon the heights against forces so superior: and if the heights are forced, there can be no doubt of the enemy's being beaten, of his cavalry being ruined and crushed to pieces, or that his retreat will be attended with great difficulty, and that he will lose the greater part, if not the whole, of his army.

Sect. V. *Of the Attack of entrenched Camps.*

The principles of war among all nations and in all times have been still the same; but the little experience of the early ages of the world would not permit those principles to unfold themselves, as they have since done, and to which it is owing that new expedients both for attack and defence have been discovered.

What a sensible difference is there in the military art, such as it at present is, compared with that of which the rules are handed down to us by Onozander, Vegetius, the emperor Leo, Frontinus, Ælian, and many others? The towns, in their times, had no other defence than walls, raised at a great charge, flanked at little distances with towers, and a large ditch in front: it is true that the little force of their weapons contributed much to the advantages of their fortifications. Their entrenched camps had only a large ditch with some waggons placed behind it; and whenever the ancients were willing to practise all the art at that time known in war, they surrounded the camp with walls, in the same manner as they did their towns, with towers at little distances. Of this kind was Pompey's camp at Dyrachium in Epirus, the plan of which is given in the marshal de Puysegur's Art of War: the wall by which it was surrounded was 15,000 paces in extent.

The emperor Leo was unacquainted with any other method of entrenching a camp, than by heaping fascines together, putting trees upon one another, and posting advanced guards.

The experience which hath been since acquired, hath, without increasing the labour, rendered the works of places stronger, and easier to be defended: the labour of the entrenchments

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trenchments for camps hath been shortened; they have taken a new form; and being constructed upon the same principles as the fortifications of towns, they are become more difficult to be forced (see Part I. sect. vi.). By this same experience the means of attacking them hath been discovered; and in proportion as offensive weapons have changed, and are become more powerful, the system of fortification has been new-modelled.

Let an army be supposed entrenched behind lines where art and nature are both joined; whose flanks are sustained and secured, furnished with troops and artillery along the whole front, with more troops behind to sustain those which line the lines. The general who would attack, ought first to survey the situation of the lines himself, and as much as possible the enemy's disposition; he should examine the construction of the lines, how they are supported, their extent, and whether the soil is firm or light. As soon as he shall be perfectly acquainted with these circumstances, he may form his plan of attack, and cause his army to march in as many columns as there are attacks to be made; but he should endeavour as much as possible to occupy the whole front of the enemy, in order to prevent him from sending assistance to those places where the attack will be briskest. The head of each column should be well furnished with artillery; and as soon as it shall be within distance of cannonading the lines with effect, it should keep up a brisk and continual fire for the space of an hour at least, so as to beat down the earth of the parapet, and tumble it into the ditch, which will in some measure render the passage of it less difficult for the troops. The time of the attack should be an hour before day, so that the cannon may have fired before the enemy shall know where to direct his artillery: after every discharge, the situation of the cannon should be changed either to the right or the left, in order to deceive the enemy's gunners, and prevent their knowing where to direct their pieces. If there should be any height within proper distance, the cannon should be planted upon it: if the cannon can be brought to cross each other upon the lines, the artillery will then have a very great effect.

The infantry should follow the artillery, furnished with hurdles, planks, fascines, pick-axes, and shovels; the fascines will serve to fill up the wells, if there are any, before the ditch; or if there are no wells, they will fill up the ditch, and the hurdles will be thrown over them. The cavalry should be formed in two lines in the rear of the infantry, in order to sustain it. The general should endeavour to find some ridges, to conceal the cavalry from the enemy; but should there be none, it must be placed at such a distance, as not to be exposed to the cannon of the lines; for should it be placed too near, it will very soon be destroyed, without having it in its power to be of any service. In the beginning of an attack of lines, the cavalry cannot be of any assistance, and cannot even act till the infantry hath penetrated in some part. It would therefore be useless to cause it to advance too near, provided it is within reach of marching readily when the infantry has passed, and hath made a passage large enough for it, by beating down the lines and filling up the ditch; the cavalry then will have no more to fear from the cannon of the lines, because the enemy's attention will be more engaged with endeavouring to repulse the infantry, than with firing upon the cavalry. As soon as the lines have been beaten down, and the enemy thrown into confusion, the infantry should march resolutely and together; and should take care to leave room for the artillery, so that it may advance at the same time, and continue its fire. The attack should be made by the grenadiers, sustained by the piquets: they will protect the soldiers who fill up the wells and the ditch; and as soon as they find an opportunity of passing, they will endeavour to get over the entrenchments, sustained by the whole infantry of the column, which will then be disencumbered of the fascines, hurdles, &c. in order to drive the enemy from his lines. As soon as there are soldiers enough upon the lines to bear the resistence of the enemy, the soldiers who have the shovels and pick-axes, and who ought to be last, will finish the filling up of the ditch by beating down the parapet of the lines, and making an opening sufficient for the passage of a squadron in order of battle. Then the whole infantry of the column that has broke through, will pass and divide into two parts, to let the cavalry pass, which will form under the cover of the fire of the infantry, and will not attack the enemy's cavalry till it shall have collected its whole force together.

If one of the attacks succeeds, on the first news, which will soon be spread throughout the army, all the troops at that time ought briskly to attack the whole front of the line, in order to employ the enemy, and prevent his sending assistance to that part that is forced. The reserve, which is composed of infantry and cavalry, ought to join the troops that have broke through the lines, to sustain the cavalry which is charging that of the enemy, and cannot be sustained by the infantry who passed first, because it is employed in taking the enemy in flank to the right and left. In this situation, when the reserve and all the cavalry which followed the column that hath passed, and to which others may yet be joined shall have passed, it should attack the enemy; if it is repulsed, it can never be to any great distance, because it has infantry behind it, to sustain it, and by its fire to stop the enemy. If the lines are forced by many columns, the success and also the defeat of the enemy will be thereby rendered more certain.

When the duke of Savoy and prince Eugene, still encamped between the town of Pianeza and la Venerie, in 1706, marched to attack the lines of the French army that besieged Turin, they caused their armies to march in eight columns; the infantry formed the advanced guard, the artillery, distributed by brigades, marched at the head between the columns, the cavalry was behind in six, and out of reach of cannon-shot.

The disposition of marshal de Coigny in 1744, in order to attack the lines of Wissembourg, of which the enemy were in possession, was similar to this, except that the whole of his army had not time to get up; but as the moments were precious, he did not wait for it. The army which came from Landau divided itself into four, which formed the four attacks; one of which was at Wissembourg, the other at the mill between that town and the village of Picards, the third at the village of Picards, and the last was made above that village, which was entrusted to the Hessian troops. His cavalry, which was behind, passed after the infantry had broke through the lines; but the enemy were then almost either killed or taken, and those who could save themselves, retired to Lautrebourg, where their army had assembled after having passed the Rhine. It is difficult to determine which is most to be admired, whether the general's disposition, the quickness and exactness of his eye, and his coolness in a circumstance so delicate, or the courage of the French troops, who forced these lines in less than two hours.

As soon as the enemy is beat and abandons his lines, he must be pursued, but with precaution. The vivacity with which he should be pursued depends upon the order with which he retires: if it is an open country, the general may follow him so long as he sees all clear before him; but if the country is divided with defiles and woods, it would by no means be prudent for him to engage himself in them, for

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for fear of any ambuſcades being placed there by the enemy, in order to ſecure his retreat: nevertheleſs, the general ſhould endeavour to make the moſt of his victory, and ſhould never be content to win a battle by halves; at leaſt it ſhould be carried ſo far as to make the enemy ſenſible of his loſs, and of rendering him incapable of continuing openly in the field.

But if the army that attacks the lines ſhould be unable to force them, after many repeated attacks, and if the general perceives that his troops are diſcouraged, he ſhould immediately retire. If the retreat is made over an open country, he ſhould begin it by marching off the cannon, the infantry next, and the cavalry will form the rear-guard in two or three lines; the huſſars and dragoons will be upon the flanks of the cavalry: if there are any defiles or woods to paſs through, the general ſhould leave ſome infantry at the entrance of them, to ſuſtain and protect the cavalry, which will retreat by files. If the enemy is in full ſtrength, the general ſhould leave ſome field-pieces with the infantry that is poſted at the entrance of the woods and defiles, which will certainly ſtop the enemy's impetuoſity: if, on the contrary, the enemy purſues the army with only a few troops, it will be proper to charge him if he approaches too near. In this diſpoſition an army may retreat eaſily, provided that order is obſerved, and the movements not made with too much precipitation.

Sect. VI. *Of the Attack of a Convoy.*

The ſame motive that ought to oblige a general to practiſe every reſource of art, in order to conduct the eſcort of a convoy in ſafety, ſhould alſo induce him to uſe the ſame expedients to carry off the enemy's ſubſiſtence; for to deprive him of the means of ſubſiſting, is, in reality, to overcome him without fighting.

An advantageous method for attacking a convoy is, by forming three attacks, one real and two falſe. Thoſe attacks are called *real* which the troops make with vigour and in full ſtrength, and when their charging is provided for and determined; the *falſe* ones are when the enemy's intention is only to keep back the enemy, and prevent his ſending aſſiſtance to the troops that are really attacked.

Theſe attacks, true or falſe, are determined by the ſituation of the country, and in proportion to the degree of eaſe with which the convoy may be turned from the road it is in; that is, if the general ſhould meet with an avenue near the advanced guard, which will draw the enemy ſome diſtance from his main body, and which alſo leads to that of the troops which attack, it is at that part the real attack ſhould be made: if this avenue is found at the rear-guard, the two falſe attacks ſhould be made at the advanced guard and at the centre, ſuppoſing there is an opportunity of attacking the centre. Theſe falſe attacks ought to be ſufficiently numerous in troops, to be able to employ the enemy, without running a hazard of being beaten, and to prevent his ſending aſſiſtance to other parts.

If the troops deſigned to attack the convoy are ſufficiently numerous, although divided into three bodies, to attack every part at the ſame time with equal vigour, the ſucceſs will thereby become more certain. The eſcort of a convoy is often more numerous than the troops which attack it; but it being certainly weakened by the diviſion it is obliged to make in order to guard the whole length of the convoy, the troops which attack have greatly the advantage, although inferior in number, becauſe thoſe which they attack cannot ſend aſſiſtance to the parts attacked, eſpecially if attacked on all ſides.

If the road is wide enough, and there is room for a waggon to turn, the general ſhould rather chooſe to attack the advanced and rear guards than the centre, to prevent the enemy's ſaving any of the waggons belonging to the rear-guard, which will undoubtedly be the caſe, if only the advanced guard and centre are attacked. If the road is ſo narrow that the waggons cannot turn about in order to go back, the general ſhould attack the advanced guard, and employ the centre and rear-guard as much as poſſible.

A convoy may alſo be attacked at the opening of a defile into a ſmall plain; then it is again the advanced guard that the general ſhould attack, though he ſhould alſo contrive to have the rear-guard attacked at the ſame time. The troops in the centre will be confuſed, and not know where to ſend aſſiſtance, becauſe they will hear firing both in front and rear; nevertheleſs, the general ſhould defer charging till part of the waggons are paſſed, and the troops of the centre are ſtill on this ſide the defile. An attack, when unforeſeen, briſk, and ſuſtained, can never fail of ſucceeding, particularly when the troops attacked are ſo divided as not to have it in their power to aſſiſt each other; and if the whole convoy is not taken, there is almoſt a certainty of taking a great part of it, or at leaſt of ſetting it on fire, and hamſtringing the horſes, if there is not time to carry them off.

The ſucceſs of theſe attacks partly depends upon the choice of thoſe places where the troops which are to fall upon the convoy are placed in ambuſcade; the moſt ſecure are thoſe which are leaſt liable to the inſpection of the enemy's parties. It is ſufficient to have ſentries upon the tops of the hills, ſo that they may ſee into the roads, and give notice when the convoy is near the place appointed for the attack: then the troops charged with the attack of the rear-guard, having nothing more to apprehend from being diſcovered by the enemy's parties, may draw near the entrances of the avenues.

If the ambuſcade is diſcovered, the conduct which ought to be obſerved by the troops compoſing it depends entirely upon their force and that of the eſcort; nevertheleſs, even when they are weakeſt, the attack ſhould be attempted, which, if unſucceſsful, will at leaſt have retarded the march of a convoy, for want of which the enemy may be greatly diſtreſſed. A general never riſks much in attacking a convoy; the object of the officer commanding the eſcort being to conduct it in ſafety, and to avoid fighting: it is the ſame with the eſcort of a convoy as with a chain of forage, the end of which is only to complete it; and conſequently the troops charged with them will rather be attentive to execute the orders which have been given them, than to purſue the enemy, although beaten and driven back.

When a convoy marches through an open country, there ſhould be many ambuſcades formed: an enemy is leſs apprehenſive in an open country, becauſe, ſeeing all before him, his ſearches become the leſs exact, in proportion as the country is unfavourable for troops to form ambuſcades; nevertheleſs, a general may always find ſome hollows, heights, or places of the ſame nature, where troops may be concealed. As ſoon as the convoy ſhall be arrived at the place fixed on for the attack, the general ſhould fall upon the advanced and rear-guards, in order to take in the whole, and to induce, if poſſible, the troops in the centre to divide themſelves, to run to their aſſiſtance; then the third ambuſcade muſt ſhow itſelf, and attack the centre, and endeavour to divide the convoy, before the commandant of the eſcort has had time either to park it or double it up. If the general ſucceeds in dividing the convoy, and if the troops in the centre of the eſcort are beaten and broke, he ſhould detach ſome infantry, cavalry, and huſſars, in purſuit of them; the remainder muſt be divided into two parts, in or-

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der to attack the troops lining the convoy; after which they muft join thofe who attack the advanced and rear-guards. The troops, when re-united, ought to make this attack with vigour, and entirely determine the defeat of the efcort, and confequently the taking of the convoy.

A convoy that is divided is half taken, as foon as the detachment of the centre is beaten; becaufe the victorious troops can be divided, and part fent in purfuit of the body that is beaten, and the other part employed to reinforce thofe who ftill meet with refiftance; whereas, if only one part is attacked, that which is not attacked can readily fend affiftance, efpecially in an open country, where there is nothing to prevent either cavalry or infantry from acting, and being a mutual affiftance to each other.

A general who would attack a convoy never runs any hazard by dividing his troops, in order to divide thofe of the enemy: the more the troops of an efcort are divided, with the greater eafe will they be beaten. An officer who would attack, fhould know the ftrength of the efcort, in order to regulate the number of his troops by the enemy's, and to be proportionably ftronger. He who is attacked, being ignorant of his enemy's force, and being charged on all fides, is at a lofs where to fend affiftance, and how to take care of every part: he who attacks by the knowledge he fhould have of the country, is enabled to poft his troops after fuch a manner as to employ all thofe belonging to the enemy, without weakening himfelf. The troops which attack have certainly great advantages, becaufe, in dividing them, they are ftill ftronger than the body attacked; and then they can choofe the place moft favourable for the attack: whatever may be the precautions taken by the officer commanding the efcort, whatever may be his vigilance, it will be very difficult for him, confidering thefe different attacks and the number of the enemy's troops, to difpofe his own with fufficient quicknefs to place the convoy in fecurity, efpecially if the attack is made with great quicknefs and vigour.

When a convoy is to be attacked as it paffes a bridge, the commanding officer fhould divide his troops into three bodies, placing two of them in ambufcade on that fide of the bridge to which the convoy is advancing, and the third on the fide from which it is marching. All the three bodies fhould remain concealed, if poffible, till the advanced guard of the convoy, the body at the centre, and fome of the waggons, have paffed the bridge; when they fhould inftantly advance and attack, each that divifion of the convoy properly oppofed to it. Three fuch attacks, made at the fame time by fuperior force, will have the whole advantage of the action; and the more fo as the troops of the efcort being everywhere employed, cannot fend affiftance to any particular part. If the two bodies which attacked the advanced guard and the centre fhould break them and put them to flight, there fhould be troops enough left in purfuit of them to finifh their entire defeat, without any fear of being repulfed; the remainder ought to march to the bridge, and caufe the waggons that are upon it to be ranged in order, and march to the rear-guard, in order to finifh its defeat, if it ftill continues to make refiftance.

It is neceffary to obferve, that fome troops ought to be left at the head and along the convoy, in order to take care that the horfes are not taken off from the waggons, and that none of the foldiers or drivers make ufe of that method to efcape.

If the general has not troops fufficient to be divided into three bodies, he can place ambufcades to attack only the advanced guard and the centre. This muft be done with vigour, but not till the troops of the centre fhall have paffed; and the attack fhould always be executed by the infantry with the bayonets fixed, and without firing, and by the cavalry, huffars, and dragoons, fword in hand. The general fhould not then ftay to make prifoners; but fhould put to death all thofe whom he finds armed. If the two firft detachments are beaten, he fhould march with the remainder to the rear-guard, which, not being ftrong enough to refift a body of troops much more numerous, will undoubtedly betake itfelf to a retreat. As it is the convoy, and not the troops of the efcort, that is the principal object, the general fhould leave only fome troops of huffars to purfue the rear-guard; he fhould make the waggons file off as faft as poffible, and conduct them the neareft way to the camp or the neighbouring town; or if this cannot be done, he muft burn them and carry away the horfes.

Sect. VI. *Of the Attack of green and dry Forages.*

Next to the convoys, the forages become moft neceffary for the fubfiftence of an army, as it is by them that the cavalry is fupported; and if a general can contrive to deprive the enemy of them, or to moleft him in the making of them, his cavalry will foon be without refource, his infantry without baggage, and his artillery without the means of being conveyed.

The detachment deftined to attack a party on a green forage, made in an open country, fhould be compofed of infantry, cavalry, and huffars: the infantry fhould not appear, but ought to remain in ambufcade in fome hollows, behind fome hedges, or other favourable places; and it fhould be careful not to fhow its arms; becaufe, by the glittering of the fteel, they may be difcovered: the cavalry fhould be divided into two bodies, three quarters of a league one from the other, taking care to be able to join in cafe of neceffity. As for the huffars, they fhould be diftributed about in many fmall detachments to the right and left, and in the centre of the two bodies of cavalry; upon one of the flanks there fhould be a more numerous body of huffars placed in ambufh, at a greater diftance than the fmall detachments. Every one of thofe fmall troops fhould have a number of trumpets with them; and when the chain is formed, and the foragers fpread over the plain, a part of thefe detachments fhould leave the ambufcades, making a great noife, and attack thofe belonging to the enemy which are advanced; and thefe detachments will charge them with fo much the more vigour, as they will be fuftained by the large body of huffars in ambufcade behind them, and which fhould march to fuftain them, and attract the attention of the officer commanding the efcort. It may happen that this firft attack, made on one fide only, may induce the enemy to unfurnifh the chain in fome place, by which it will confequently be weakened; and if fo the other detachment of huffars fhall inftantly advance, followed by one of the bodies of cavalry, in order to attack that part that has been unfurnifhed. If the enemy, more prudent, does not weaken the chain in any particular part, but contents himfelf with making the referve march to the affiftance of the troops which have been attacked, the fecond attack ought always to take place; but in order to employ the enemy everywhere, the fecond body of cavalry fhould march and attack the centre. This attack ought to be made with great brifknefs fword in hand, whether the enterprife fucceed or not: if it fucceed, a great advantage may be drawn from the rout of the chain. Whilft the cavalry and part of the huffars are purfuing the troops of the chain, the other part fhould fall upon the foragers, where they will without doubt find but little refiftance. If the attack do not fucceed, and that, by the good difpofition of the troops of the chain, the detachment has not been able to force it, it fhould retire to the infantry that has remained

mained behind in ambuscade; this infantry will facilitate the retreat of the cavalry and hussars. But suppose that the enemy, too eager, is carried away by this first success, a great advantage may be derived from his imprudence, by attacking him resolutely. The whole strength, and each body being united, it is to be imagined, and even hoped, that the advantage will turn on the side of those troops which were repulsed but a moment before; and the more so, as the general commanding the chain can have pursued only with his cavalry, his hussars, and dragoons; because his infantry will have remained in the posts which it occupied, either to guard them, or to sustain the horse, supposing they should be repulsed.

If the forage is made in a mountainous country, the infantry must act alone, the cavalry being only necessary when it can have ground on which to act, and sustain the infantry in case it is repulsed: the infantry should attack the avenues and the heights, and possess itself, as much as possible, of those which have the greatest command, and make the attack in many places, as in an open country. These different attacks render the enemy undetermined with regard to his dispositions; he does not know where to send assistance: the uncertainty of the general becomes visible to every officer, and communicates itself to all the troops; and thence proceeds their confusion, and consequently their defeat.

The prisoners and horses that have been taken should be sent off first with an escort; the rest of the troops will retire immediately after by the shortest road. It is cruelty to abandon the wounded, whether friends or enemies; and as the detachment has undoubtedly found, within the circumference of the chain, some waggons with horses to them, they should be made use of to carry off the wounded, who should also be sent on before: if there are no waggons, the detachment must take them from the neighbouring towns.

The attack of a dry forage is conducted nearly in the same manner as that of a green one; but it is often necessary to employ a greater number of troops; because, as the forage is made in the villages, it is almost a certainty they will all be guarded by infantry sustained by cavalry; whereas the chain of green forage is formed with a much greater number of cavalry than infantry, unless it should be in a country where cavalry cannot act. It is difficult to force the villages where infantry is sustained by cavalry; whereas it is easy for cavalry to attack each other in a plain, where the affair is immediately determined; but it is not so soon decided when entrenched infantry is attacked by infantry: but whatever resistance a commander may find, he should always attempt to force it. As the principal object is to prevent the forage, it is obtained by attacking the chain briskly and in all parts; because it is certain that the general commanding the forage will cause the foragers to assemble; or else, seeing the chain attacked, without waiting for an order, they will of their own accord dismiss, and fly toward the camp: but whether they assemble, retire in order, or shift for themselves, the end is answered, and the forage is left unperformed. If by their flight the commander cannot hope to make any prisoners, he must keep the troops of the chain at bay such a length of time as to make it impossible to continue the forage for that day: he should even if possible endeavour to force them to retire; which if they do, he should pursue them long enough to be certain of their retreat, and then collect all the waggons from the neighbouring villages, cause them to be loaded with the forage intended for the enemy's army, and conduct it to the camp: if they do not retire, the commander must remain in sight of them during the night, and send to the camp to demand a reinforcement of troops, in order to oblige the enemy to retire. For the same reason that a forage should not be abandoned till the last extremity, the troops that would prevent the enemy from attacking it should be absolutely bent upon it, at the same time without exposing themselves to the danger of being beat by any assistance that may come from the camp to the troops belonging to the chain.

Sect. XI. *Of the Passage of Rivers.*

There is hardly an operation of war more difficult than the passage of rivers, whilst war cannot be carried on in countries where there are not rivers to be passed.

Rivers may be passed by swimming, by fording, or upon bridges; but small bodies alone can pass with safety by swimming, and, unless the stream be very shallow, none but the cavalry should pass at a ford; for it is surely much better to throw over a bridge or two, than to expose the infantry to the fatigue of wading through a deep current, or the artillery and baggage to the danger of being damaged by water. When a ford is discovered and intended to be made use of, it should be secured in every part, and the soldiers employed for that purpose should be furnished with proper instruments to clear the bottom of every thing which may retard the passage. Its banks should likewise be examined, that it may be known whether they are of difficult or easy access, and whether the ground on the other side be marshy, or such as will permit the troops to form immediately on their landing. When bridges are to be built for the passage of the army, they must be laid upon BOATS, PONTONS, PILES, or wooden HORSES (see these articles); or in some cases RAFTS may be employed instead of them; and when a general is furnished with these necessaries, he will pass the largest river, in the absence of the enemy, without difficulty or the loss of a man.

It is not, however, to be supposed that the enemy will be absent. When a country is invaded, the army that is defending it will endeavour to meet the invaders with the greatest advantage; and as in the passage of rivers the advantage is wholly on the side of the defensive army, the general commanding it should there, if possible, oppose the enemies of his country. We shall therefore, in this section, treat, *1st*, Of the defence necessary to be made for opposing the enemy, and prevent his passage. *2d*, Of the means which a general should employ in order to facilitate the passage, notwithstanding the enemy's opposition; and, *3dly*, We shall demonstrate by facts the securest method of retreating.

I. It would be impossible to run through every precaution that can be taken to dispute the passage of a river; we shall therefore confine ourselves to the principal ones, by a succinct relation of the different systems of the authors who have treated on that subject.

The first precaution to be taken, according to the chevalier de Folard, is, to draw off all the boats which are upon the river; to observe whether any other river has a communication with it: to examine the course, the windings, and the most accessible parts of it; to raise good redoubts near the banks; to render the bottom uneven by means of sacks and baskets filled with stones, large trees with their branches, and by stopping them with stakes.

To this precaution may be also added another, which, executed with exactness, may produce great effects; that is, to throw whole trees with their branches into the river, not so heavy as to sink to the bottom, but whose size and quantity shall be so considerable as not to be easily stopped; their branches should also be interwoven, and formed like a chain from one bank to the other; they should be held fast till the enemy's army is engaged in the fords or upon the bridges,

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bridges, at which time they should be let into the current, the quickness of which will increase the force of this kind of moving bank, which will overturn every thing it meets with, soldiers, baggage, horses, bridges, and boats: in short, nothing will be capable of withstanding it, if there is any degree of rapidity in the torrent. This method is pointed out in M. de Puysegur as levelled against bridges only. To avoid also giving any suspicion to the enemy, this chain of trees can be placed upon the bank of the river, of which some engineer must have been careful to take the dimensions before-hand; and when it shall be nearly the same size of the river, and the enemy is passing, it must be held at one end, whilst it is shoved off by the other; the whole of it will be taken by the current, which, without any other assistance, will direct it against the enemy.

In regard to the troops designed for the defence, the best method, according to M. Folard, is to form small camps of 2000 or 3000 men, a league distant one from another, with patroles and signals from one to another; to have canoes, in order that the river may be crossed silently in the night by soldiers, who will endeavour to make some prisoners, and who will also listen in order to discover whether the enemy is preparing to march. A general should particularly endeavour to possess himself of the islands, if any, under cover of which the enemy may attempt the passage; and if the general can be certain that the enemy's intention is to throw over a bridge where they are, in order to set out from thence, to save so much of the way, the general will by this means assure himself of the place where the enemy will attempt the passage, which circumstance will be almost sufficient to prevent him.

But in order the better to explain the manner in which a river should be defended, let two armies be supposed, one of which, consisting of 40,000 men, defends the passage against another of 60,000. This last is divided into three bodies; that of the centre consists of 40,000 men, and the two others of 10,000 each: the centre-body is encamped nearly opposite to the place where the passage is intended to be effected; of the two bodies which are upon the flanks of the centre, one will serve to keep the enemy in suspence, with relation to the true place where the passage is designed. They ought to be continually moving, sometimes at a distance from the main body of the army, and pretend to throw bridges higher up, or lower down, in order to induce the enemy to divide and separate the different bodies of his army in such a manner, that they can no longer be of assistance to each other, or be in a condition of opposing a superior body of troops that may attempt the passage.

The army defending the passage is divided into many bodies; three of 10,000 men each, at a league distance from one another, and two others of 5000 men each, composed of the light troops, both horse and foot, and dragoons, encamped at half a league upon the two flanks of the army. The communication should be preserved between each separate body, and constant patroles kept upon the side of the river, which ought continually to cross each other; and detachments of hussars upon the right and the left, both up and down the river: the general is also supposed to have planted batteries of cannon, in different parts upon the shore; and to be possessed of two islands which he has fortified, and in which he has also placed troops and cannon: in short, he is supposed to have taken every advantage of ground for rendering the passage difficult to the enemy, and to oppose troops to him in every part where he may attempt it.

See Plate DXIX. fig. 1. where A represents the camp of the main army, divided into three parts, for the defence of the river. B, The camp of the light horse, light infantry, and dragoons upon the wings of the army. C, Castle and village, guarded by light infantry. D, A town occupied by the infantry belonging to the army. E, Bridge broken down. F, Islands occupied by infantry. G, Posts of infantry distributed along the side of the river. H, Batteries established along the side of the river. I, Posts of cavalry, to keep up the communication between the camps. K, Bridges constructed to preserve the communication of the islands. L, Bridges constructed for the communication of the camps.

If, notwithstanding all these obstacles, the enemy attempts the passage, he should be attacked as he debarks; and it is for this reason that the defending army should not be divided into very small bodies, which, too weak to resist a superior number, will be easily routed. In attacking the enemy, there is no danger to be feared from their cannon, which they cannot make use of without annoying their own troops; whereas the cannon planted upon the side of the river, to defend the passage, can always fire upon the troops which follow, in order to sustain those who attempt the passage: there should also be infantry placed near these batteries, to defend them, and to flank such of the enemy as have already passed.

There yet remain many stratagems to be practised on these occasions: a general may make use of those mentioned in the section which treats of ambuscades; and they should be particularly directed against such places as are supposed to be most favourable for the enemy. The history of prince Eugene, whom the chevalier Folard styles a great traverser of rivers, furnishes many examples.

The general should be particularly attentive in disturbing the enemy when constructing his bridges; which appears the more practicable, as the bridge is never properly established, if not guarded at each end: besides, by the assistance of artillery, the enemy may be easily prevented from going on with his work. M. Feuquieres indeed relates examples, where the enemy hath not been able to prevent the bridges from being built under their very noses; but besides the rarity of these examples, the precautions he used are a very convincing proof of the difficulty attending such undertakings.

A prudent general, and one who is himself acquainted with the river, of which the enemy would attempt the passage, is guided by its depth, by the difficulty of gaining its banks, and in proportion to its rapidity: he often pretends to be inactive, permits the enemy to throw his bridges over it, and waits till he is in the middle of his passage; at which time he makes a furious fire upon him, spreads disorder amongst his troops, and overthrows his ranks; and the enemy, besides losing a great number of men, also fails in the success of his enterprise.

II. With respect to the means to be employed for passing a river in the face of the enemy, it is to be observed, that the general who attempts such a passage, ought, in the first place, to be very certain of the steadiness of his troops. He should place the most intrepid in the front, in order to encourage those who follow them: on such occasions every thing is to be apprehended from ill-disciplined troops, who, as soon as they are engaged in the river or upon the bridges, having no longer any place of refuge to fly to, will be discouraged, and spread the panic throughout the whole army.

If the army passes upon two bridges, it is impossible to take too much care for their security: history is filled with fatal examples of bridges falling under the weight of troops. One of the greatest dangers ever experienced by Charles XII. was when, having caused a bridge to be thrown

thrown acroſs the Viſtula, the wood which had been made uſe of being too weak, and the timber-work ill ſecured, the bridge broke down whilſt the king was paſſing. Charles, the prince of Wirtemberg, and many others, fell into the water: the king, having caught hold of a piece of the timber that was floating, was carried away by the current. The troops which had already paſſed found themſelves at the enemy's mercy, who might have deſtroyed them; but they did nothing, ſays the hiſtorian Nordberg, becauſe of the heights of which the Swedes were in poſſeſſion, and from whence they kept a fire upon the Saxons. Was it not rather an inſtance of the good fortune which uſually attended that intrepid prince?

It is probable, when a river is paſſed upon bridges in preſence of the enemy, that they have been built before his arrival, and conſequently there has been time to entrench them at each end, but particularly on that ſide next the enemy. Theſe entrenchments ſhould be made in ſuch a manner as to prevent the bridges from being flanked by the enemy's cannon; therefore, inſtead of the entrenchments uſual at the heads of the bridge, ſuch as a horn-work, a crown-work, or a half-moon, the general ſhould cauſe redoubts to be thrown up, the fartheſt of which ſhould be 400 yards diſtance, and oppoſite to the bridge; and the others ſhould be thrown up nearer to the banks of the river, forming a ſemicircle: in order for their better defence, the general ſhould follow the ſame diſpoſitions which have been laid down in the preceding part. If there are many bridges, they ſhould be conſtructed as near each other as poſſible, that the ſame redoubts may equally ſerve to cover them: the reaſon of theſe redoubts being placed at a diſtance from the bridges is, that, as the troops paſs, they may have room to form, and ſuſtain thoſe occupying the redoubts. Theſe redoubts, it muſt be acknowledged, require a greater degree of labour than is requiſite for the conſtruction of a half-moon, or even a crown-work; but it ſeems impoſſible to paſs a river upon bridges in preſence of an enemy, however ſtrongly they may be entrenched, if there is not ſpace enough left between the entrenchments and the bridges to contain a number of troops ſufficient to oppoſe the enemy, and to give time for the remainder of the army to paſs. Labour ſhould never be conſidered when an enterpriſe is ſucceſsful; a general, therefore, ſhould never ſpare any pains for the attainment of his ends, but ſhould take every precaution neceſſary for ſucceſs, without troubling himſelf about the time and the labour it will coſt: the glory of having forced the enemy to leave the paſſage open to him makes ſufficient amends for the trouble he has given himſelf in order to attain it.

Suppoſe an army of 60,000 men would paſs a river, guarded by an army of 40,000. Let it alſo be ſuppoſed, that the army intending to paſs has got the ſtart of the enemy, either becauſe he was not yet arrived, or becauſe he has been amuſed with marches and counter marches; that the general has alſo had time to conſtruct three bridges, and to entrench them in the manner above-mentioned: he muſt begin the paſſage by cauſing the redoubts to be occupied by a battalion, or half a battalion, according to their ſize; and he muſt plant cannon between thoſe redoubts, with infantry to guard them. Theſe diſpoſitions being made, the army muſt march in three columns; the centre column muſt be entirely infantry, and the other two compoſed of infantry and cavalry. As the infantry paſſes the bridges, it muſt divide, and form columns, conſiſting of four battalions each, which muſt paſs between the redoubts, having cannon upon their flanks: the cavalry muſt paſs to the right and left through the interval of the two redoubts neareſt the river, and form in order of battle upon the flanks of the columns; the right wing with its right towards the river, and the left with its left. When all theſe columns ſhall be formed, and ready to march towards the enemy, the right and left of the two lines of cavalry muſt ſuſtain it; and the right of thoſe of the right, as well as the left of thoſe of the left, will march to put themſelves in a line in preſence of the enemy: in this poſition the army muſt march towards the enemy, and attack him, if he is ſo raſh as to hazard an action; and if he ſhould retire before the army is entirely paſſed, the paſſage will be the more eaſily effected.

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See Plate DXIX. fig. 2. where AAA are bridges of boats. B, Redoubts which cover the bridges. C, A battery, under cover of which the infantry work at the conſtruction of the redoubts. D, A battery to prevent the enemy from annoying the army on its march. E, The march of the army. F, The artillery diſtributed among the brigades of infantry. G, Infantry, forming in columns to open on the oppoſite ſide through the intervals of the redoubts. H, March of the columns into the front of the redoubts, where they halt in order to give time for a part of the cavalry to form upon its flanks. I, A battery erected to facilitate the forming of the cavalry. K, Cavalry, which, in gaining the oppoſite ſhore, forms in order of battle. and poſts itſelf upon the flanks of the infantry. L, Eight battalions in column upon the right wing of the army, to go and examine the village, and attack the enemy in it, in caſe he ſhould be poſſeſſed of it. M, Huſſars and dragoons, who have taken poſſeſſion of the height which is on the left wing of the army. N, A brigade of infantry poſted next the height, covering the left wing of the cavalry. O, The diſpoſition of the army marching up to the enemy.

From this diſpoſition it appears, that the army which attempts the paſſage is almoſt certain of ſucceeding; it is ſheltered behind the redoubts during the paſſage of the bridges; it has ground to form itſelf upon, and to ſhow itſelf in full ſtrength. But it is ſeldom that a general has time to build the bridges and entrench them after this manner, when the enemy is on the oppoſite ſide with an intention of diſputing the paſſage: ſo circumſtanced, he muſt endeavour to find ſome fords, and, under ſhelter of one or more iſlands, conſtruct a number of rafts behind them; he muſt endeavour to keep the enemy at a diſtance from thoſe places by marches and counter-marches; and when that is done, he muſt cauſe the cavalry to ford over with grenadiers and labourers behind them; theſe labourers muſt throw up entrenchments as faſt as they can, whilſt freſh infantry is cauſed to paſs over upon rafts. Provided theſe entrenchments can ſtop the enemy for ſome time, and contain infantry enough to reſiſt him, the remainder of the army will be very ſoon paſſed: the cavalry will at the ſame time paſs at the fords which have been diſcovered, in order to cover the flanks of the infantry; when it will ſpread over the plain, being itſelf protected by the infantry, as it leaves the entrenchments in columns.

The paſſage of a river cannot be ſafely attempted, if the general does not provide for a defence, and take infinite precautions to protect the army in its paſſage.

All that authors have ſaid upon this ſubject, ariſes from this principle of Vigetius, which they ſeem to have commented upon, and to which they have applied different examples. "As the enemy (ſays he) are accuſtomed to form ambuſcades, or to attack openly at the paſſage of rivers, the general ſhould poſſeſs himſelf beforehand of a good poſt on the oppoſite ſide, and entrench himſelf even on that on which he already is, to hinder the enemy from attacking his troops, ſeparated by the channel of the river; and ſtill, in order for greater ſecurity, the general ſhould cauſe the two poſts to be entrenched and well palliſadoed, that in caſe of an

an attack, he may be able to fuftain the efforts of the enemy without great lofs."

It may not be improper, in this place, to relate a difpofition of M. de Valiere's, formed upon this principle.

He fays, "After the cannon are planted, a parapet fhould be raifed upon the banks of the river, 200 yards in length or thereabouts, behind which fome infantry fhould be immediately launched from the centre of the parapet, and fome foldiers with labourers fent over, who muft immediately erect a fmall half-moon: as foon as that is done, more foldiers fhould be fent in order to defend it in cafe it fhould be attacked; more labourers fhould alfo be fent to erect another half-moon, both upon the right and the left.

"If the labourers are not annoyed by the enemy, they fhould at the fame time erect an horn-work, whofe wings fhould be flanked by the firft parapet, and the cannon planted in it: if the river is fo large that the wing of the horn-work cannot be defended by mufquetry, it muft be defended from the half-moon, made from thence to the water."

In the mean time, the general fhould caufe the bridge to be continually worked at; and, as foon as it is finifhed, make the troops pafs over it, if the enemy is not in fight; but if he is, the horn-work muft be completed, to prevent the enemy from falling upon the troops as they pafs. The horn-work being made as ftrong as is judged neceffary, as much infantry as it will hold fhould be lodged in it, with fome field pieces; and as the cannon upon the rifing will keep the enemy at a diftance, the general may order the cavalry to pafs: but ftill all this cannot be effected but before an army very inferior. If the enemy's army is of fuperior force, the fafeft method is to try a paffage at fome farther diftance, ftill keeping the army in fight as long as poffible, and concealing from the enemy that any troops have been detached.

It is impoffible to forefee every ftratagem that may be employed, as they depend upon many circumftances; but it is always right to fend, if poffible, fome trufty fpy to difcover the enemy's pofition on the other fide of the river, what obftacles he can place in the paffage, what methods are to be ufed to avoid them, and what parts of the bank are moft acceffible or beft guarded.

A general fhould make many falfe attempts, particularly at thofe parts where he leaft intends paffing; they fhould be made as fecretly as poffible; and alfo, in order to deceive the enemy, the general may throw over two or three bridges at hazard, in fight of the enemy, at thofe very places where he has refolved not to pafs: the enemy's whole attention will be directed to that fide; and a conftant fire fhould be made on him from the other fide, fo that he may not be miftruftful of the ftratagem. There is no doubt of thefe bridges being taken, which is of no confequence, provided the enemy is amufed, and the general has time to throw over another bridge at a diftance from that place, by which he can pafs.

We cannot pretend to recapitulate every ftratagem which a general may practife: in the hiftories of prince Eugene and Charles XII. the reader may fee the different methods which they made ufe of; it will be fufficient here to relate the rules laid down by Montecuculi, with fome modern examples, by which they feem to be corroborated.

1. The general muft plant artillery upon the bank oppofite to the poft he intends taking; which will be attended with great advantage, if the river forms a re-entering angle, and if there is any ford near it. 2. In proportion as the conftruction of the bridge advances, he fhould poft fome infantry upon it, in order to keep a fire upon the oppofite fhore. 3. When the bridge is completed, he muft caufe a body of infantry, fome cavalry, fome field-pieces, and fome pioneers, to pafs it, in order to fortify the head of the bridge on the other fide. 4. The general muft take great care that the enemy has not pofted armed barks, or other machines, to break down the bridge when half the army fhall be paffed. 5. If the general would preferve the bridge, he muft fortify it at both ends, and place fufficient guards in it.

In 1743, prince Charles intending to pafs the Rhine, kept a continual fire upon all the French pofts from 11 o'clock at night till three in the morning, in order to conceal his real defign with regard to the paffage. Marfhal de Coigny affembled his army in three large bodies, and lay all night upon his arms, the only prudent ftep he could take on that occafion. By this difpofition he found himfelf in a condition of tranfporting himfelf oppofite to the ifle of Rainac, of which the enemy was in poffeffion; and it is well known that they ended the campaign there, without being able to penetrate into Alface.

The number of columns ought to be regulated by the breadth of the ford, or by the number of bridges that are eftablifhed.

The third of June 1747, at day-break, the army commanded by M. de Belleifle paffed the Var in five columns. This paffage was effected without any refiftance on the part of the enemy, and M. Belleifle had 15 men drowned, although there was a chain formed of peafants, acquainted with the fords, to direct the march of the columns, and to affift the foldiers who were carried away by the rapidity of the current.

III. All paffages of this nature, whether in a march, in defence, or for an attack, may be forefeen. A general may, at a diftance, make all the preparations neceffary for thefe operations; he may anticipate or forefee the difpofitions of the enemy: in regard to a retreat it is otherwife: for although it may have been provided for, a general cannot be certain whether it can be effected after the manner he hath intended; befides, he muft, in a retreat, unite all the different difpofitions already mentioned: the leaft negligence becomes irreparable, and gives the enemy a very great advantage. A moment loft, a movement difcovered, may alfo be the caufe of a rout, and render the retreat impoffible, or at leaft very bloody; therefore if a general, in thefe circumftances, has not a perfect knowledge of the river he has to pafs, if he has not been careful to preferve the bridges, or to keep the materials and inftruments proper for the throwing over of new ones, he will be unable to pafs in fight of the enemy. Xenophon's retreat with the 10,000 Greeks, furnifhes examples of the paffages of rivers, which a general fhould always have prefent to his view. What prudence, what activity in founding the fords himfelf, whenever he met with any ftream or river to be croffed! What orders to prevent confufion among his troops, and what ftratagems to avoid being repulfed!

If a general is certain of returning by the fame place at which he has formerly paffed, the beft way would be, as Vigetius fays, to have the bridges guarded, and to erect a fort with large ditches at the head of each, for their fecurity, and to place troops in it to guard the bridges and the paffage, as long as fhall be thought neceffary.

Thus circumftanced, a general fhould entrench the heads of the bridges in the manner already directed; and that the troops may pafs the bridges without confufion, according as one brigade of infantry fhall enter the circle formed by the redoubts, another fhall pafs the bridge, and that which enters fhall take poffeffion of the pofts which that which paffes occupied: he muft be careful to eftablifh batteries of cannon to the right and the left, on the other fide of the river, to flank the redoubts, and defend the approach to them;

fo

so that when the whole army shall have passed, the troops who occupy the redoubts may retire with ease. The cavalry will pass the bridges without stopping behind the redoubts.

In a retreat of this kind, the infantry should march in column, and the cavalry in order of battle, upon the flanks of the infantry. Before the march is begun, some troops must be sent to occupy the redoubts; and as soon as they shall be in possession of them, the army will put itself in march, and proceed towards them. The cavalry of the right must pass over the bridge nearest to it, and that of the left will do the same. The columns of infantry must enter by the spaces which are between each redoubt; the grenadiers and the piquets must remain, in order to sustain the troops occupying the redoubts: some pieces of cannon should also be left to fire upon the enemy in case he should approach too near; the columns must pass over the three bridges; the grenadiers and the piquets must also draw near the head of the bridges at night-fall; the troops occupying the redoubts must quit them silently, and pass the bridges; they must be followed by the cannon that has been left during the day; the grenadiers must pass last of all; after they are passed, the bridges must be broke down. This may be easily executed, provided order and silence are preserved; but if the enemy entertains the least suspicion of the redoubts being abandoned, he will come in full strength to attack the troops still remaining on that side. These troops, too weak to resist a superior number, cannot avoid being beaten, slaughtered, or drowned, the cannon taken, and the bridges burnt.

For greater security, the grenadiers and the piquets may be furnished with chevaux-de-frise, which will make an entrenchment, till the troops which occupied the redoubts are retired. A retreat never merits the epithet of *fine*, except it is performed with order, and with the loss of as few brave men as possible, to save the rest of the army.

In every enterprise formed by a general in difficult places, he must, according to M. de la Valiere, provide for his retreat. In retreats of all kinds, adds the duke of Rohan, a general cannot be too attentive to render it safe, and to avoid disorder: when it is the effect of his own choice, it ought to be made so early, and so expeditiously, that he may not be under a necessity of fighting.

During the passage of a river, or even after a general has passed it, if he should be repulsed, the retreat becomes very difficult, and cannot be performed without great loss; it is for that reason that many generals, who have been mistrustful of the firmness of their troops, have burnt their ships in the port, in order to animate them to victory, from considering the impossibility of retreating.

The following retreats by M. Saxe across rivers, will give the reader some notion how such enterprises should be conducted.

In the campaign of 1742, the disposition of that commander for passing the Danube owed its whole success to secrecy, to his address in profiting by circumstances, and particularly to a very thick fog.

The two armies were encamped two leagues distant from each other, and the light troops skirmished together the whole day. At seven o'clock at night, count Saxe sent for the general officers, furnished them with instructions, and caused the guards to be doubled. At nine o'clock, the baggage filed off over two bridges; one of rafts and another of piles: after which the infantry passed, and the grenadiers, who formed the rear-guard, cut down and burnt the two bridges. The enemy advanced in order to charge his rear-guard; but 18 pieces of cannon that had been planted beforehand, very soon silenced the fire of their musketry, and he lost not a single man. At day-break the army formed in order of battle, upon two lines, in order to give time for the Imperialists to retire from Pladling; and as soon as they had joined, the army put itself in march in four columns.

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It is particularly necessary, either in passages or retreats, to be acquainted with the nature of places, and if they are fit to furnish the timber necessary for making rafts and bridges. In Germany, and countries where wood is very plenty, in order to pass with greater expedition, a general can make use of rafts or flying bridges. (See *Flying Bridge*.) Two may be placed, one upon the right, the other on the left, of a bridge built upon piles; by which means three columns can pass at once. It should be observed, that the flying bridges are by no means secure against torrents.

In 1742, count Saxe having beforehand possessed himself of Thonastauf, caused two flying bridges of rafts, and a great work of redans, to be erected, in which he posted five battalions and some cannon.

On the 9th of September all the baggage passed the Danube: on the 10th the army put itself in order of battle in two lines, which retired successively toward the river. The lines passed one after the other; that is, the cavalry at the ford, and the infantry upon the flying bridges.—Six thousand of the enemy's advanced guard were witnesses of this retreat without daring to molest it; so prudently were the orders given, and so exactly executed.

It is in retreats that bridges are most liable to break under the weight of the troops; it is at that time the precautions are neglected, because the danger becomes more pressing, and they are not sufficiently acquainted with the rivers over which the bridges are thrown.

Sect. XI. *Of Battles.*

Of all the operations of a campaign, the most important, and that which is most deserving of attention, is a battle, because it is generally decisive; every other operation is but preparatory to, or consequent of it. A general engagement, says Vigetius, is often decided in two or three hours; after which there scarcely remains any resource for the vanquished. Battles, says M de Montecuculi, bestow and take away crowns; from their decisions princes cannot appeal; by them war is put an end to, and the name of the conqueror immortalized.

A general should by no means suffer himself to be forced to a battle; neither should he offer it but when there is a real necessity for it; and even when he gives battle, it should be rather with an intention of saving than shedding blood; more with a view of asserting the rights of his master, and the glory of his country, than of oppressing mankind. However bloody a battle may be, it is always less so than a long war; which, by reiterated troubles, consumes the treasures of sovereigns, that sinew of a state, and drains the blood of the subjects.

Nevertheless, there are some occasions where it is not left to a general's choice, either to give or accept of battle. An army of observation, and an army acting on the defensive, neither can nor ought to be desirous of coming to action. Both the one and the other should have no other object in view, than that of posting itself in so advantageous a situation, that the enemy may neither entertain a thought of attacking it in its camp, or any hope of forcing it. The army of observation, whose only object is to protect, or to cover the troops forming a siege, should never seek to fight the enemy, unless attacked by him: the other, obliged by its want of strength to act upon the defensive, should only be desirous

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desirous of occupying advantageous posts, to prevent the enemy's penetrating into the country, and attacking it in any position it shall have taken.

If the choice is left to the general, he ought to be particularly careful, before he comes to a resolution of giving battle, to examine whether he can gain greater advantage by winning it, than he will sustain damage by losing it.

It is therefore neither caprice, nor a mistaken courage, or the desire of distinguishing himself at an improper time, that should determine a general to give battle; but his superiority over the enemy, both in the number and quality of troops, the enemy's incapacity, his ill-chosen encampments and negligent marches, the necessity of succouring a place, or the certainty of a reinforcement, by the junction of which the enemy will become superior, or circumstances which may change the original designs of the campaign. This was the reason which induced the viscount Turenne, in 1674, to give the battle of Einsheim, because the prince of Bournonville waited the arrival of the elector of Brandenbourg, who was coming to join him with a considerable reinforcement; and if he had not given battle before that junction, the enemy's army would have had a very great superiority over his. The reasons given by Montecuculi for avoiding a battle are, "when the loss of it will be more prejudicial than the gaining will be advantageous; when inferior to the enemy, or when succour is expected; when the enemy has the advantage of the ground; when it is perceived the army is working its own ruin, either by the fault or division of the commanders, or through the disagreement of confederates." It may also be added, when the enemy's army labours under some disease; when it is in want of provisions and forage; and that, disheartened by these circumstances, his troops desert from him.

It is on a day of battle that it becomes particularly necessary for a general to be acquainted with his own ground, and also that which is occupied by the enemy; to know in what manner his wings are supported, the nature of the places where these supports are; whether he can be surrounded, and in what part he can be attacked with the greatest facility.

But however essential these branches of knowledge may be, it is not always the superiority of number, or quality of the troops, or advantage of ground, that will secure the best disposed army from being routed: it is the foresight of the general in the precautions he has taken before the battle; it is his genius, his activity, his coolness, in the time of action, and the capacity of the general officers acting under him, that determine the success.

Ground, seemingly the most advantageous, often presents obstacles, which do not immediately strike a general, although an experienced one, and which may prove fatal in the course of a battle; how, therefore, will a general be able to correct these mistakes, if he considers them as only trivial? At the battle of Cerignoli, fought on the 28th of April 1503, the enemy's front being more extended than at first it was supposed to be, in order to give a greater extent to that of the French army, it was necessary to continue the lines across vineyards and thickets; by which means, the neglecting to fill up a ditch caused the defeat of the French, and the death of M. de Numours their general.

A general should not always pursue his own opinion, it being impossible for one man to see every thing; he should, therefore, cause an exact account to be given to him of whatever he cannot have an opportunity of seeing personally; to inform himself by spies of the enemy's order of battle, and act in consequence of that knowledge; he should possess himself of all places capable of containing ambuscades, which he ought to have had examined some days before the battle. Santa Cruz hath given a particular detail of all these preparations.

It is in these moments, which decide the fate of nations, that the genius and prudence of a general ought to be conspicuous; he should see, at the same time, what is doing among his own and the enemy's troops. Beside the precautions which ought to have preceded the day of battle, those which ought to be taken in the course of the action are so numerous, that it is impossible for them all to find a place here.

Some depend upon the general's ability, others upon circumstances, which it is almost as difficult to describe, as to mark out the necessary dispositions for them.

It depends upon the general's genius and foresight to make choice of intelligent, active, and prudent aids-de-camp, to assign to each particular body the properest commander; not, for example, to place, at the head of infantry, one who has been long accustomed to the service of the cavalry; or, at the head of cavalry, one who is more used to the infantry, &c.; to encourage the soldiers by the hope of rewards, and by motives which may spirit them up, and to threaten those who are so unmanly as to tremble at the sight of an enemy, or rash enough to run forwards without order.

The general should also be capable of forming new schemes, in order to render those of the enemy abortive; he should also take care, whatever may be the nature of the country, to dispose his army after such a manner, as to render it equally strong in every part, that all the bodies of which it is composed may protect and assist one another without confusion; that the intervals necessary for acting be well preserved, and that the reserve can easily march wherever it shall be ordered: in a word, the troops should be disposed after such a manner, that even before the action they may perceive in what manner they are to act.

It is the work of genius to take advantage of circumstances, and to submit to them; it is impossible to foresee the precautions dependent on them, as the very circumstances must be themselves unforeseen: it is by a general's address, in knowing how to profit by circumstances, that he shows his superiority in the day of battle. M. de Montecuculi reduces all the advantages that can be gained over an enemy to four principal heads, which, in reality, are of themselves reduced to the knowledge of profiting by circumstances; such are the advantages of number, when the enemy is beaten in his posts, his convoys, and in his forages; when an ambuscade is surrounded, or when a whole army falls upon a small, weak, and separated body: the second head consists in the knowledge of the commander; the third in the manner of fighting; and the fourth in the advantage of the ground. A general, who properly considers these heads, will dispose of a combined army after such a manner, that it may, at the same time, receive orders without mistake, and execute them without confusion; a very necessary precaution, and one which Hanno, general of the Carthaginians, neglected to take with regard to the strangers allied with them, which occasioned the troubles related by Polybius. He should have mixed the soldiers belonging to those countries, where bravery is in a manner natural to them, with those belonging to countries where it is more extraordinary.

Vigetius points out the precautions necessary to be taken by a general, to avoid having either the wind or the sun in his front. The wind, which raised the dust, and blew it into the eyes of the Romans, contributed to the loss of the battle of Cannæ: the sun, on the other hand, dazzles the soldiers, and lays open their dispositions and evolutions to the enemy: in a word, the general should not neglect even those

PLAN of the Position of an Army for the Defence of a RIVER.

I.

Scale of 1 League.

100 400 1200 2400 T.

PLAN of the Passage of a RIVER.

II.

Scale of ½ a League

50 300 600 1200 T.

A. Bell Prin. Wal. Sculptor fecit.

those precautions which may be in appearance useless, whether before the battle, or at the very time they may be put in execution after the action; as the rallying the troops, the refreshing of them, the retreating from before the enemy, or the pursuit of him, supposing the battle to be gained. A general should have beforehand formed the plans of the marches and the enterprises he would attempt, and be almost certain of the means of executing them: if, on the contrary, he fails, he should have determined the positions by which the army, fixed in a camp strong by situation, may prevent the enemy from reaping any great advantage from his victory: he should also have provided for the security of the prisoners, the hospitals, the plunder of the soldiers; in short, for all that is necessary for preserving order and discipline, and every thing contributing to the security of the troops: the distress of the enemy, and the glory of the sovereign, should be provided for without waiting for the event; for at that time confusion and disorder would prove more fatal than even the battle.

In the treatise written by Santa Cruz, upon the dispositions before and after a battle, may be seen a long detail of the precautions depending upon genius, and of those which are regulated by circumstances.

The general's post during the action ought to be, according to Vigetius, on the right wing, between the cavalry and the infantry. Onozander fixes it upon some height, and Santa Cruz towards the centre, in the front of the second line. Titus Livius and Polybius have observed, that the posts of Scipio and Hannibal were always in those parts which were least exposed: because, as observed by Onozander, a general who runs into danger is a rash man, fuller of presumption than courage: neither is daringness, adds his commentator after Plato, always a sign of courage; besides, a man who is really brave, is never daring but when it is absolutely necessary.

A general should not always suppose that what particularly strikes him is right; he should reason calmly upon the probability of it, in order to come to a greater degree of certainty with regard to the practicability: he ought also, says Vigetius, to be acquainted with the nature of the enemy, and the characters of his generals, whether they are prudent or rash, daring or timid; whether they fight upon principles or at hazard: in effect, a general ought to be earlier or later in making an attack in proportion to the rashness of the enemy. If, says M. de Montecuculi, any sign of fear or confusion is perceived among the enemy, which will be known when the ranks are disordered, when the troops mix together in the intervals, when the colours wave about, and the pikes shake all at the same time, then he should charge and pursue the enemy without giving him time for recollection: some dragoons, light cavalry, platoons, some loose troops, should be sent forward; who, whilst the army advances in order of battle, will go before to seize some posts into which the enemy must fall. A general ought also, says Vigetius, to sound the spirit of his soldiers, and observe whether they have a firmer countenance than the enemy. It is dangerous to lead an army on to action that is not thoroughly determined to do its duty. "Battles," says Vigetius elsewhere, "are generally won by a small number of men." The great mystery consists in the general's knowing how to choose them, to post them well, conformable to his plan, and the services required of them.

I cannot assign the reason (says he) why particular bodies fight better against other particular ones, or why those who have beat bodies stronger than themselves, have in their turn been often beaten by those that were weaker: It is undoubtedly owing to want of confidence; because the place of action has been different; or from other circumstances which cannot be laid hold of, but on the very instant. The situation of the mind is shown in the countenance of the soldiers; it is declared in their discourse, and by the most trifling of their actions. The general should consult them; he ought even to go farther — the best countenance is not always a sign of the firmest courage. Cowardice often conceals itself under the mask of intrepidity; but soon as the action begins, the veil falls off, and the coward shows himself, notwithstanding all his endeavours to the contrary. Neither at this time should a proper degree of fear be thought blameable; nature must be allowed to shrink in that awful and uncertain situation: the coward gives himself up to his fears; the bully seeks in vain to dissemble them; and the rash man, who cannot distinguish between danger and safety, is sensible of both; the real soldier is always modest, and contented with having done his duty. A good general turns every thing, even want of strength, to advantage. Hannibal, at the battle of Cannæ, posted his best troops upon the wings, that the centre, which was composed of those on whom he had the least dependence, might be the sooner broke, in order to give the wings an opportunity of surrounding the Romans.

It also requires a very strict examination in a general, in order to be thoroughly master of the circumstances on which he should regulate his dispositions; and he will also find it sometimes necessary to make some change in his original intentions. It is always proper that the corps of reserve should be composed of veterans, and even of part of the flower of the army; for should the army happen to be broke, this reserve alone may probably give a new face to the action: it was this method which Hannibal pursued at the battle of Zama; where Scipio, after having defeated the troops which presented themselves to him, was astonished to find he had a new army to fight with. At the battle of Fontenoy, the household troops placed in reserve, with some brigades of infantry, determined the success of the day. Nevertheless, on some occasions this disposition may prove disadvantageous; as, for instance, where it would be necessary to present a large front to the enemy, or where it is necessary to prevent his getting possession of a pass or a defile; where a general finds himself too inferior, and where there are also posts to be defended.

It would be unnecessary to repeat every thing mentioned by Vigetius, relative to the precautions necessary to be taken before a battle; time, and the difference of weapons, have greatly altered dispositions: fire-arms, which are now made use of instead of darts and slings, and the bayonet instead of the pike, have contracted the intervals which must necessarily be left between every soldier.

The order and disposition of troops for action depend entirely upon the general, who knows how to profit by circumstances; the just execution of them depends upon the capacity of the general officers. The general cannot be everywhere, or see every thing; he is obliged to rely upon the understanding of those who command under him for the just execution of his orders; the general officers should know how to vary them, in proportion as circumstances, and the situation of the enemy changes. They should have an exactness and quickness of eye, both to oppose and profit by them; and, as M. de Puységur observes, the disposition of the troops being once regulated by that of the enemy, by the situation of the country, and the general orders that have been delivered, the only part the general can have in the action lies in those places where he is within reach of giving orders himself.

M. de Montécuculi with great reason observes, that there cannot be too many officers in an army on the day of battle, in

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in order to supply the places of those who are killed: but can a man possessed of any degree of humanity approve of what he adds, that this number should be increased in time of war, and reduced in time of peace? What a prospect for a soldier, who, after having lavished his blood for the safety of his country, and the glory of his prince, sees himself exposed to the fate of Belisarius! Whatever were the virtues of his master Justinian, can any one, without indignation, see this general, after having overcome the Persians, reunited Africa to the empire, punished the Vandals, driven the Goths out of Italy, ravaged Assyria, scattered at a distance from both empires that throng of barbarians by which they were over-run, and preserved the throne, and the life of the emperor; upon the bare suspicion, or rather under the pretence of a conspiracy, deprived of sight, and reduced to beg alms of passengers in the streets of that city which he had so often saved?

It has been already seen, that the dispositions in a mountainous country change according to the situation of the ground. Vigetius repeats, speaking of a field of battle, what has been so often established in the foregoing sections, that an open country is always most advantageous for an army that is strongest in cavalry; and that an enclosed spot, divided by ditches and marshes, covered with mountains and woods, is most convenient for infantry. In this last, the knowledge of the country, the art, the ability of the general, and the understanding of the general officers under his orders, sooner ascertain the success, than a superiority of troops in an open country, which presents little or no variety of ground, and which allows the greatest part, or indeed the whole, of the troops to act; the superiority in troops is attended with great advantage, provided also the disposition is good.

The different dispositions for troops are so many, the circumstances differ so greatly, that were it even possible to connect in one body only all the battles which have been fought since the time mankind resolved to regulate their properties by the law of the strongest, the number of contrivances which remained to be collected would be greater than of those which have been actually executed. It is impossible to give a detail of every thing; for in that case every particular spot, and the disposition proper for it, every country, and all the circumstances that may oblige these dispositions to vary, must be described. Those now going to be mentioned, are only with a view of giving the rules, and of more clearly demonstrating those precepts which lead to the knowledge of all others.

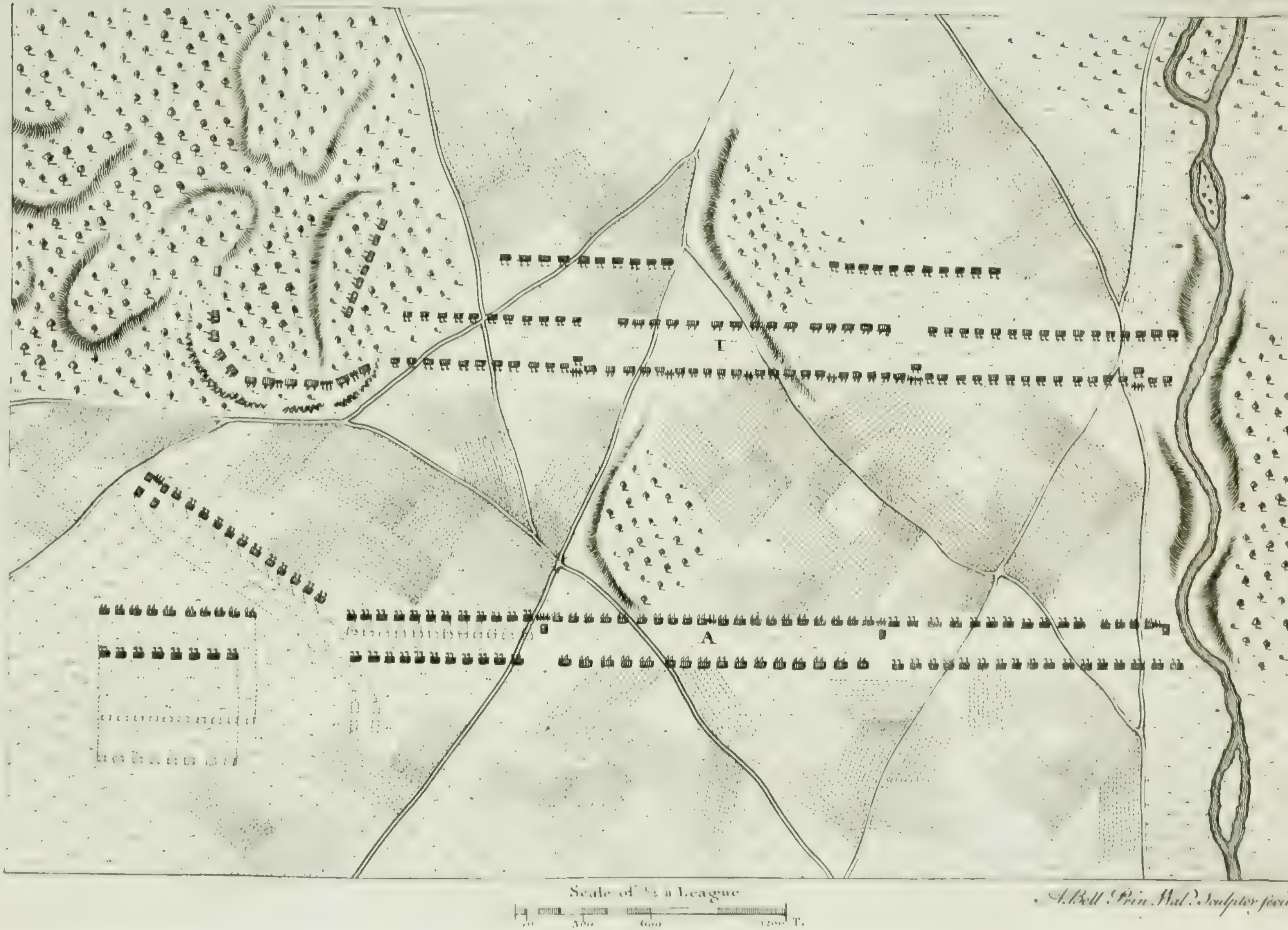
Disp. I. Let two armies of equal force be supposed, in an open country divided by a river, consisting of 57 battalions and 72 squadrons each, cavalry, hussars, and dragoons. The two armies are on the same side, the right of the one, and the left of the other, to the river. The left of the army whose right is to the river is unsupported; and that whose left is supported, has a wood on its right. By this disposition may be seen the necessity of covering the wing of the army A, that is exposed. Plate DXX.

The army I, whose right and left are supported, is formed upon two lines, and presents the same front as the army A, with a reserve in the rear. The following is therefore thought to be nearly the disposition which should be made by the general commanding the army whose left is unsupported. The first line ought to consist of 20 battalions, with intervals of about three toises between each battalion; 12 squadrons on the right, with their proper intervals; four battalions on the right of the cavalry, 10 pieces of cannon, and a battalion in column close to the river; 12 squadrons on the left of the first line, with their proper intervals; 16 battalions in the second line, 300 paces distance from the first; 11 squadrons on its right, placed behind the intervals of those in the first line; and on their right, six squadrons of dragoons next the river, in order to sustain the infantry and cannon covering the right; 11 squadrons on the left, placed in the same manner as those on the right; 10 pieces of cannon, supported by a battalion in column, between the infantry and the cavalry of the right; 10 others, supported also by a battalion between the infantry and the cavalry of the left; four battalions in the rear of the second line on the left, with orders to transport itself obliquely, or sidewise, as soon as the army moves to attack that which is drawn up against it; 12 squadrons of cavalry in the rear of the first line upon the left, to post themselves obliquely upon the flank, at 100 paces distance from the first squadron on the left, next to the four battalions and the cannon; the reserve, consisting of 10 battalions and eight squadrons of dragoons, in the third line upon the left flank, so that it may fall into the first line as soon as the squadrons of cavalry, which were in the rear of those of the first line, shall be posted obliquely: in this position, the army will move forward, the right never quitting the banks of the river.

If the enemy's army should advance, the disposition of the army A will become still better, because the army I will quit the support it had on its right; but if, on the contrary, it remains in its post, in order to keep this support, then the 10 battalions of the reserve, followed by the eight squadrons of dragoons, will join the four which support the flanks of the cavalry which is posted obliquely. When marching, this line posted sidewise should proceed obliquely; and when the cannon shall be near enough to cannonade with effect, it should make several discharges, in order to break and beat down the entrenchments, or felled trees, which the enemy may have made, and also to destroy their disposition. As soon as the army A shall be near enough to cannonade the army I with success, it must halt, and amuse it with a continual fire of the cannon. The principal attack ought to be made at the wood by the 14 battalions; in order to give more strength and certainty to this attack, six other battalions, with 10 pieces of cannon, should be detached to it from the second line, always keeping up a fire from the front. If during this attack, it is perceived that the enemy weakens his line, in order to carry assistance to the wood that is attacked, then the centre and the right of the army should march up and charge him briskly. The troops who cannonade the wood ought not to advance, but should only keep the troops posted in it at bay; because that part which the enemy has weakened will then become the principal object of attack: it is probable, that the enemy having weakened his front, will certainly be broke. If the enemy should not weaken his front, and the attack of the wood should succeed, as soon as the enemy is driven out of it, the troops which attacked it should take the enemy in flank; then the body of the army, by advancing, ought to determine an affair already half gained. If by the intelligence the general hath received, and the number which he knows the enemy's army to consist of, and which he sees before him, he judges the wood is filled with infantry, and that consequently the attack of it will be attended with difficulty, he must attack on the side of the river, by marching by degrees from the right, as if to sustain the left. For the greater certainty of succeeding in this attack, he should reinforce the five battalions upon the right with some others from the second line: the left should continue in the position already mentioned, to keep back the enemy. If it should happen that the enemy, seeing his left attacked, causes the troops to leave the wood in order to replace those of the centre, which he caused to march to the assistance of the left, the 14 battalions which

Plan of an Order of Battle, I[st] Disposition.

Plate DXX.



A. Bell Prin. Mal. Sculptor fecit.

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which are posted sidewise, ought briskly to attack the wood sustained by dragoons. These last should post themselves upon the left flank of the infantry in order to cover it; and as soon as it shall be within 60 paces of the enemy, it should march up to him with bayonets fixed; and the dragoons ought to attack him in flank at the time the infantry does the same in head. The wood is all this while supposed to be practicable for the dragoons on horseback; but in case it should not be so, they must dismount, the infantry being sufficiently supported by the 12 squadrons of cavalry, which are placed sidewise.

The general may with ease, especially in an open country, attack the enemy's whole army together; but this may be attended with great danger, and if the whole front of the first line is broken, there will not be much difficulty in breaking the second: whereas, by attacking the enemy's army in one or two parts, if one of these attacks succeeds, the battle is won; because the troops who are victorious, take the enemy in flank, at the same time that he is attacked in head by the rest of the army. In case it should not succeed, the troops who made the attack can retreat, protected by the whole army, which hath not at all suffered.

The general should, as much as possible, conceal the motions he intends making from the enemy; consequently the five battalions and 10 pieces of cannon which support the right of the army next the river ought to march in the rear of the squadrons of the first line, the infantry with their arms secured, and not range themselves in the order of battle intended, till the two armies are ready to march to charge each other. It is the same with regard to the squadrons of cavalry, which should be posted behind those of the first line, to execute the design already laid down.

Disp. II. If the two armies are not supported either on their right or their left, the same position should subsist that hath already been established for the cavalry, which is in the rear of that belonging to the first line, except that it should be distributed on the right and the left. If there is not cavalry sufficient, hussars must be substituted in its place; but if there should be cavalry enough, it must be used on this occasion; because cavalry being a greater body, its charge is heavier, and it also makes a greater impression upon other cavalry opposed to it, provided they execute their order with great quickness. This cavalry or hussars, which are posted sidewise, should not quit their post, but wait the success of the attack. If the enemy is repulsed, they must then fall upon his flanks, and by a brisk and vigorous charge endeavour to involve the second line in the confusion of the first; they will be followed by part of the wing of cavalry that is victorious, in order to give a greater force to the attack of the second line, taking as much care as possible not to leave any body of cavalry upon the wing of infantry that is in a condition of protecting it. After these two lines of cavalry have been broken and pursued, half of the victorious line should remain in order of battle; and, by a motion to the right from the left, take the enemy's infantry in flank, at the same time that it is attacked in head by the infantry of the army. The second line should then move into the place of the first, in order to be near enough to assist it in case the enemy's infantry should stand its ground firmly; but it is probable, that being deprived of its cavalry, it will neither have the same firmness, nor the same spirit, as if it was supported, especially when it is attacked on every side.

The cavalry and the hussars who pursue the beaten wing should not expose themselves too much, or break their order in the pursuit, for fear the enemy's hussars which are behind should fall upon and beat them by attacking them on all sides; which may very probably happen, if they do not take care to keep in order of battle; which should at least be attended to by the cavalry. After the hussars have pursued the enemy's cavalry so long as to entirely disorder them, they should return and take their former posts, in order to march from thence to whatever place they may be serviceable. Although it may appear something hard to make the hussars return, there is nothing so difficult but what may be accomplished, when order and discipline are firmly established, and when an officer has the art of making himself obeyed.

At the battle of Cannæ, the Carthaginian cavalry, superior to that of the Romans, having broke through them, one part continued the pursuit, and the other fell upon the rear and the flanks of their infantry; at the same time the Carthaginian infantry charged that of the Romans in all parts, which decided the victory. Thus Hannibal owed his victory partly to his superiority in cavalry, and to his attack upon the flanks. The Numidians, who were upon the right wing of the Carthaginian army, and who fought nearly in the same manner as the hussars, performed on this occasion the same service as the hussars would certainly do in the disposition now before us; so true it is, that infantry, destitute of its cavalry, hath no longer the same firmness, nor the same spirit; and if it is also attacked in head by infantry, it cannot avoid being beat. The principal attention of a general, says M. de Montecuculi, ought to be to secure the flanks; experience having taught, that when the wings of cavalry are broke, the infantry is easily surrounded, and hath no longer the means, nor even the courage, of defending itself. The reader may see the principles he lays down upon that subject. It is seen by the example of the battle of Cannæ, what use the cavalry ought to be put to, particularly in an open country where it can easily act. What advantage may not be expected from it, when an army of Romans, 80,000 strong in infantry, and 6000 horse, was overcome by the Carthaginians, weaker by the half in infantry, but which derived its principal strength from 10,000 cavalry, all veterans, and well disciplined.

But if the wing of cavalry is beat, it ought to retreat with as much order as possible. The cavalry, or hussars, that are posted sidewise, should always continue in the same place; there is no reason to fear that the enemy will advance briskly to the pursuit; because he will be taken in flank by the body that is posted sidewise; a circumstance which ought not only to abate the eagerness of the conquerors, but also animate the conquered. By this manner of acting they gain time to pass through the intervals of the second line, and to rally in the rear of it, which they can perform with the greater ease, as they are neither pursued nor molested, at least but very slightly.

In order to prevent the inconveniences that may arise if the hussars in charging the first line of the enemy in flank are charged by the second, it is necessary to detach instantly from the reserve a body of dragoons sufficient to fill up the intervals of the hussars, which will form a full line without taking up more ground: this can be so much better effected, as there would be no ground on the other side of the troops who are posted sidewise, and that, besides, these troops would be at too great a distance from the main body of the army.

Again, without causing them to fill up the intervals of the hussars, they may be placed in a second line behind them; and when the hussars attack the flank of the enemy's wing, the dragoons will take their place, in order to keep back the enemy's second line. This method hath the same effect, and is performed with less difficulty. It is almost evident, that the second line will not dare advance to protect the first for fear of being charged in flank by

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by the dragoons, but that on the contrary it will be obliged to retreat.

This disposition, the performance of which appears very difficult, is not in reality so, if the general hath taken the necessary measures, and if his troops are well disciplined, and know how to move with order and exactness. Even when this motion is not performed with all the exactness possible, it can never be dangerous, because the front of the two lines will not be destroyed, and because it is also made upon the rear; and that if the dragoons and hussars are attacked and beat in marching up, their defeat cannot be any way prejudicial to the main body of the army.

When the field of battle is in an open country, all the troops generally come down, especially when there is no obstacle to prevent them. On these occasions, it is requisite that the disposition of the troops should be strong in every part; there should always be a reserve, whether of infantry or dragoons, in order to be ready to assist the troops which have suffered.

If it is possible, in an open country, to find any hollow to support the right, and a village to support the left, the general should make choice of that situation, supposing his intention is to accept, and not offer battle. If he designs to give battle, it would be unnecessary to take this position, because he must quit it in order to attack the enemy: but if circumstances require his accepting it, he must seize this post, and place infantry and cannon in the village, and station other infantry in the rear to support that which is in the village.

As to the disposition for the order of battle, especially for the front of the line, it must be regulated by the ground, by the disposition the enemy has taken, by the troops that can most easily act, and by those that the enemy can oppose to them.

If the enemy has pitched upon a field of battle, and the general would attack him in it, he should keep his whole front employed; but should make his chief efforts on one or two parts, upon the wings, or at the centre. This was the method practised by marshal Saxe in all his battles: when he accepted battle, as he was obliged to do at Fontenoy in 1745, he was in expectation that the opposite army would attack him on one side sooner than another; in this situation the dispositions should be properly regulated, the posts intrenched and occupied, the cannon distributed, and troops placed in the rear of each post to sustain those which are in it: victory should then be expected from the capacity of the commanders, the firmness of the troops, and the assistance that is properly given them. But when a general gives battle, he may attack either the right, the left, or the centre, always conforming to the situation of the ground, and the field of battle which the enemy has chosen, which cannot be ascertained but by a thorough knowledge of the country.

It is dangerous to attack the whole front of the opposite army with equal vivacity, because, if the attack does not succeed, the troops are disheartened, and are witnesses of each other's defeat. If the first line is repulsed, the second is seldom of any great use; whereas, by only employing the whole front of the enemy, and making a strong attack upon one or two parts, if it is successful, the troops can take the enemy in flank; and those which amused his front will then attack him briskly, and prevent him sending assistance to the troops that are beat. If the general does not succeed in the first attack, he can try it again with greater force, by causing the troops of the second line to march as was done at the battle of Lafeldt fought in 1747: the French troops being repulsed four times, M. Saxe sent them a reinforcement; these troops being united, carried the village at the fifth attack, which determined the fate of the battle.

In a plain but inclosed country, a general can attack only part of an army. Antiquity furnishes many examples of this. Epaminondas, at the battle of Leuctra, attacked only the right of the Lacedemonian army, with a large column of infantry that formed his left; causing the right to be supported, and making the left march, the whole army, according to the opinion of the chevalier de Folard, wheeled. The battle of Mantinæa, won by the same general, is also of the same nature; with this exception, that it was the centre of the Lacedemonian army that was attacked. These examples are only proposed as what may possibly happen, but which it would be dangerous to imitate on every occasion, and which should be pursued in circumstances only where a general expects great advantage from them.

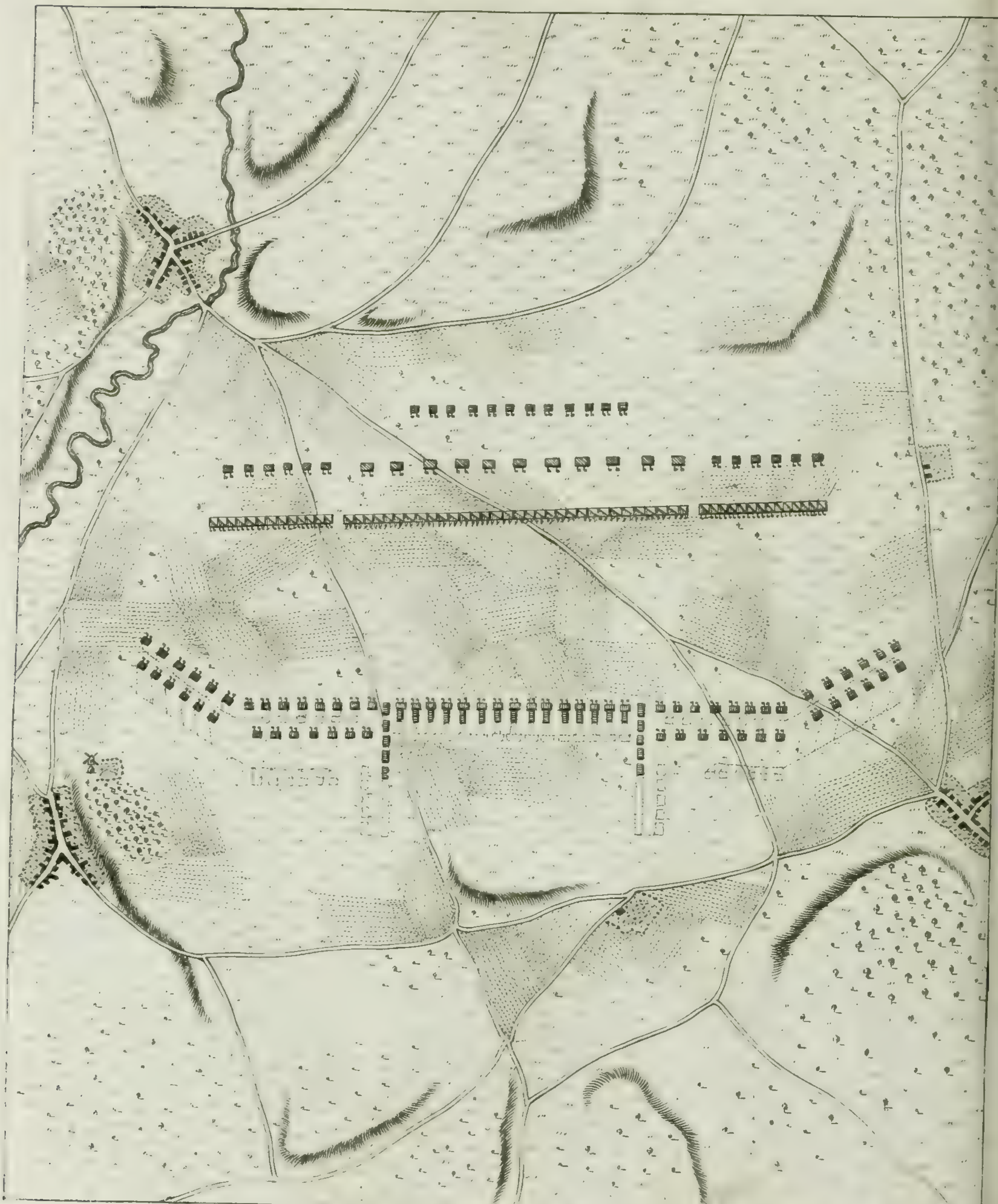
As the cavalry can easily act in an open country, and be of great assistance to the infantry, all possible means should be used to contribute to the success of their attack; they should always be supported by troops in their rear. Cavalry is of great use, particularly where the two armies, from the situation of the country, find no obstacle to prevent their joining; and if the cavalry, as M. de Puysegur observes, is beat, even when the infantry of the same army is victorious, the best thing that can afterwards happen to it is, to retire in good order.

The ground so often varies, that even in an open country there are unevennesses, thickets, morasses, and hollows; in each of these situations the dispositions should be changed. If these thickets happen to be in the line of cavalry, and it can act there (for if it cannot, it would be a very great fault to place it in them), it should be intermixed with platoons of infantry, observing also not to take them from the main body of the army, but from the reserve, in order not to diminish the strength of the front; which should never be done on any occasion whatever, unless part of the army, either by its own or the enemy's position, cannot act offensively, by reason of some morass, hollow, or any other obstacle that the enemy may have placed before him; if, nevertheless, a general can take an advantageous position, by causing these thickets or these hedges to be occupied by infantry, he should give it the preference, to enable the cavalry to act with the greater facility.

The dispositions vary not only according to the situation of the ground, but also according to the general's views. Some draw up the battalions without intervals, or like a wall; others, with small intervals; others leave the distance of half a battalion between each; and others, in pursuance of the chevalier de Folard's method, place them in columns.

The first disposition is without doubt formidable as to infantry; but, as it has been already remarked, it is defective with regard to cavalry. In the third, the interval of half a battalion is too wide: it would require an immense tract of ground; besides, the battalions would not be near enough to have it in their power to protect each other. The second seems better, because the front is not so large, the battalions are more within reach of assisting each other, and have only the distance necessary to prevent their mixing confusedly together. The fourth is undoubtedly very good; but can a general promise himself, that the soldiers can always march at an equal pace together, and without stopping? The fire of the column is continual, it defends itself on all sides; but its oblique fire does not do much execution, and there are situations and spots where this position in column would be faulty. When it cannot approach the enemy, and is also exposed to his cannon, this disposition would be dangerous; because it is certain that cannon

Plan of an Order of Battle, II.nd Disposition. Plate DXXI



Scale of ½ a League

30 300 600 1200 T.

A. Bell. Prin. Wal. Sculptor fecit.

cannon plays with much greater advantage upon depth than upon breadth: besides, not being able to get near the enemy, there are only the heads of the columns able to fire, and the rest remains inactive, exposed to the cannon. The position of the column is therefore only very good, when it can get up to the enemy and charge him.

The marshal de Puységur asserts, that an army in an open country, formed in two lines, the first of which is without intervals, ought of course to beat an army that is formed with intervals.

The reason he gives for it is plausible: it being certain, that a full line keeps itself much closer in marching; and that, charging the first line of the army that has intervals, it ought to have broke through it before the second line, which is 150 toises or 300 paces behind, can have time to come up to its assistance; which might very well happen, and examples of it may also be cited. But could not there be another disposition opposed to this disposition in wall, keeping the necessary intervals, not only capable of resisting it, but also stronger, whether by the position and arrangement of troops, or by the ready assistance they can give each other, without being confused in their motions?

Let two armies be supposed in a plain country, without support to the wings of either side, or without any obstacle that may prevent their getting up to each other. The enemy's army, as hath already been said, is in two lines; the first of which is formed in wall, both infantry and cavalry; the second is formed with large intervals, and a body of hussars in the rear. The army to be opposed to it is of equal force, and consists of 40 battalions and 54 squadrons, cavalry, hussars, and dragoons. The following seems to be nearly the manner in which it ought to act against the enemy, who is supposed to be drawn up in wall.

The first line of infantry composed of 15 battalions, has the distance of three toises between each battalion, and the distance of half a battalion between each brigade, eight squadrons on the right, and as many on the left, with their proper intervals: 15 battalions in the second line, 200 paces distant from the first, seven squadrons on the right, and the like number on the left, in the rear of the intervals of those of the first line, supporting the infantry of the second; 10 battalions in reserve in two columns, one of which in the rear of the squadrons on the right of the second line, and the other of the same force posted in the same manner on the left; 12 squadrons of dragoons in the rear of the second line, half on the right, half on the left; and 12 squadrons of cavalry, or hussars if there is not cavalry, in the rear of those of the first line.

By this disposition, the army appears to be ranged in two lines, with a reserve, and will leave no room for the enemy to doubt of the motions it may make in marching: this disposition will undoubtedly have that effect, and does not appear very formidable; but as soon as the two armies begin to move forward, the second line of infantry must advance as unperceived as possible, forming itself in columns by battalions, each of which, with its head to a battalion of the first line, will form as many T's. The 10 battalions in reserve, which form two columns of five battalions each, will march and fill up the space on the right and left, between the infantry and cavalry. The cavalry, or hussars, which are in the rear of the first line, one by a motion to the right, the other by a motion to the left, will post themselves sidewise, at 100 paces from the wings of the army; the dragoons must post themselves in the rear of them in a second line. This will be performed much easier marching, because it is not complicated; it is also performed in the rear, and the front of the first line is not put into disorder; and consequently, the enemy will not perceive it soon enough to change his position, and oppose the disposition which is presented to him. This first line, by this disposition, forming as many columns as there are battalions, of course ought to break through the enemy's army, which is in wall, but not above four deep, because the impression of a column ought to be much stronger than that of a battalion four or six deep. See Plate DXXI.

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Supposing the wings of each T to give way, the battalions which penetrate there will find themselves between two columns hedged in with bayonets; the 10 battalions in reserve, which, according to this disposition, ought to join the right and the left of the infantry, should of course separate the two wings of the infantry, which are on the outside of the disposition in columns. Four battalions should remain in pursuit of them, and the two last take the line in flank, at the same time that it is attacked in head. The cavalry should charge the line which is in wall with great vigour; and the second line should follow it very close, but in good order: the cavalry, or hussars, which are posted sidewise, will attack it in flank, and the dragoons must remain in their post, in order to keep back the enemy's second line.

Whatever dispositions are made in the drawing up of an army, they should always have some object. A general should foresee all that may be done by the enemy, whose disposition he should always suppose to be a good one, and to which he should oppose one at least as strong, and always better if possible; he should particularly conceal from him the motions he intends making, or disguise them from him in such a manner, that he shall not have time to oppose them, or at least not readily enough: neither should a general be so near as to give the enemy an opportunity of discovering and profiting by the method he intends following.

The disposition of an army in wall is good; but in general only so with respect to infantry, because that body acting by itself requires but very little ground to retreat, or present itself to the enemy, or to make a motion to the right or to the left. But this same disposition is defective, and even hurtful for cavalry, unless there is a moral certainty of its getting the better: but as, with regard to war, a moral certainty would be a real presumption, this disposition of cavalry in wall would be dangerous, because it may be broke. If that which is opposed to it marches up to it resolutely without confusion, and without being afraid of that mass of cavalry, and charges it the first, sword in hand, how can it retire in order if it is broke, being as much straitened in its retreat as in its disposition? All the squadrons filling up the ground, it will neither be able to make any evolution, or to act; and if it retreats through the large intervals of the second line, it will carry it away with it in its flight: were there even six lines behind it, they would all be carried away, the second by the first, the third by the second, and so on with the others.

It is true that it may give the first charge, and consequently make those squadrons which have intervals give way; but as these last have more ground to act on, they can retreat with greater ease than those who have none, by passing through the intervals of the second line, which is not to be done by a line that hath no interval. They can rally in the rear, while the second will charge the line that is without interval, and which is already disunited by its first attack; even when these two lines are beaten, they can retire with greater ease, each squadron having ground enough to act upon. They will never be so much disordered as the line which has no interval, which cannot escape being cut in pieces if broke, or which can only find its safety in flight; whereas, those that have intervals can retire one after another, and in a soldier like manner, sustaining each other.

Besides, in order to prevent the impetuosity of this caval-

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ry in wall, it appears that nothing is to be done but to poft huffars, if there is not a fufficiency of horfe, behind the fquadrons of the firft line, who, when the two armies begin to move forward in order to charge, will place themfelves on the right and the left fidewife, 100 paces diftant from the firft lines of cavalry: by this pofition, they will be able to take the enemy's line in flank, whenever it comes to attack the cavalry. If a part of this line perceiving this motion, divides into two, one part to attack the line that has intervals, and the other the huffars, it is fo much ftrength loft; confequently, the line with proper intervals has fewer troops to fight, and may expect to break them by giving the firft charge. If the huffars fhould be beat, it is of no great confequence, the defeat of thofe troops never deciding the fuccefs of the battle: it is the body of the army the enemy muft break, and not two regiments of huffars, which retreat with great eafe from before cavalry, and rally and return to the attack as readily as they retired. But if, inftead of huffars, cavalry can be pofted there, the enemy's line, which is divided into two, will find itfelf obliged to fight upon equal terms: the certainty of fuccefs depends upon the quicknefs with which the enemy is attacked; and the more fo, as he will be obliged to make a motion in the prefence of troops already pofted and ready to charge. If this line without intervals advances, without fhowing any attention to the huffars, in order to charge the cavalry, the huffars, at leaft a great part of them, ought to fall upon the flanks; and the dragoons, which are in the rear of them in referve, fhould take their place, to keep back the enemy's fecond line, and to prevent the huffars from being taken in the rear.

Thefe two difpofitions are ideal. A general feldom chooses to fight upon a fpot where the wings are void of fupport; and prevents the enemy, as much as poffible, from getting poffeffion of an advantageous poft, or at leaft does not attack him when he cannot prevent him doing it, efpecially if the ground which he occupies is everywhere expofed; there are, neverthelefs, circumftances where a general is obliged to fight, although not in a poft ftrong by fituation. By the two difpofitions juft now defcribed, the order which would be moft proper to be preferved for covering the wings, which may be expofed by the fituation of the ground, has been endeavoured to be fhown; it has been feen of what confequence it is for a general to know, and to fecure all the heights, moraffes, hollows, and every obftacle he may meet with. On occafions fo important, a general fhould take the fame precautions that he would ufe under the cannon of a place, if he found heights that overlooked the works; in which cafe he would not fail of conftructing others more advanced, to prevent the enemy from getting there, and retarding their approaches.

If the duke of Savoy, at the battle of Marfaille, gained in 1698 by the French army, commanded by M. de Catinat, had been poffeffed of the heights of Piofaca, the two wings of that prince's army would have been fupported; inftead of which, his left wing was expofed. M. de Catinat, profiting from this fault, extended his right to the foot of thofe heights, of which he poffeffed himfelf, and outftretched the enemy's left: it was from thefe heights that the diforder in the duke of Savoy's army commenced; it foon communicated to the whole front, and got poffeffion of the whole army: fo true it is, that the moft trifling object, being neglected, changes the order of things; that the leaft fault becomes effential; that confidence in the number and in the courage of the troops is often dangerous; and that having a contemptible opinion of an enemy is always fatal. The enemy, although inferior in troops, will foon attain a degree of fuperiority, if he has the advantage of ground.

Armies can engage in fo many different pofitions, that it is impoffible to particularife all of them. In this fection two armies have already been prefented in an open country, without any fupport to their wing: two others have been pofted, one of which is upon a fpot advantageoufly fituated, its two wings covered; the other hath only its right wing fupported, and its left expofed. It has been endeavoured to give to that, whofe left wing is unfupported, the greateft ftrength in its whole front that is poffible, and by the difpofition of the left wing it is both ftrong and fecure; but there are fuch a variety of fpots where two armies may meet, that it will fuffice to know in general the advantages they may derive from their fituation.

DISP. III. A third difpofition very different from the two former is as follows. The enemy's army is fuppofed to be advantageoufly pofted; it hath a hollow on its right, through which run the waters of an impaffable morafs, forming a rivulet. Its left is fupported by a large town, croffed by a rivulet. In the centre is an height, capable of containing 12 battalions; in the front of it is a plain of 700 or 800 toifes, which extends from its left to the cavalry on its right. Oppofite to this cavalry the plain grows narrower, by reafon of an height which reaches to the rivulet, and which the cavalry could not occupy, becaufe the enemy hath taken poffeffion of it during the night. The town is entrenched, and filled with infantry and artillery; 16 battalions in two lines are pofted next the town, in order to fuftain the troops that are in it. Behind the town there are three bridges upon the rivulet: in the front of the town, on the other fide of the rivulet, are pofted four battalions and five pieces of cannon, in order to flank the troops intending to attack the town: thefe four battalions are fuftained by eight fquadrons of dragoons. The centre of the army confifts of 20 battalions in the firft line, and as many in the fecond; eight of which are next to the morafs, fuftained by fix fquadrons of dragoons; 12 fquadrons in the firft line, and 12 in the fecond. The cavalry on the right confifts of 11 fquadrons in the firft line, and 11 in the fecond. Thirty fquadrons of huffars, diftributed half on the right, and half on the left, and the whole front of the army lined with artillery. Plate DXXII.

The army A, which was encamped a quarter of a league from the height by which it is feparated from the enemy, began its march at dark; it halted at the foot of the height, and fent fome detachments of infantry to take poffeffion of the fummit of it. The army I made the above-mentioned difpofitions, becaufe the army A was too near to be able to avoid a battle. The army I is compofed of 78 battalions and 90 fquadrons: thefe two armies are nearly of equal ftrength.

The left of the army A hath a fine plain before it, extending from the morafs to that part where the height commences. In that place are pofted eight battalions in two columns of four battalions each, next the morafs, with 10 pieces of cannon between the two columns: there are 14 battalions in the firft line, and 13 in the fecond; four battalions towards the height, and next the cavalry. Sixteen battalions occupy the height as far as the fmall wood; four battalions occupy the other fide of the wood, and 32 battalions upon two lines very clofe together; 12 battalions behind the height next the rivulet; 12 fquadrons of horfe, and 20 of huffars, who have orders to pafs three bridges thrown over the rivulet, and attack the town with three columns of four battalions each, fuftained by the 12 fquadrons of horfe, and the 20 of dragoons. In the rear of the cavalry upon the left, are pofted 16 fquadrons of dragoons at a little diftance, with intervals; fo that, if the enemy fhould attack this left and beat it, the cavalry may eafily retire through the intervals of the dragoons, to give them the greater facility of acting, and turn their defeat into an

Plan of an Order of Battle, III.d Disposition.

Plate DXXII.

an almost certain victory. Fifteen squadrons of horse are posted behind the height, with their right toward the height, and their left toward the camp, in order to take the enemy in flank, whilst he is employed in pursuing the cavalry of the left, which he has beaten. The chief object of the attack should be the town, although the most difficult. If it is forced, the enemy will be beat without resource: because the infantry who has driven him from that post, will attack him in the rear; at the same time that the infantry which remained on the height will come down from it, and join, either to attack, or at least to employ the enemy upon the height, and by that attack prevent him from sending assistance to the troops already driven from the town and put to flight: the cavalry upon the left will advance at the same time to support the infantry, and, if necessary, to charge the enemy's cavalry.

The 32 battalions which are upon the height in two lines, will be divided into six columns, of which four of six battalions will be employed in attacking the town, the last battalion of every column excepted; which must remain at the entrance of the wood, with four columns of four battalions upon the left, in order to sustain the infantry attacking the town, and to keep back the enemy's cavalry upon the left. They will descend from the height under the protection of the wood by which it is covered, and which ends at about 400 toises from the town. These troops will be followed by artillery, which must be posted between the columns; they must halt on leaving the wood, and will begin by making a continual fire of cannon upon the town and the cavalry: during this fire of the artillery, the 12 battalions on the other side of the rivulet ought to attack the four battalions and the eight squadrons of dragoons belonging to the enemy; and when they have forced them to give way, they will amuse them by a constant fire of musquetry. When the artillery shall have played long enough to have broken down the enemy's entrenchments, and destroyed the order of the troops, the four columns, formed of 20 battalions, will march up, and with their bayonets endeavour to penetrate at some part; the 12 battalions on the other side of the rivulet will charge at the same time; the two columns of four battalions each, as well as the four last battalions belonging to the columns which attack the town, will remain at the entrance of the wood with the artillery, in order to keep back the enemy's infantry and cavalry which was next the town. If any one of the columns can penetrate as far as the bridge that is in the town, it will take possession of it, as well as of the market-place; the others following it will take possession of the hedges and gardens. One column only will be sufficient to secure the banks of the rivulet, and take possession of the bridges. As soon as the bridges are free from the enemy, the 12 squadrons of horse and the 20 of hussars will pass and attack every thing they find to oppose them; then the left ought to advance: the battalions which have remained upon the heights should come down from them, and all together attack the front of the army, whose left wing is already broken and taken in flank.

But if the enemy, after having examined the disposition of the army A, imagining that the principal attack will be directed against the town, instead of remaining in his first disposition, changes it entirely, and causes a part of his second line of infantry to march to the town; and if he strengthens his right by the cavalry of the left (a spot more favourable for cavalry than infantry), the attack of the town will then become impracticable, because of the great superiority of the troops defending it; therefore it would be useless to persist in it; but his right should be vigorously and briskly attacked. It is true, that it is reinforced by the cavalry from the left; but as the ground between the height and the eight battalions which are next the morass can contain but 12 squadrons, those which the enemy hath drawn from the left can only be posted behind the height, or in the third line; if they are behind the height, nothing can prevent their being attacked: but supposing the first line broken, it should not be too warmly pursued, for fear of separating, and being taken in flank by the cavalry behind the height. The 16 squadrons of dragoons which are behind, ought to remain in that situation; the 15 squadrons of horse, which are with their right to the height, and their left to the old camp, ought to take the place of those who have attacked the enemy; and then the 20 battalions which are upon the height will come down into the plain and attack the enemy's infantry, at the same time that the 15 squadrons of cavalry and the 16 of dragoons attack the cavalry which is posted behind the height. If they succeed in beating it, or whether they do or not, if the enemy sends assistance, he will weaken his left, and then the 44 battalions, who till this time have remained inactive, may come down from the height and attack the town, not so much with a design of forcing it, as to oblige the enemy not to take any troops from it; if no assistance is sent to the right wing, it will be undoubtedly beaten, being attacked by forces so greatly superior to it: the whole of the cavalry being thus put to flight, the most prudent part the enemy can take is, to endeavour to pass the rivulet by the three bridges behind the town, and by so doing secure himself from farther insult: if the enemy does this, the 12 battalions, the 12 squadrons of horse, and the 20 of dragoons, will retire by the same road they marched up, and they will be in security as soon as they are in the wood: besides, a beaten army is seldom to be feared; therefore, they may retire unmolested, and in order.

But if it happens that the enemy, without changing his position, is not to be forced in any of these attacks, the general had better retire to the height, where there will be no danger of the enemy's endeavouring to attack him: but if he should attempt the attack of the left wing of the army A, it must be reinforced by all the cavalry that can be employed without causing confusion, and two brigades of infantry should be joined to the two which are next the morass.

Disp. IV. The fourth disposition is supposed in a country mixed with thickets and plains. The enemy's army hath its right to some mountains, and its left to a river; at about a third part of the length of his front, there is a village a little behind its right. His disposition is, four battalions and six pieces of cannon upon an height which overlooks the plain, to which is also added the cavalry of the right. Behind are two passes entrenched and guarded by four battalions; upon the heights of these passes there are four more, to prevent the enemy penetrating at the flank. There are eight squadrons in the first line, four battalions posted at the village, and 12 in it with cannon: 16 battalions on the left of the village, 14 squadrons and four battalions next the river. The second line consists of 11 squadrons upon the right, eight battalions behind the village, in order to carry timely assistance to it; 12 battalions in the rear of the 16 of the first line; 15 squadrons and four battalions to the river. The reserve consists of 18 squadrons of dragoons next the mountains (in order to dismount and be within reach of assisting the battalions guarding the passes), and of 24 squadrons of hussars on the left next the river. An island is supposed a little in the front of the first line: in this island are placed two battalions and six pieces of cannon. A stone bridge is also supposed between the two lines, behind which is posted two battalions, to support those in the island, and to facilitate their retreat. It seems impossible to attack an army thus

 situated;

Offensive Operations.

situated; all the troops are near to support each other: the flanks are secured and well guarded; artillery is planted along the whole front; and the passes are entrenched, and troops posted in them.

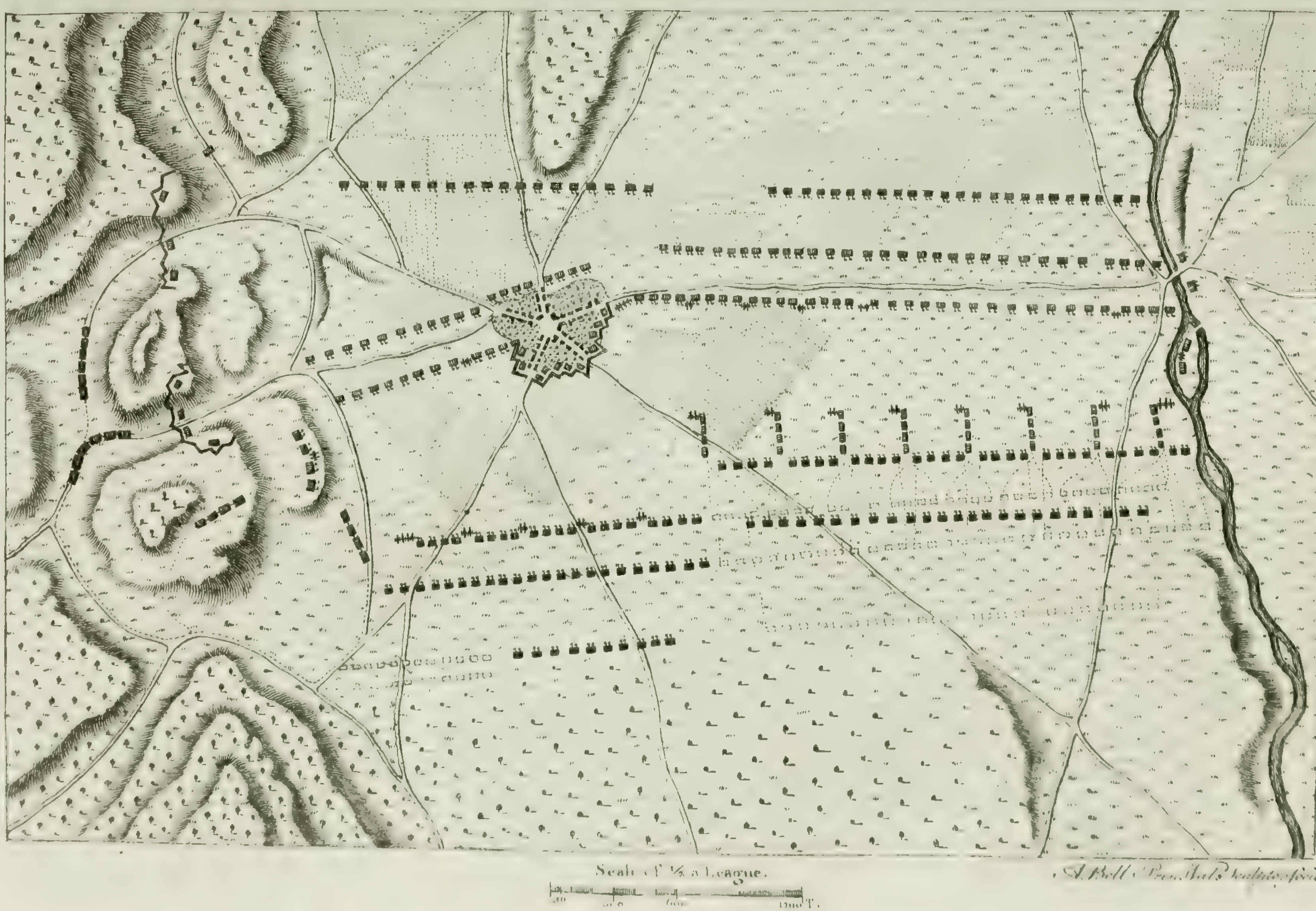
In the front of the enemy's army is a large plain, which runs from the mountains as far as the river; but the largeness of it is broke into by some thickets, where nevertheless cavalry may act: in order to attack this army, thus advantageously posted, a disposition must be made, entirely different from that which it is in. If the village, which is entrenched and well furnished with troops and artillery, is attacked, the forcing it will be doubtful: but supposing it should be forced, it will not be without losing a great number of men; which should be avoided, because it is the duty of a general to spare the blood of his soldiers as much as possible, and even, if practicable, to employ but few of his troops against a greater number of the enemy's. If the passes only are attacked in order to take the enemy in flank, it is very certain he can send assistance to it without weakening his front, having it in his power to cause the eight battalions in reserve behind the village to march there, and to cause the 18 squadrons of dragoons to dismount. If only the left wing next the river is attacked, it is true that attack is more practicable, there being no obstacle or entrenchment to prevent coming up with the enemy: but still there is but one wing beaten; and that, by falling back upon the troops in the village, can retreat by the mountains of which the enemy is master. There is great reason to imagine it will be beat; but the general must endeavour to reap as much profit from that victory as he can: it is therefore thought that, not to lose the fruit of it, the enemy should be attacked on the left wing, from the centre to within about 200 toises of the river, at the same time that the entrenched passes are attacked. During these two attacks, a brisk cannonade should be kept up upon the village, the infantry and cavalry upon the right, the infantry that is posted in the island, and that which is next the river: by these two attacks the enemy's front and right wing will be equally annoyed; he will not know where to send assistance, and in that state of uncertainty may probably send it to a part where the danger is not so pressing. But suppose he should act in the most proper and prudent manner, as it should always be imagined he will, the assistance which he will send to that part, cannot be effected without unfurnishing or weakening some other: if he strengthens the passes and the heights with the eight battalions behind the village, they perhaps will not be forced; but he will scarcely venture to take any troops from the village, in order to send them to the assistance of the front that is attacked. But if he should unfurnish the village, it must then be attacked, and that vigorously; which may be the easier done, as it hath been for some time cannonaded, and consequently the earth hath been tumbled down, and openings made, at least large enough for the infantry to enter it: this attack will not at all prevent that at the front from going on.

In order to execute the attack upon the enemy's army, it is imagined the troops ought to be distributed after the following manner: all the infantry should be placed in the first line, excepting that of the reserve, which should consist of 20 battalions; the second line should consist of the cavalry; and the third should be formed of the dragoons and hussars. The 20 battalions on the left, forming five brigades, should remain in order of battle at the coming out of the thickets, with artillery distributed between the intervals of each brigade; the 28 battalions, after making seven brigades as soon as they come out of the thickets, will form in column: then the 24 squadrons which are in the rear of the infantry, formed in column, will post themselves, four squadrons in the intervals of each brigade. The brigade supporting the right flank will advance on the side of the river: and then the seven columns and the 24 squadrons will march up to the enemy and attack him with their bayonets, without losing time in firing. As soon as the columns have broken or staggered the enemy's first line, the cavalry will fall furiously upon them, sword in hand; a part of the dragoons and hussars should follow, in order to be within distance of sustaining the troops who have attacked, or to join themselves to the cavalry who have broken in among the enemy: it should be observed, that as soon as the hussars are engaged and pursuing the enemy, the cavalry should rally in order to sustain them, or to flank the infantry which may still make resistance. The brigade of infantry which supported the right, followed by the seven squadrons, should attack the four battalions on the left of the first line, and the seven squadrons will take them in flank; which they can with the greater ease effect, as the cavalry hath been put to flight. The seventh column should, with four squadrons, attack the four battalions of the second line, at the same time that this attack is executed from the front as far as the river; 16 battalions of the 20 in reserve should attack the passes, and also the heights; the remaining four will march under cover of the mountains, sustained by a brigade of infantry and eight squadrons, in order to attack the cavalry on the right; thus of the whole front of the enemy's army, there will remain only the village that hath not been attacked, unless there hath been such a number of troops drawn from it, as to render the carrying of it not difficult. It is to be supposed that one of these attacks will succeed; that made by the columns sooner than the rest: the disposition of columns intermixed with cavalry is very formidable, because each body is supported without confusion: besides, it is to be supposed that a column four battalions in depth, and from 18 to 20 men in front, ought to break through a line that is only four deep, and which being once penetrated, the cavalry will find no difficulty in breaking through it. See Plate DXXIII.

The movement of the infantry to form itself in column, and the evolutions of the cavalry to fill up the intervals of each column, ought to be performed with great quickness, and near enough to the enemy to surprise him, but not at such a distance as to give him time to remedy it.

The nature of the ground, which is continually changing, cannot be followed through all its various shapes; the author from whose work we take this article hath therefore endeavoured to form his dispositions in those situations which most ordinarily occur, in order that these general dispositions may be assistant to the ideas in more particular and critical situations. Mountainous countries have not been mentioned, because it is very rare that they present an opportunity of coming to a general action: the affairs which happen among them are generally with regard to some post, which can never decide the fate of an army, however brisk they may be. The four dispositions now mentioned are ideal; and although the propriety of them may be defended, it would be very imprudent to answer for their success; because with regard to the business of war, the whole depends upon circumstances, and the least accident often renders a disposition, seemingly the best, the most prejudicial that can be taken. A motion of the enemy's troops ill conducted by their commanders, too much sloth or too much eagerness in the execution of orders, an accidental word falling from the mouth either of an officer or a soldier, and which is always increased when told again, may occasion the defeat of an army, however well disposed or advantageously situated. The epithet "best" should be given to that general who commits the fewest faults; for there

Plan of an Order of Battle, IV.th Disposition.



there is no man who can flatter himfelf with having committed none: it is impoffible for a general to fee every thing himfelf, or to remedy any unforefeen acident that may happen, if he is not affifted by his general officers, who fee things which it is impoffible he can: they ought not only to be the means of putting his orders in execution; but even, in certain circumftances, they fhould prevent them, and make the fame difpofitions which the general ought to make, and would certainly order, were he in their fituation.

Petite Guerre.

Part III. Of the PETITE GUERRE.

THE Petite Guerre confifts in the manœuvres of the Partifan in fecret marches, occupying, defending, or attacking pofts, reconnoitring countries or the enemy, placing of ambufcades, &c.

Sect. I. *Of the Qualifications of a Partifan, and the Nature of his Corps.*

They generally call every officer a partifan who is deftined to go at the head of a detachment, whether draughted from the body of the army, or of a party which he belongs to, and for that reafon has no other name than that of a partifan.

Of all military employments, there is none which require more extraordinary qualities than that of the partifan. A good partifan ought to have an imagination fertile in projects, fchemes, and refources; a penetrating fpirit, capable of combining the whole circumftances of an action; a heart intrepid againft every appearance of danger; a fteady countenance, always affured, and which no figns of difquiet can alter; a happy memory, that can call every one by his name; a difpofition alert, to carry him through every thing, and give a foul to the whole; a piercing rapid eye, which inftantly catches faults or advantages, obftacles and dangers of fituation, of country, and every object as it paffes; his fentiments ought to be fuch, as to fix the refpect, confidence, and attachment of the whole corps. Without thefe difpofitions, it is impoffible to fucceed.

A partifan ought to fpare nothing to be affured by his fpies of the march, force, defigns, and pofition of the enemy. As chief, he owes the example of an irreproachable conduct to his corps, by which he will infpire refpect, love, zeal, and vigilance, and gain the hearts of the whole to his fervice. It is extremely dangerous for fuch an officer to contract the leaft attachment to women, wine, or riches. The firft makes him neglect his duty, and frequently occafions the moft ruinous treacheries: the fecond leads to dangerous indifcretions, and is fure to draw down contempt: the third leads to guilt, and deftroys all fentiments of honour. The partifan muft be content without the delicacies of the table, as he may be often expofed to want provifion; his bed the fame with the mens, a cloak and ftraw, never ftripping but to change linen. Nothing animates foldiers fo much as the prefence and vigilance of a commanding officer fharing with them the fatigues of the fervice: the officers follow his example; the men are affured, encouraged, and content.

A corps capable of carrying on the Petite Guerre to advantage fhould be compofed of infantry and cavalry; and as it is inconteftable that the cavalry ought to be the moft active in carrying on the Petite Guerre, it were to be wifhed that they were likewife the ftrongeft, fo as to have 600 cavalry and 400 infantry in a corps of 1000 men, making four companies of infantry and 12 troops of cavalry.

The commanding officer fhould have the naming of the officers of this corps, or at leaft have liberty to reject fuch as he is convinced are not qualified for fuch fervice, as every officer who may be ambitious to ferve in the corps, tho' poffeffed of great military merit, may not have the talents requifite for the duties of the partifan.

To fupport the honour of this corps upon a folid and refpectable footing, the ftricteft fubordination muft extend from the chief to all the officers, and the moft rigid difcipline infpire vigilance, patience, bravery, and love of glory, to the whole corps.

It is of the utmoft importance for the officer that commands, to have the choofing his men and officers whom he knows to be fitteft for his enterprife, and thereby preventing many difficulties, contradictions, and dangers, which jealoufy and diftruft always occafion among ftrangers.

No recruit for the corps of a partifan, either cavalry or infantry, fhould exceed 30 years of age; but the younger they are, if they can carry arms, fo much the better for fuch a fervice, to which youth is particularly inclined. In the choice of recruits for the cavalry, it were not unworthy the attention of officers to prefer men that are lovers of horfes, and to recruit chiefly in thofe countries where fuch are moftly to be expected.

As for arms, the firelock and bayonet is fufficient for a foot foldier; and in the corps of the partifan, barrels of 36 inches, with a long bayonet, but to have the caliber the fame as that of the reft of the army, which, for the fake of having ammunition made up to fuit the whole, ought to be invariably the fame. A helmet likewife is preferable to a hat, as the fword is almoft the only thing to be dreaded from the enemy's cavalry. Four fpades and four pick-axes fhould be given to each company of infantry.

The prefent manner of equipping the light dragoons is fo perfect, it is unneceffary to fay any thing on that head; but no white horfe, ftone horfe, or mare, fhould be fuffered in the corps of the partifan, as the leaft neighing or perceivable colour may make enterprifes fail. No horfe fhould be mounted for fervice till fix years old. The fize of the light dragoons is very proper for the partifan; and while they have firm ground to act upon, and plenty of forage, none can excel them; but when they come among moraffes, and feel the feverity of want, perhaps the Hungarian huffars may be found more equal to the duty: poffibly, therefore, in forming the corps of the partifan, 200 horfe, fuch as are bred in the mountains of Wales or Scotland, mounted by the lighteft men, might be found of good fervice.

The principal attention of an officer of cavalry fhould be, to fee that the men feed and drefs their horfes well. During the whole campaign they fhould have dry food only, as green weakens them. When the exigency of the fervice requires the horfes to be kept faddled day and night, every horfeman fhould feize fome moment to turn the faddle-cloth, which greatly comforts a horfe, keeps him at eafe, and lefs apt to gall; and care fhould be taken to keep the cloth foft, and clean from fweat and duft.

Sect. II. *Of Pofts, &c. and the different Works with which they may be fortified.*

Posts are generally fuch places as bodies of troops can fix in when detached from the army, to cover and fecure the frontiers; and upon the vigilance and refiftance of the parties

Petite Guerre.

parties that are detached there, depends the safety of the army. Whatever the abilities of a general may be, it is scarce possible that he can have an eye to every detail that contributes to their defence; it is sufficient if he knows that the guards are properly placed, and the line that they make properly established. It is then the business of the particular officers who command them, to make the best disposition for a vigorous defence, and answering the views of the general.

An officer who is detached to a post, is either to relieve a party, or take possession for the first time. In the first case, if the guard which he relieves happens to be entrenched, as soon as he arrives at the post, and has taken his instructions from the officer who commands, he should prepare himself for his defence, as shall be mentioned in that article. In the second, if an officer who is detached is to entrench himself, he must examine if the place is advantageous for the execution of his projects, the defence of his people, and the securing a retreat.

He must consult, 1st, Whether the situation be convenient for sending parties to discover the enemy; whether to give intelligence of their situation and march, or to disturb and surprise them. 2d, If it has some natural defence on its front or flanks, such as a river, rivulet, morass, or small wood that can be easily penetrated. 3d, If he can preserve his communication with the army, and if there are some covered places to favour his retreat. 4th, If he can discover all the approaches; because if the enemy can come within a small distance of the post without being seen, he will place himself under cover there, and rest while the besieged are obliged to remain continually under arms, and will watch the moment for making an attack. If then he finds hollow roads, clumps of wood, or any place where the enemy can secure himself in the neighbourhood of his post, he must fill them up, or guard them with detachments of six or seven men. 5th, He must take care not to be commanded by any neighbouring heights, or must prevent the enemy from profiting by that advantage; because if they can take his soldiers in the rear, it will be impossible for them to defend themselves. 6th, The extent of the work must be proportioned to the number of men that are to defend it. Good sense and numberless examples prove, that too large entrenchments can only be defended by considerable bodies. 7th, He should take care to have all the parts of his entrenchment nearly of an equal strength, so as to be able to make an equal resistance everywhere; and, lastly, He will take care to fulfil exactly the intention of the general in posting a guard in that place.

There are some places so advantageously posted by nature, that though they are not fortified, they may in a short time, and with little charge, be made so strong, that it will require as much art to besiege them as many others that are perfect fortifications; such as islands, peninsulas, and places seated on eminences of difficult access, or in morasses.

If the post is in a level country, or upon a height that may be surrounded, as happens almost always to small detachments, they should construct a redoubt, or small square fort, composed of a parapet with its banquette and ditch.

Plate DXXIV.

The ground being chosen, you must trace a straight line AE (fig. 1.), and raise the perpendicular BC, as directed in practical geometry; observing to give to each of these lines which mark the interior side of the parapet but two toises, or two and a half for 30 men, four toises for 50, and eight for 100; which will leave a space of two feet at least against the parapet for each man. Having traced the two first lines A, B, you must put the cord over the picquet C of the perpendicular B, and with the same length trace the arch D, then put the cord over the picquet E of the line A, and trace the arch F. The point where the arches intersect each other, is the point to end the lines EH and CG. These four lines mark the interior side of the parapet.

Then trace four other lines at the distance of two or three feet parallel to the first, as I, L, M, N, to mark the size of the banquette, which should be greater or less according to the number of soldiers you would place in a file. Then trace a third parallel square on the outside of the first, as O, P, Q, R, to mark the exterior side of the parapet, and to determine its thickness, which is usually eight or nine feet, or 18 if it is to resist cannon, which you should always be prepared to do.

Then trace a fourth and last square STVX, to determine the width of the ditch, which is the same or two feet more than the thickness of the parapet; leaving a picquet planted at all the angles, as likewise at the lines already traced, so as not to lose the points from whence the lines were drawn.

While you are employed with two or three men in tracing, five or six men should be ordered to cut down the trees that are in the neighbourhood of the post, not only to open the approaches, but to serve for constructing the intrenchments. The smallest branches serve to make fascines, which are a sort of faggots about six feet long, two feet thick, and of the same size all over, tied in the middle and at the two ends, to serve for supporting the earth, which would tumble down without that support. The middling branches serve to make picquets proper for mixing with the fascines, and fixing them in the ground, or one above another to raise the parapet. The trunks to which the large branches are left, serve to increase the strength of a post, as shall be mentioned afterwards.

Having traced all in the manner directed, fix a row of fascines upon the small square ILMN, to support the earth of the banquette; then fix a second row upon the square ABGH, to support the interior side of the parapet; then a third row on the third square OPQR, to support the exterior side of the parapet. You should observe in the beginning to picquet the fascines, to leave a passage of three feet PB, on the side least exposed to the enemy, to serve for an entry to the redoubt; but if this passage can be taken in a straight line, it should be made like a mortoise, as you see at Y, fig. 2.

After having picqueted the three rows of fascines as directed, you must dig the ditch AB, as in the profile, fig. 3. a foot distant from the exterior side of the parapet. This distance or breadth is called *berme*, and serves to support the earth, or receive what falls from the parapet by the enemy's cannon. This *berme* is more or less according to the solidity of the earth; the earth to be thrown into the intervals C, D, E, marked for the parapet and banquette, taking care to make the men tread it well down, and observing to leave a *talus* or slope on the two sides of the ditch FG, more or less according to the consistence of the earth, so that it may not tumble down. The slope F, which is on the side of the redoubt, is called the *scarp*; and the opposite slope, which is next the country, is called the *counterscarp*. Care must be taken in picqueting the fascines with which the parapet is raised, to bring them nearer one another by degrees in raising it as at H, so as to leave the same slope on each side. The distance DE marks the banquette; the distance DC the thickness of the parapet at the bottom; the distance IL the thickness of the parapet at the top; MN the width of the ditch at bottom; AB the width of the ditch at top.

If the ground is level, the banquette of this work must be

be raised two feet; but in low places two banquettes are necessary, the one above the other like steps: but if this banquette is raised on account of some neighbouring heights from whence you may be taken in the rear, the parapet must be raised to such a height, that the enemy's shot can no longer plunge down upon you. A slope must be left on the top of the parapet, as IL, so that the soldiers may see round the post, and fire easily towards the country at O.

Though the square form of a redoubt, which we have given the method of constructing, is almost the only one used in the field, yet it has its faults, which ought to make it be rejected, at least for those posts which ought to defend the environs equally. Experience shows us, that we ought never to depend on the oblique firing of musquetry, as the soldiers almost always fire right forwards, as at A, fig. 4. and often even without taking aim. This being the case, there are large spaces opposite to the angles of the redoubt at B that are not defended, and where we may say that the enemy remains in safety. The chevalier Clairac proposes an excellent method to prevent this inconvenience, by constructing the interior edge of the parapet like the edge of a saw, in form of small redans, to hold a man or two in each side, fig. 6. which by the cross fire takes the enemy on the two flanks, so that there are no approaches but what are defended; but the construction of this redoubt is too tedious and complex to be executed by small detachments.

The same author prefers constructing circular redoubts as at C, fig. 5. because all the points of the circumference being equally disposed, the soldier posts himself indifferently over all; and the exterior spaces D which are defended, varying every moment, the enemy is nowhere in safety.

The circular redoubt, then, is the most perfect that can be constructed: but where a road or the edge of a river, is to be defended, the square, or long, or triangular redoubt, is preferable, because they ought to oppose the faces of the intrenchment as parallel as possible to the places they are to fire at, observing always to round the angles.

To trace a circular redoubt, after fixing the central point of the post, let a picquet be fixed in that point, and draw from it as centre the circle EE, with a length of cord in proportion to the number of the party, to mark the interior side of the parapet; then trace another within the first, at the distance already given, to mark the banquette; then trace a third FF, to mark the exterior edge of the parapet; then trace a fourth GG, to mark the width of the ditch; which being done, picquet the fascines, and make them take the bend of the circle, finishing as in a square redoubt.

If an officer is posted with a detachment on a passage or before a bridge, in a defile, or opposite to a ford, he may make a parapet either bending or straight, with a banquette or ditch which should shut up the whole entry; or he may make a redan, which is a work with two faces, and in such a situation should be made with a re-entrant angle (that is, the angle pointing from the enemy); taking care when he is to guard a ford, to construct it so near the river that the enemy cannot have room to form after they have passed. A deep ditch may be dug opposite to the ford, into which they should let the water of the river pass; they may likewise make the banks steep; throw trees across, and scatter chaussetraps, which are instruments of iron with four spikes, made so as to have always one point erect.

The strength of a redoubt or any other work may be augmented by blocking up the passage that leads to it, surrounding the post with felled trees, and sinking their trunks three or four feet deep in the earth, which must be dug on purpose, leaving a number of large branches on them, which must be sharpened at the ends, and the leaves taken away, and placed as near to one another as possible, so that the branches may mix, and taking care that they incline towards the enemy. Two or three rows may be made in this manner; but they should be at least two toises distant from each other, that the enemy may not burn them all at once to approach the entrenchments. M. Saxe in his Reverie says, that redoubts are proportionably advantageous as they take less time in constructing, and are proper for numberless circumstances, where one of them may serve to stop an army in a close country, hinder them from troubling you on a critical march, or to occupy a large space of country when you have but few troops.

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There is no need to mention large works which require engineers to construct, and great bodies to defend them, as these have been described under the article FORTIFICATION; but a redoubt, such as A, fig 7. may be strengthened by filling the ditch with water, by turning a rivulet, or cutting a river or pond. If the ground is uneven, so that the water cannot be put equally in all parts of the ditch, dams should be left in digging at C; or little traverses of earth to form banks proper for keeping the water in the upper part of the ditch D, from whence it may be let run into the lower E. These banks should have but half a foot in thickness at the height D, which should be raised sharp; but a good deal more must be left below at E, by sloping the two sides pretty much. Dams likewise are made of planks or boards, as at F; but they must be strong, and supported by large stakes, so that the body of water above may not overturn them; and then they are reckoned preferable to those that are of earth: but a more particular explanation of this figure may be of use.—A therefore is the ground within the redoubt. B, The bottom of the ditch. C, D, E, Dam of earth. F, Dam of planks, boards, or fascines. G, Upper part of the redoubt constructed of fascines, and the earth dug out of the ditch. H, The lower part of the redoubt dug in the earth. I, The berme or space left at the bottom of the parapet to support the earth. L, The entry of the redoubt. M, The inside of the parapet. N, The upper part of the parapet. O, The banquette. P, The glacis. Q, Rivulet from whence water may be let into the ditch of the redoubt.

But it is not with the works alone which have been already mentioned that an officer may fortify a post; there are an infinity of ways to stop an enemy, to tire him, and even to repulse him, with which it is necessary that every commander should be acquainted.

All the schemes for opposing the enemy, of which we have given a detail, serve only to add to the exterior strength of posts; there are others which have some natural fortifications, such as churches, church-yards, mills, or farm-houses, &c. An officer who is sent to a post of this kind, which is detached from other buildings, ought, before he begins to work, to make the inhabitants go out, and the magistrates of the nearest place receive and lodge them. He should then entrench the house with a turning parapet, if he have people enough to defend it; but if he have only a few, he should make a breast-work of felled trees round the house, especially opposite to the angles, to prevent the enemy from undermining it. He must likewise take off the tiles and slates, lest the enemy should get up by ladders, and crush his people that are within. If the house is covered with thatch, it should be pulled off and burnt, as well as every thing combustible that can be found in the neighbourhood, lest the enemy make use of it against the house.

Though the house is surrounded with a parapet of felled trees, yet the walls should yet be pierced with loop-holes, about

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about a foot from the ground, so as to discover the enemy's legs, that they may not get footing on the outside. These loop-holes should be four inches wide, and three feet distant from one another; and a little ditch should be made a foot and a half from the wall within the house, to place the soldiers in who are to defend it. Other loop holes should likewise be pierced seven or eight feet from the ground, opposite to the interstices of the lower ones, and of the same width, placing the soldiers that are to defend them upon tables, planks, or ladders; and taking care to pierce a greater number opposite to the avenues, before, and at the sides of the gate, and the angles of the house, because these are the places where the enemy usually makes his greatest efforts. If the house has an inner court, the walls should be pierced which inclose it, so as to fire upon the enemy after he has made himself master of it. If there are several gates, they should all be blocked up except one, to be left for an entrance to the post, which should be made so as to admit but one man at a time.

If there is a broad staircase for going up to the first floor, it should be broke down, or blocked up with stones or casks filled with earth. If it is a winding stair, the wall should be pierced in different places with loop-holes, to fire upon the enemy that are already entered, keeping ladders for the troops defending the house to get up to the first floor, which should have the boards pierced with a number of holes about four inches diameter, to fire down upon the enemy, observing to pierce them only where there are no trees below, but to have a greater number over the door and other weak places which the enemy can force. A post entrenched in this manner may resist a great while, and even tire out the besiegers if defended by resolute men.

Captain d'Enfernay of a French regiment, with a company of volunteers, in the campaign of 1748, took post in the church of Bevera, two miles from Ventimiglia. It is detached from other buildings, and he fortified it with a parapet and ditch full of water; but his entrenchment was commanded by some houses in the village, so that the enemy could fire down upon his party. He remedied this defect by covering the commanded part with a kind of blind made with rafters, leaning with one end on the wall of the church, and the other upon posts raised a foot higher than the top of the parapet, which left room to fire through. This blind, covered with fascines and earth, prevented the enemy's fire from piercing, and did not prevent his firing upon them, so that they durst not attack him.

This example is mentioned to show how to secure a post that is commanded by a height. When there is no redoubt or entrenchments of earth, the interior side of the parapet which is commanded should be raised, or a sort of penthouse should be made with rafters, placed perpendicularly against the inner side of the parapet, upon which planks or fascines are nailed, taking care to leave room between the bottom of the penthouse and the top of the parapet for the men to fire through.

If an officer has not time to oppose all the schemes which have been mentioned to the enemy, when the general wants to make a forage, and throws infantry into the house to form a line, he should immediately place a couple of trees across before the door, pierce the boards, shut the windows, and prepare for his defence, which gives time to the foragers to retire, and the supporting parties to advance

The fortification of villages, if they consist of scattered houses, differs nothing from the fortification of a few contiguous posts, between which a communication is to be preserved. If they consist of houses collected, the commander must proceed upon the principles laid down in another article. See FORTIFICATION.

SECT. III. *Of going on Detachments and Secret Marches.*

DETACHMENTS are particular bodies of soldiers detached from a greater body, to guard a post, or to go on an expedition.

When an officer is ordered on a detachment, he should provide himself with a cord regularly divided, in case he has occasion to entrench; and be at the parade by times, to get information from the brigade-major, whether he is destined to relieve a detachment, or to occupy a post for the first time. If to relieve a party, he is only to know where the guide is who is to conduct him; the guide is a soldier, sent by the officer who is to be relieved, as orderly-man to the major-general, who by having been at the post before can lead a new detachment to it.

If it is a post that is to be occupied for the first time, the officer is to ask the brigade-major for instructions relating to its defence; which being got, he must inspect his party, and take care that every soldier is properly equipped; his firelock loaded, fresh primed, and a good flint well fixed; his cartouch-box filled with cartridges; and that he carries provision for 24 hours, which is the time that detachments commonly continue, and are not allowed to go away to eat. Care must be taken to have spades, pick-axes, hatchets, and wood-bills, one or two of each kind; and if any thing is wanting, to apply to the brigade-major for it, that they may have every thing necessary for entrenching.

When an officer has inspected his party, he ought to get information from his guide whether the way is broad or narrow, open or inclosed; if the enemy's posts are near; if they go on patroles, or see their parties in the day; and, lastly, if he is to pass mills, farms, manors, &c. and from these informations take the necessary precautions for his march.

When the whole are ready to march, the advanced guard A (fig. 8.), which should consist of cavalry only, should set out. It is surprising that all the authors who have written on this part of the art of war, have neglected to show sufficient attention to so essential a point: the greatest part are silent, and the rest passing slightly over the different duties of this corps, are content that it should be composed of infantry; though, on the least reflection, in the most ordinary cases of a secret march, reason must determine that none but cavalry ought to be placed there, whether it be to stop passengers who may discover your route, or suddenly to attack an advanced guard of the enemy whom they meet face to face, or to harass their corps, in order to gain time for your own to form: it is incontestable, that for all these purposes, cavalry has greatly the advantage of infantry; who are by no means capable of running here and there to seize passengers, or of pouring suddenly on an advanced guard of the enemy; or of resisting their cavalry a moment in case of a sudden rencounter, when they must expect to be thrown down and trod under the horses feet, and the corps attacked before the commanding officer has had a moment to prepare for his defence.

As examples serve best to illustrate opinions that have been seldom declared, the spirited behaviour of Cornet Nangle of the 15th regiment of light dragoons merits our particular notice, and will serve as a proof of the great advantage of having the advanced guard of cavalry. In the campaign of 1761, when the French army under the command of Marshal Broglio and the prince of Soubise were retiring towards Hoxter, where they passed the Weiser, Prince Ferdinand followed close after them for several days, and

and on the evening before they gained the pafs over the river, one of Prince Ferdinand's German aid-de-camps defired the grenadiers and Highlanders who were in front, to pufh on and take fome of the enemy's baggage, which was a little way before them and but weakly guarded. They were immediately formed, and marched in a hurry over a plain with a thick wood in front, which they were told was clear, and had got within 400 paces of the enemy's baggage, when feveral fquadrons of French dragoons rufhed fuddenly out upon them from the fkirts of the wood upon both flanks, and were hewing them down without mercy, when Cornet Nangle with an advanced guard of 20 men coming up the hill, got fight of the attack, and inftantly rufhing on, charged the French cavalry, who, ftartled at the brifknefs of an attack which they were not expecting, immediately reined back; when the reft of the regiment getting in view, came on; and attacking the French, drove them off, having killed and wounded a few, and taken fome prifoners. The determined bravery of this young officer with his 20 men faved a great number of the grenadiers and Highlanders from being cut to pieces, and fhows what may be effected by the fudden attack of an advanced guard of cavalry.

An advanced guard by night fhould be of double the force of one by day. In an open country, it is a matter of indifference at what diftance they advance, provided they keep in view of the commanding officer, who fhould continually obferve them: but in covered places, and in the darknefs of the night, they fhould not be more than 50 paces diftant.

This advanced guard fhould have an advanced corporal B, with fix horfemen divided into three pairs; one in the centre B, the two others out of the road on the right and left at CC, to examine as wide as poffible, filently and attentively fearching all hollow and covered places, taking care that there is nobody lying on the ground, or hid in dry ditches, behind trees or bufhes. At the fame diftance of 50 paces upon the flanks of the corps, fhould march two wings DD, confifting of eight or twelve horfemen, each according to the ftrength of the corps, led by a non-commiffioned officer. They can harafs an enemy who may happen to rufh fuddenly out of ambufcade, and give time to the corps to form. Each wing to detach two men EE, keeping 50 paces wide from the others, and preferving the fame route as exactly as the face of the country will permit. At the entrance of the wood NN, the horfemen fhould fpread, and clofe again at coming out, and do the fame at meeting any little hills, to examine them on both fides. When they perceive any traces of a party, they fhould immediately communicate it from one to another, till it comes to the commanding officer.

The advanced guard ought to march flowly, and the commanding officer at the head of the corps fhould follow at the fame rate, fo that the rear of the detachment may not be obliged to gallop. As the rear-guard H is only eftablifhed for form, there is no need of its being numerous. The officers and quarter-mafters fhould be careful to keep the men from fleeping, as a horfe is eafily hurt under the irregular motions of a fleeping rider, which retards the march. The whole corps fhould be forbid to fmoke or fpeak; and if any one is obliged to cough or fpit, let him cover his mouth fo as to make no noife.

When the corps is numerous, the cavalry fhould march by fquadrons, the infantry by platoons, to follow alternately, fo that each platoon of infantry FFF may march at the head of a fquadron of cavalry GGG; which difpofition will preferve the whole at an equal pace, and keep them readier to form in cafe of meeting the enemy, or being fuddenly attacked, as we are about to mention.

When the advanced guard perceives an enemy at a diftance, whether it is day or night, they fhould not purfue them, for fear of falling ftupidly into fome ambufcade, if it is not in a country that has been well examined; but if they meet them fuddenly face to face, as may happen at the entrance of a hollow way I, opening obliquely upon them, then the advanced guard, without deliberating about their ftrength, fhould inftantly rufh upon them. This manœuvre cannot fail againft infantry, and gives a great advantage in a rencounter with the cavalry; but if the advanced guard falls back, they expofe the whole body to be defeated with them.

When the commanding officer fees the action of his advanced guard, he will inftantly turn the infantry on the fide of the road moft proper to protect them from the enemy's cavalry, and will form them quickly at the fide LLL, or on fome neighbouring height MM. If it is day, they ought to face the cavalry, ftooping down till the inftant of the attack, while the firft fquadron advances to fuftain the advanced guard. If the enemy appears defirous to renew the charge, and obftinate in difputing the paffage, he may make ufe of a feint, and by falling back bring them oppofite to his infantry, who will have them in the flank, and by a well-placed fire put them inftantly in diforder. His cavalry profiting by this, muft immediately face about, and fall upon them with all poffible violence; which cannot fail to complete their defeat.

All villages, hamlets, and houfes, fhould be avoided, efpecially by night (which is the moft common time for the partifan), to avoid being difcovered by the barking of dogs, or being feen by peafants who can inform the enemy. You will fee equally how dangerous it is to keep the great roads by day, or to crofs places that are too open in an enemy's country.

If you cannot avoid paffing through a village, it fhould be done in a hurry, marching confufedly, very clofe, and filling up the whole breadth, by which you will conceal your ftrength from the peafants; fome officers fhould remain at coming in, and in the rear, till the whole are paffed, taking care that no one ftops or withdraws. The fame care fhould be taken at every road that opens upon your route. At the approach of every place that is covered or hollow, fuch as houfe, wood, gully, &c. they fhould halt till it is well examined, and continue attentive in paffing it.

At the paffage of defiles, bridges, or fords, the advanced guard fhould ftop at 100 paces, and form till the whole corps is paffed and in order. The ancients employed dogs to difcover the enemy in ambufcade; but it will be well to diftruft fuch fpies, and to fuffer none with the corps, as there is nothing more dangerous; their difpofition leading them to bark at meeting the leaft animal, they will furnifh the enemy with a thoufand opportunities of obferving you, before you can know where they are.

You fhould always detain the guides that were taken at fetting out; but if neceffity requires another, the quarter-mafter fhould go and take one without making a noife, and lead him a round-about way, that none of the peafants may difcover either your party or route. If any of the party difcover paffengers in fight of the march, they fhould be ftopped and brought to the corps, and care taken to prevent their efcape.

The party fhould never refrefh in a village, but in a wood by day, and open country by night, caufing every neceffary to be brought to them from places in the neighbourhood, which ought to be received from the peafants at a diftance,

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ſo that they can neither diſcover the number nor quality of your corps. During the whole time of ſtopping, you ſhould not be ſparing of ſentries, and have always ſix horſemen ready to ſecure any perſon by whom you imagine you are perceived; when their number becomes conſiderable, they ſhould be tied together, and great care taken that none eſcape till the ſtroke is ſtruck. The officers ſhould be equally attentive that no ſoldier gets out of ſight; and if they meet a deſerter from the enemy, he ſhould be conducted immediately to the corps, and then to the army, under the care of a non commiſſioned officer.

When neceſſity obliges you to ſtop in the neighbourhood of ſome farm or hamlet, you muſt take poſſeſſion of it, and carry off the farmer or chief of the place at going away, threatening to kill him and ſet his houſe on fire if any one ſtir from the place before he is releaſed. Every horſeman ſhould take care to have a ſpare fore ſhoe, and a peck of oats.

If an officer of the infantry marches a detachment to relieve a poſt at a diſtance, he ſhould not mount his horſe till out of ſight of the camp, and ſhould diſmount on coming in ſight of the poſt: but if it is only about a league diſtant from the army, and near the enemy, it is better to go on foot, ſo as to be leſs encumbered in caſe of engaging with any parties of the enemy. The men ſhould not be preſſed too much for fear of lagging in the rear, but ſhould march cloſe without ſtopping, and in as many files as the roads will permit, keeping profound ſilence, that they may hear any orders that are given.

An officer who marches at the head of a party, ought to keep exact order and profound ſilence, that they may be in a ſtate to execute whatever he may order for their defence; but in giving his orders, he ſhould take care to do it with a firm and determined countenance, ſo as to make the ſoldiers think that he is ſure of what he is about, and that nothing better can be done. When the men ſee their officer heſitating, or varying in his orders, they imagine he does not know what to do; and ſeeing him diſordered, they become ſo. It is upon ſuch occaſions that an officer ſhould be ſteady to reſtrain his party, and make them inſtantly obey. The danger is greater on a march than in an attack. Here the ſoldiers have their arms in their hands; and, ſeeing the enemy before them, are ready to engage. It is otherwiſe on a march; they are leſs upon their guard, and have not their arms in readineſs: then, ſays Vigetius, an attack confounds them, an ambuſcade diſorders them. An officer ought therefore to take every precaution in examining, by his advanced guard, all places that may conceal any of the enemy.

But as the greateſt precaution cannot prevent an officer on a march from being attacked, it is neceſſary, as ſoon as he perceives the enemy, to obſerve if the party is ſuperior to his detachment; whether it conſiſts of cavalry or infantry, or both together. If it is cavalry, and ſuperior, there is no neceſſity of being diſcouraged; but, on the contrary, he ſhould profit by every advantage that offers, by gliding into land that is furrowed, uneven, cut, and difficult or inacceſſible to cavalry; or if the country is incloſed, he ſhould line the hedges, and cheer up his ſoldiers by ſome encouraging language, while he diſpatches a truſty fellow with advice of his ſituation to the general. If the enemy march up to him in this ſituation, he muſt do all that he can to ſuſtain the attack, by ordering his party not to preſs upon one another, to keep up their fire, and not to diſcharge their pieces till they are at the muzzles.

When you have the advantage of rocks or other obſtacles to the acting of cavalry, continue the route as near as poſſible, keeping the party cloſe, and always ready to receive the enemy. If the number of the enemy's cavalry do not exceed your party, you may continue your route; and keeping your men cloſe together and prepared, they will not venture to attack you. If an officer ſees no means of poſſeſſing an advantageous poſt, or of getting to the poſt he was detached to, he can do nothing better than retreat to the camp, along ſome river or wood, to prevent being broken: but if he is ſo cloſely purſued that he cannot avoid being beat or taken, there is no better manœuvre to imitate than that of the Barbets (A); who ſcatter themſelves, and retire from tree to tree, from rock to rock, and deſtroy a party, who can neither beat them, nor take one of them.

The moment of taking poſſeſſion of a poſt is the moſt critical that a detachment can have; officers have been frequently attacked at the very time they thought they had nothing to do but quietly take the neceſſary meaſures for remaining in ſafety.

If the party which arrives at a poſt is to relieve another, the officer that is to be relieved gets under arms as ſoon as his ſentries give notice of the approach of the relief. The detachment being known, they are permitted to enter and occupy the poſt in the room of thoſe that are to depart; at the ſame time, the corporals go to relieve the ſentries, and the officers and ſerjeants give the counter-ſign, with the detail of all that is to be done at the poſt by day or night. He ought likewiſe to get information from the officer he relieves, if the enemy make incurſions in the neighbourhood; if their guards are diſtant, whether cavalry or infantry, and whereabouts placed. After theſe precautions let him guard againſt his poſt being ſurpriſed.

The ſentries being relieved, the officer that is to go out muſt form his detachment, and return to camp with the ſame precautions as in coming. The new detachment remain under arms till the other is gone 50 paces: then the officer is to make them lay down their arms againſt the parapet, putting their havre-ſacks againſt the gun-locks, to prevent duſt from ſpoiling them, or the dew of the night from wetting the powder. In an open country without fortification, the men muſt not go to any diſtance from their arms when they lay them down in the day, and keep them between their knees when they ſit round their fires in the night, with the locks inward, to prevent accidents.

Sect. IV. *Of Reconnoitring.*

Parties ordered to reconnoitre, are to obſerve the country or the enemy; to remark the routes, conveniences and inconveniences of the firſt; the poſition, march, or forces of the ſecond. In either caſe, they ſhould have an expert geographer, capable of taking plans readily: he ſhould be the beſt mounted of the whole, in caſe the enemy happen to ſcatter the eſcort, that he may ſave himſelf more eaſily with his works and ideas.

All parties that go for reconnoitring only, ought to be but few in number. They ſhould never conſiſt of more than 12 or 20 men. An officer, be his rank what it will, cannot decline going with ſo few people under his orders; the honour is amply made up by the importance of the expedition,

(A) They are peaſants ſubject to the king of Sardinia, who abandom their dwellings when the enemy take poſſeſſion, and are formed into bodies to defend the Alps which are in his dominions.

pedition, frequently of the most interesting consequence, and the properest to recommend the prudence, bravery, and address of any officer that has the fortune to succeed.

It must be evident that the success of such a commission depends upon secrecy, and that it is impossible to fulfil the intention without keeping out of sight of the enemy. It is incontestable, that a numerous party cannot glide along so imperceptibly as a small handful of men. As these detachments must finish their course quickly, it is necessary that they should consist of cavalry only; but if they are to go far, they may increase each with 30 foot, to remain in ambush about half-way in a wood or covered place, with whom the cavalry can leave their provision they brought with them.

An officer charged to reconnoitre in front, should take his instructions in writing, and set out at such time as to arrive at the place proper for beginning his observations at day break. Every time that he has occasion to stop, the party should face toward the enemy, and send a non-commissioned officer with two horsemen to run over the neighbouring heights, and closely examine the environs. When near the enemy, avoid stopping in a village.

The officer, and geographer who is supposed to be present, should remark every interesting particular: The heights, woods, ponds, morasses, rivulets, rivers, fords, bridges, roads, crossings, difficult and dangerous passages, by-ways, meadows, fields, heaths, gullies, hills, and mountains; the distance and strength of villages, hamlets, houses, farms, and mills; what sovereign the country belongs to, and what are its productions.

If the enemy comes in sight, the officer should quickly assemble his party, though his reconnoitring be not finished, and let him retire to his infantry, if he placed any; but if not, let him gain some other place that he has chosen for a retreat. After being refreshed, let him go back with the cavalry to finish the reconnoitring; but if he was obliged to return quite to the post, he should not go back till next day. Mid-day is the time of being least incommoded, as detachments are less frequent at that hour. The commanding officer ought always to avoid coming to blows, even though he thinks himself secure of success, unless he happen to be on his return, and near to his post, so that he foresees the grand guard, hearing the firing, cannot fail to run to his assistance. If obliged to engage with a party who are cutting off your retreat, and that no other means is left of turning them, you must risk all without hesitating, by rushing on, and try to save the geographer with the fruits of his commission, especially if the reconnoitring was of importance to the general of the army, and merits the sacrificing a dozen men, which they can easily retrieve on another occasion.

When a party goes out to obtain news of the enemy, it ought to approach as near as possible, but cautiously: day-break is not the time proper for such a purpose, because at that time the enemy send their different parties and patroles to make discoveries; you should therefore prevent them by approaching in the night. You may easily reconnoitre their position and extent by their fires, which they never extinguish at the head of the guards and picquets; and you may easily remark if they are about to change their position, by hearing a more than ordinary noise; besides, as it is easy to approach by night, you may discover a number of things by the light of the fires.

A partisan ought not to neglect to reconnoitre every place round his post for two or three leagues, or farther, if it is possible on the side of the enemy; and for that purpose he should employ the method of Mr Jeney; who, during the campaigns that he made, often examined the enemy's posts without approaching, in the following manner, which he recommends as infallible.

I suppose myself, says he, with my party at Soest in Westphalia A (fig. 2.), and the enemy posted at Bervick B, two leagues from me. To know the situation of this place without stirring from Soest, I take the map of the country; and from Soest as centre, I draw a circle whose circumference passes half a league beyond Bervick.. I draw a circle of the same size upon a leaf of paper, to make my plan as in fig. 2. and then place Soest in the centre A; and I mark all the villages which I find in the map near the circumference, upon my plan, with the distances and bearings as they are represented in the map, making use of a pencil to mark the places DDD, so as to correct the errors more easily which the map may have led me to make.

The Gu[illegible] Plate DXXV.

Having thus formed my plan, with a scale of two leagues (which is the distance I suppose Bervick), I go to the burgomaster of the town of Soest, where I cause some of the most intelligent inhabitants to come, speaking to them freely, and openly induce them to communicate all the information I have occasion for.

The better to conceal my designs, I begin my reconnoitring by Brokhusen, a village distant from the enemy. I ask the distance from Soest to Brokhusen; if they say it is seven quarters of a league, I correct the distance of my plan which made it two leagues: then I inform myself of all that is to be found on the road from Soest to Brokhusen; chapels, houses, woods, fields, orchards, rivers, rivulets, bridges, mills, &c. If they say that at half a league from Soest they pass the village of Hinderking, I mark that place upon my plan. I ask if the road from Soest to Hinderking is crossed by any other road; if there is any morass or heath; if the road is inclosed, paved, or straight; if there is any bridge to pass, and at what distance. I take care to mark every thing in my plan, forgetting nothing, even to mills, bushes, gibbets, gullies, fords, and every thing that can be got from their informations; which will probably be perfect, because one always knows more than another. I continue my questions from Hinderking to Brokhusen; and advancing by little and little, observe the same method on the roads of the other villages round, marked DDD. In this manner I cannot fail to acquire an entire knowledge of all the places; besides, I find myself imperceptibly instructed in the position of the enemy, by seeing the different routes by which I can approach most secretly.

It is plain that such a plan must be very useful to regulate secret expeditions. It is chiefly useful, not to say necessary, for a commander of a party, who can give more ample and precise instructions to his officers, by accompanying them with a copy of the routes marked out, which they can consult even in the night, if it happens to be clear; by which they will be guarded against being deceived by ignorant or treacherous guides, which occasion the mistakes of so many who go unprovided with such helps.

There is still another means to secure a reconnoitring party; which is, to compose them of people who speak the language of the enemy, and give them surtouts of the colour of a regiment of the enemy, and cockades the same. This scheme may be carried so far as to line the surtouts with the colour of another regiment of the enemy, provided that by turning the surtouts, they appear to be a different corps, and deceive guards, spies, and peasants, and confound their reports.

Sect. V. *Of the Defence of Posts.*

When a partisan has taken every precaution that prudence suggests in reconnoitring a place where he would fix a

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a post, he is to take possession in the following manner. The infantry remain under arms in the middle of the place, the cavalry to patrole without, while the commanding officer, escorted by a dozen horsemen, goes to examine the environs to make his arrangements; having sent several small detachments before, to cover him in time of reconnoitring.

Having remarked the places proper for his guard, defence, and retreat, as well as the dangerous ones by which the enemy can make approaches secretly to surprise him, he should choose the most convenient in the front of his post to fix his grand guard D (fig. 1.), which must face the enemy. He must mark the heights for this guard to place their vedettes EEEE, and regulate the number according to the exigencies of the situation. In a covered country you must not be sparing of them, and must reinforce every guard. At 50 paces before the front of the grand guard, a subaltern or non-commissioned officer with eight horsemen should be always ready to set out at K, to go and reconnoitre, when the vedettes have observed any party.

Plate DXXV.

The grand guard being fixed, you should form another in the middle of the village, called the *ordinary guard*, composed of cavalry and infantry, placing sentries at the entries and vedettes all round; the last at such distance as to see one another. A picquet should likewise be fixed before the quarters of the commanding officer, which should be near the ordinary guard and the whole corps. In the day, half the cavalry of the picquet must keep their horses bridled and ready to mount; but if the enemy is near, they must remain on horseback, the other half to unbridle till the hour of relief.

According to the arrangement we have given for composing the corps of a partisan, the grand guard may consist of a captain, a first and second lieutenant, a quarter-master, two serjeants, four corporals, a trumpeter, farrier, and 52 private horsemen. The ordinary guard to have cavalry equal to the grand guard, with a captain, a first and second lieutenant of infantry, two serjeants, and 60 men, including four corporals, two lance-corporals, and a drummer: the picquet to consist of the same number of cavalry and infantry as the ordinary guard.

If there is any dangerous place capable of covering the approaches of the enemy in the environs of the post, and out of the circuit of the patroles, there should be a guard placed there, more or less strong according to the importance of the place, and care should be taken to preserve the communication. The guards and picquets being placed, the detachment that was sent out on the roads must be called in, and then go to work to lodge the party in the gardens that open upon the country, and the commanding officer's quarters; beating down hedges, filling up ditches, and levelling a piece of ground large enough to draw up the whole corps. The horses to be put under cover in barns contiguous to the gardens; but in case there are no barns, they may substitute sheds open on one side, that the horses may go out altogether in case of an alarm.

The officers should occupy the houses in the neighbourhood of the sheds, and one of each company remain day and night with the company, to prevent any of the men from entering the village without leave, upon any pretence. The commanding officer must acquaint the officers of his having chosen the place M for the rendezvous in case of a retreat; which ought to be at some distance from the village, and on the side he judges most convenient for retiring to the army. At sunset the grand guard are to return to the post and join the picquet, the one half of each to mount alternately till day-break, and then the grand guard to return to the place they possessed the day before. The sentries and vedettes should be doubled, and all the passages shut up with waggons placed in two rows, except one for sallying out at, in case of a retreat, made wide enough for the passage of the patroles or the whole cavalry.

The corporals of the ordinary guard should lead the relief of the vedettes every hour, setting off together; but when they come to the passage of the post A, they must separate into two parties, the one to the right to relieve the vedettes BBB, the other to the left for the vedettes CCC; then each of them with the parties they have relieved should go on at their head a quarter of a league, by the two routes pointed out in the plan, to examine the environs, supposing an hour to each. Besides this reconnoitring, the captain of the grand guard should send two patroles in the night. To fill up the intervals, they should set one about half an hour after the corporals, and make the same round. At returning to the post, the corporals to make their report to the officer of the ordinary guard; the conductors of the patroles to the captain of the grand guard.

A little before sunrise or sunset, a grand patrole detached from the corps should be sent under the conduct of an officer to search the whole environs of the post minutely, especially the dangerous places, because at these times the enemy are most likely to attempt a surprise. If the patroles discover them, they will be in a state to repulse them, or at least to harass them till the commanding officer, upon the first notice, draws up the whole corps. The officers should take great care to instruct the sentries in their duty, explaining it to them every time of their mounting, and forbid them to smoke, as the least fire can be easily perceived in the dark, and serve to direct the approaches of the enemy. No sentry to move more than 50 paces to the right, and as many to the left of his post: and let the weather be ever so bad, he must not get under cover. No one to be allowed to go out of the post without leave of the commanding officer; and to prevent desertion or marauding, the sentries and vedettes must be charged to let no soldier pass.

The vedettes must stop all passengers, and take them to the next sentry, who must call a corporal to conduct them to the commanding officer. If there are a great number passing at once, the vedette at the challenge must hasten to stop them at 100 paces, till the officer has sent to reconnoitre them; but if he finds them to be a party of the enemy, he must fire upon them and retire. At the first alarm, the grand guard and picquet ought to mount, and each of them to detach a subaltern officer immediately at the head of the best mounted horsemen, to go quickly to encounter the enemy. The rest of the grand guard and cavalry of the picquet to follow immediately, led by their captains to sustain the first detachments, to repulse or keep back the enemy as long as it is possible, and give time to the commanding officer to form the whole corps.

If the commanding officer observes that the enemy are of no very extraordinary force, he must without hesitating put himself at the head of his cavalry, and instantly charge them, pouring upon them with his whole force, which is the best way to succeed; and in the mean time, the infantry should form to sustain the cavalry. One essential circumstance should not be forgot here, which is, that at the going of the detachments of the grand guard and picquet, all the infantry of the picquet should march immediately to the place appointed for the rendezvous in case of a retreat, and a strong detachment of cavalry should follow to occupy the place. If it is at the entrance of a wood or some covered place which the enemy may occupy, and thereby cut off your retreat, you must prevent it by fixing the infantry of the picquet in the post, to remain day and night, with a

Fig. 1.

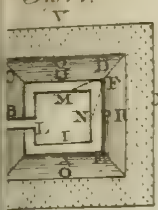


Fig. 2.

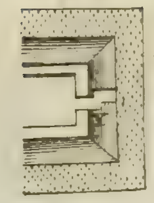


Fig. 4.

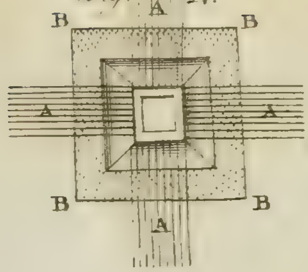
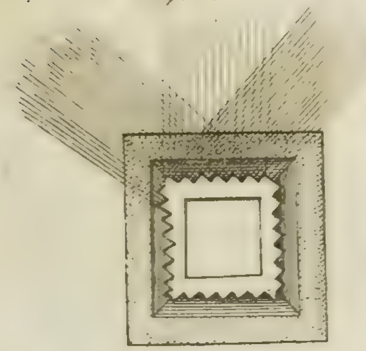


Fig. 6.



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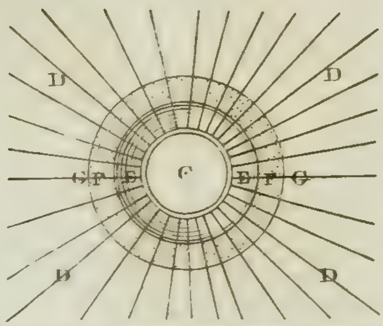


Fig. 7.

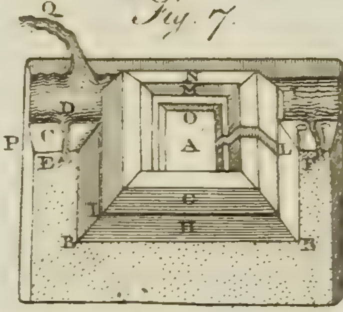
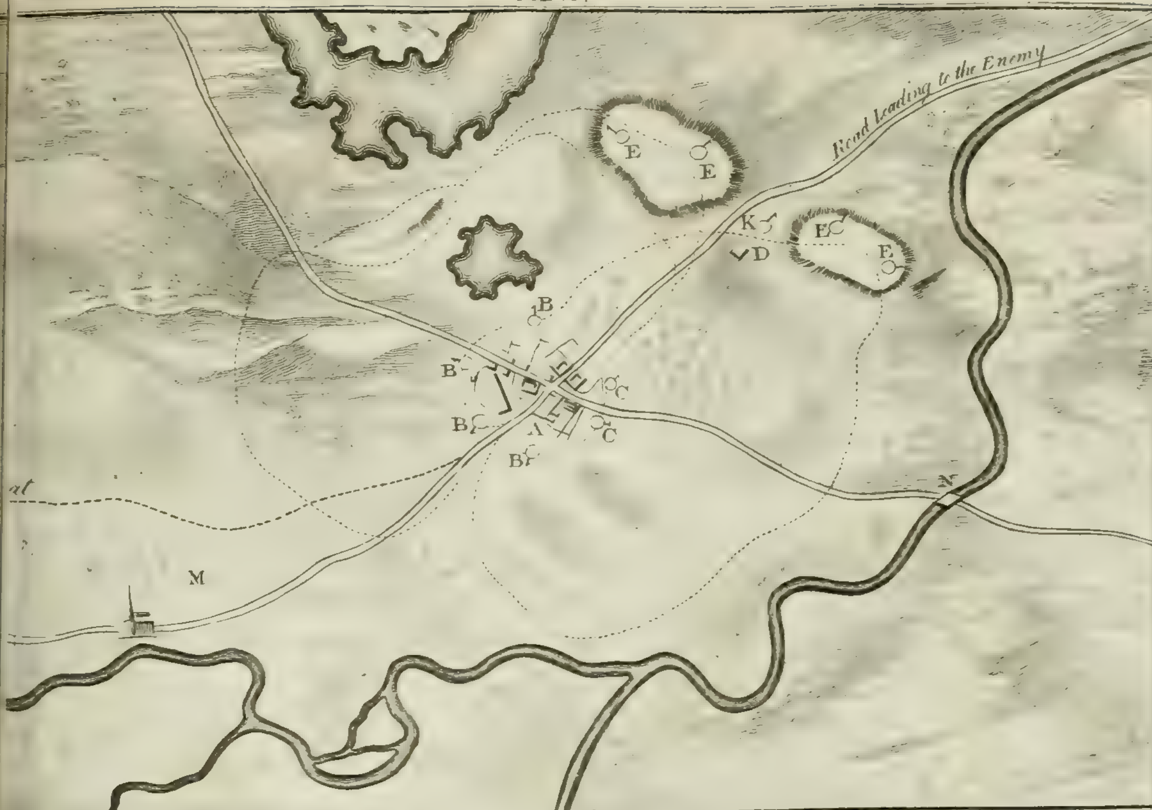


Fig. 3.

Fig. 8.

Bell Prin. Wal. Sculptor fecit

Fig. 1.



A. Bell Prin. Wal. Sculp.

lieutenant at the head of 20 horfemen to clear round it. If the enemy is too fuperior, and appears to form an attack on that fide, the commanding officer fhould get there before with all his force to oppofe them, till all his detachments join, and then regulate his retreat, as will be feen in the fection of the Retreat.

To be better fecured in a poft which you expect to remain in for fome time, and where you find that the enemy will not fail to difturb you, it will be proper immediately to employ fome of your people with the peafants, to form fome intrenchments in a hurry in the moft dangerous places, to have breaft-works of felled trees in the woods; herfes placed in the fords (fee HERSE); pits dug at the entries and plains without defence; fo that the cavalry coming full fpeed to charge you, may tumble in. If there happen to be a bridge either in the front or on the flanks of the poft, as at N, by which the enemy can facilitate their approach or retreat, it muft be inftantly deftroyed, unlefs you find it may be of ufe, and neceffary to fix a good guard on it.

To regulate the attack and defence moft advantageoufly, you fhould take care to obferve the places by which the enemy can approach, and form a plan of operations for cutting off, or taking in flank, the different routes which he can attempt. You fhould inform your officers, and not fail to hearken to the advice of thofe whofe talents, genius, and experience, render them competent judges of your defigns. Thefe arrangements will be of great ufe in furprifing the enemy's parties, who will come from time to time to reconnoitre the poft. If the enemy approaches in the night, take care how you attack him; you cannot reconnoitre his force, and you ought to fuppofe that he is informed of yours.

Do not fuffer any fufpected woman to approach the foldiers; their vifits are dangerous in debauching your people, and the enemy frequently employ them to difcover your ftrength. Let no deferter ftop in your poft; and if he comes in the night, keep him till day-break is near, and then fend him to the army. Every party that approaches your poft will profefs belonging to you; but if they are not provided with a proper paffport from the general, or if you do not know any of the officers, truft neither to their word nor uniform.

Thefe inftructions may ferve for the corps of a partifan according to the propofed arrangements; but partifans of lefs force muft regulate their precautions according to their ftrength; and detachments of 30, 50, or 100 men, will feek to poft themfelves in redoubts proportioned to their number, or in mills, farms, hamlets, detached houfes, churches, church-yards, &c. obferving that the more a poft is extended, the more care and fatigue it requires.

The principal object for an officer that is detached, fays Monfieur Vauban, is to forefee every troublefome event. The want of exactnefs, and the fmalleft relaxation in the fervice of out-pofts, may have the moft fatal confequences; and hiftory furnifhes a thoufand examples of camps being furprifed, and armies cut in pieces, by the negligence of detachments that ought to have watched for their prefervation.

The manner of relieving detached pofts has been mentioned; but if an officer is detached to a mill or houfe, let him draw up his party about 15 or 20 paces from the poft, and fend a ferjeant or corporal with five or fix men to fearch the chambers, cellars, and barns: which being done, the fentries muft be placed, the poft taken poffeffion of, the arms ranged fo that every one can find his own without confufion, and the inhabitants lodged in fome other houfe; and then intrench himfelf according to the rules given.

If an officer is to fix in a village where it is difficult to examine every place where the enemy may lie in ambufh, he fhould fend for the magiftrates to come and fpeak with him, while his party remain drawn up at the end of the village, that they may declare if they know whether there are any of the enemy's parties, fufpected perfons, or concealed arms in the place; which being done, the fentries are to be placed, and the party to take poffeffion; putting fmall detachments of five or fix men, more or lefs according to the ftrength of the party, at the avenues; and examining the church, or any detached houfe, to make the principal poft in cafe the advanced pofts are forced. The men beft acquainted with the duty fhould be planted on the moft expofed and diftant places, fo as to fee all the approaches; and fometimes in trees, that they may fee at a diftance, and remain concealed from the enemy.

If he finds any place near him where the enemy can lie concealed, he fhould place a corporal with fix or feven men there, with orders to fall back upon his poft if attacked, or remain till they find themfelves difengaged. The foldiers of this leffer poft fhould take care to make no fires, becaufe it would ferve for a guide to the enemy to avoid them when they want to fall upon the principal poft; but fires may be lighted in the places where they have no guards, to make the enemy think they have them every where, at the fame time placing foldiers in ambufh where there are none lighted. This fcheme may ferve for all pofts in a level country, where two or three foldiers fhould be kept going all night to ftir up the fires.

The exterior arrangements being made, and fentries placed on the avenues, bridges, and fteeples, the works for fortifying the poft fhould be marked out, and executed by the workmen, and the magiftrates ordered to fend ftraw to the neareft houfes for lodging the foldiers, who muft never abfent themfelves. The officer muft always be in readinefs to go where his prefence may be wanted, and make his ferjeants and corporals frequently go the rounds. Monfieur Vauban fays, that if an officer is to remain but four hours in a poft, he ought to intrench. If he is to pafs only fome hours in a poft, it is a good way to make a parapet of felled trees; or if it is in a village, to intrench a detached houfe.

The way to guard againft being furprifed, betrayed, or made prifoner, is to take precautions againft all that the enemy can undertake; and whatever diftance he may be at, we ought not to found our fecurity on probabilities, but extend them even to poffibilities. Neither ftranger nor foldier of any other party fhould be admitted into the poft; and the roll fhould be called three or four times a-day, that the men may not abfent themfelves: the commander fhould likewife examine the fentries, to fee whether they are acquainted with the detail of their duty, and fhould fhow them how to defend themfelves in cafe of being attacked; obferving to them, that if the enemy make fuch a manœuvre, they fhould oppofe fuch another; if they try this fcheme, to refift with that, and deceive them at every ftep. He may make fome of them try to fcale the intrenchment, to fhow the difficulty of mounting it; and by exercifing them in this manner, he will prepare them to refift the enemy; it will flatter their vanity, and give them a confidence in him.

An hour or two before day, the men fhould be kept alert, fitting on the banquette near their arms; and the patroles fent at that time, rather than in the night, to march flowly, to liften attentively, and examine every place round the poft where a man can conceal himfelf.

It frequently happens that two armies are encamped oppofite to one another, and have feveral pofts on the fame line, and two patroles meet in the night. As it is impoffi-

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ble to diftinguifh whether they are friends or enemies, they who firft difcover the others, fhould conceal themfelves on the fides of the road, behind bufhes, or in a ditch, to examine if they are ftronger; and in that cafe to let them pafs in filence, and return another way to the poft to tell what they have feen: but if they find them weaker, he who commands the patrole fhould make the fignal which is ordered for the patroles of the night, which is commonly a ftroke or two on the cartouch-box or butt-end of the firelock, which is anfwered by an appointed number; but a word is the fafeft. If the patrole does not anfwer, they fhould advance upon them with fixed bayonets, fire upon them if they fee them retiring, and make them furrender.

If detached oppofite to the enemy, it is to be prefumed that you may be attacked: therefore fmall detachments fhould be advanced between the fentries in the night, about 30 or 40 paces from the poft, with their bellies on the ground, in thofe places where they imagine the enemy may come; with orders to thofe who command them, to make a foldier reconnoitre any parties that are feen, fo as not to confound their own patroles with the enemy's parties, and to retire to the poft on the firft firing.

In villages there fhould be great care taken of fufpected perfons, or of the peafants revolting; and for this purpofe, you fhould make the magiftrates order two peafants, the beft known in the place, to be put on duty with the fentries of the party, at the paffages left in intrenching. Thefe peafants, whom the magiftrates muft caufe to be relieved every two hours, fhould be charged to recollect all who pafs out or in of the village; and both one and the other muft be told, that they fhall be anfwerable for all the accidents that may happen from the treachery or negligence of thofe fentries who have let enemies in difguife enter the village.

They muft likewife order the foldiers who guard the intrenchments, to let no peafant approach, and to fhut up the paffage, with two trees acrofs in the night, and not to open them till day, except for the paffing of the patroles. They muft examine with iron fpits, or their fwords, all carts that pafs loaded with hay, ftraw, or cafks, or any thing that can conceal men, arms, or ammunition.

An officer cannot watch too carefully to prevent fchemes that may be contrived againft him; and the attempt on Brifac, in the month of November 1704, is fo much to the purpofe, that it ought not to be paffed in filence. The governor of Fribourg having formed the defign of furprifing Brifac, fet out in the night of the 9th or 10th of November, with 2000 men, and a great number of waggons loaded with arms, grenades, pitch, &c. and fome chofen foldiers: all thefe waggons were driven by officers difguifed like waggoners, and were covered with perches, which had hay placed over them, fo that they appeared like waggons loaded with hay coming in contribution. They arrived at the new gate by eight o'clock in the morning, under the favour of a thick fog: three waggons entered the town, two full of men, and one with arms, when an Irifhman, an overfeer of workmen, obferving 30 men near the gate, who, though they had the drefs, had not the manner of peafants; afked them what they were, and why they did not go to work like other people? Upon their not anfwering, and appearing confounded, he ftruck fome of them with his cane; upon which the difguifed officers run to the arms which were in the waggon next them, and fired 15 or 20 fhot at him within half a dozen paces, without wounding him. The Irifhman leaped into the ditch, where they likewife fired feveral ufelefs fhot at him, while he called *To arms, to arms*, with all his might.

At this noife, the guards of the half-moon and the gate run to arms, and would have pulled up the draw-bridge, but were prevented by the waggons which the enemy had placed upon it. The officers and foldiers who were in the waggons, rufhed out with their arms, and having joined the reft, attacked the guard commanded by a captain of grenadiers; but being repulfed, and five of them killed, the reft were difmayed, and fled either into the town, or out into the country. The captain of the guard made the firft gate, which was a grate, to be fhut, acrofs which the enemy, who were upon the bridge, fired at all who appeared; and having left the half of his guard, he mounted the rampart with the other half, and continued firing upon the enemy. A lieutenant who commanded 12 men of the advanced guard, was attacked at the fame time by an officer who prefented a piftol to his breaft; but fnatching it from him, he fired it at him, and killed him; this lieutenant defended himfelf to the end of the action; but having received feveral wounds, he died that day.

Upon hearing the noife of the furprife, the commanding officer of the place diftributed his garrifon to their proper pofts: and having made every difpofition neceffary for his defence, the enemy faw that their defign had failed, and retired in diforder, leaving a number of waggons behind them, and more than 40 foldiers who were killed or wounded. Such was the enterprife on Brifac, which failed by a trifling accident.

This example, and many others which might be cited, fhow that an officer who commands in a poft cannot be too much on his guard to prevent his falling into the fnares which the enemy prepare for him, as the feizing of a poft, of however little importance it may feem, may be attended with the moft troublefome confequences.

In an enemy's country, the inhabitants are always ready to revolt and betray; therefore the commanding officer ought to take one or two of the magiftrates children, or three or four of the moft confiderable families of the village, and keep them in the principal poft as a pledge of the fidelity of the inhabitants. The children (to whom they fhould take care to do no manner of hurt) fhould only be kept half a day each, and changed for fome others. The commanding officer fhould forbid the inhabitants to affemble in taverns or public walks, or any place whatever, and caufe thefe orders to be fixed up at the door of the church. If they are feen to ftop and converfe at coming out of church, or in the market-place, let the patroles oblige them to retire. The tavern-keepers and all the inhabitants muft be forbid to receive any ftranger without acquainting the commanding officer. None to be permitted to ftir abroad after retreat beating, on pain of being killed by the fentries who fee them, or ftopped and conducted to dungeons by the patroles; who ought to march flowly, ftop from time to time to hearken if they hear any noife, go over all the quarters that are marked out to them, and give an account of every thing that they have difcovered that can caufe any alarm in the poft.

If fire breaks out anywhere, or the inhabitants quarrel among themfelves, an officer fhould take care how he fends a party to their affiftance, becaufe thefe are frequently fnares of the enemy to divide the ftrength of a detachment on purpofe to attack them; he fhould therefore ring the alarm bell, make all the different pofts get under arms, and order thofe who command them, to make the foldiers remain armed againft the parapet, fo as to obferve what paffes without the village. The foldiers of the principal poft fhould likewife get under arms, and the officer detach four or five men with a ferjeant or corporal to part the fray, or fet the inhabitants to work in extinguifhing the fire.

As all the neceffary precautions for the fafety of a poft are

are too many to have them executed by giving them verbally, the commanding officer should give his orders in writing, and have them fixed up in all the lesser posts. One thing to which officers who are detached to a village should give particular attention, is, not to vex the inhabitants by making them furnish too much: whatever they are allowed by the general to exact, such as firing, forage, candle, &c. for the guards, should be demanded in proportion to the abilities of the inhabitants; and an officer cannot be too delicate in preserving the character of a gentleman in ordering contributions, and preserving the inhabitants from being robbed or treated ill by the soldiers.

It is not sufficient for the preservation of a post, to raise intrenchments, nor to take every precaution against being surprised. As the enemy must attack with a superior force, your dispositions must be made in such a manner as not to confuse one another, and every one being properly placed, contributes to the common safety. If it is a redoubt, or other intrenchment of earth that is to be defended, seven or eight trees with their branches should be kept in reserve, to throw into the breaches the enemy may make, and the parapet kept well lined with men, who ought not to fire till the enemy are on the glacis. They should be provided with grenades to throw in the midst of the enemy who have jumped into the ditch, nay even ashes or quicklime, whose burning dust cannot fail to blind the enemy, should be had if possible. If the strength of your detachment will admit of it, eight or ten soldiers should be placed in the ditch (on the opposite side from the enemy), so divided as to take the enemy on the flanks, who have jumped into the ditch. This kind of sally, by running round upon the right and left at the same time, must astonish an enemy who could not dream of being attacked.

If there are heights from whence the enemy can crush your people with stones, they must be occupied with eight or ten men covered with a breast-work, to prevent the enemy from possessing them, or guard against them, as has been formerly directed.

In the defence of houses, mills, &c. as well as regular fortifications, the men should be made acquainted with the different manœuvres they may employ for their defence; without which they do not foresee the intentions of their officer, and may counteract one another by their being in disorder.

The obstinate defence of a post is the action where an officer detached singly can acquire the greatest glory; the resistance not proceeding from the number of soldiers destined to defend it, but from the talents of the officer who commands. It is in him that the strength of the intrenchment lies; and if he joins to determined bravery the abilities necessary on these occasions, and can persuade his soldiers that the lot the enemy prepares for them is a thousand times worse than death, he may be said in some sort to have rendered his post impregnable.

In the defence of detached buildings, there are so many different retreats, that it becomes an arduous task to succeed in an attack, when brave people are to defend them. They have the loop-holes on the ground-floor to defend, when beat from the intrenchments without, and may resist great numbers, by retiring gradually to the different floors of the house, where they should have large buckets of water provided to throw upon the enemy, which, though it may appear trifling, is one of the most disagreeable that can be opposed to the assailants; for at the same time that it wets their powder, arms, and clothes, it hinders them from seeing what is doing above, prevents every scheme for setting fire to the house, and may oblige them to desist from the attack.

Having observed that the defence of a post does not depend upon the soldiers who are destined for that service, but upon the officer who commands, the following example may serve to confirm the observation, and will at the same time show the utility of having stones collected to throw over upon the enemy, as formerly recommended.

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In the month of September 1761, captain-lieutenant Alexander Campbell of the 88th regiment, with 100 men under his command, was pitched on to defend the remarkable post near Cassel in Hesse, called the *Hercules*. Monsieur Roziere, the celebrated partisan and engineer of marshal Broglio's army, with 600 infantry and four squadrons of cavalry, arrived in the neighbourhood of the post the morning of the 22d; and having beat a parley, surrounded and carried off the two men who were sent out to receive the message. After having examined them separately, he caused a detachment, under cover of his musquetry from a hill that was opposite to the principal passage, to advance and mount the stair, three men abreast; which they did so slowly and without any interruption, that the whole stair of about 100 steps was full of men, when Captain Campbell (who had made an excellent disposition for the defence of all the parts of his post), having some chosen men at each side of him, waited to receive those who advanced first upon their bayonets, and firing at the same time, gave the signal for the rest to throw over large stones which he had collected and disposed for that purpose; which made such havock, that Monsieur Roziere, startled at the unexpected reception, and despairing of success, wished to get his party off. Captain Campbell seeing the destruction of the enemy without a man of his being hurt, and that he could renew the reception as often as they chose to repeat the attempt, was elated with his success, and encouraging his men, when he happened to move from the wall that covered him, and received a musket shot from the opposite hill, which entered a little below the left temple and came out at the same distance below the right; upon which he fell, and the party beat the chamade and surrendered. After two hours possession the French retired, carrying off the prisoners, and leaving Captain Campbell, whom they thought dead, to be saved by our troops, who soon took possession again, and sent him to be recovered, and to display new merits in his profession.

If the enemy take cannon to force the post, it does not appear how it can be resisted, unless the house is low, and they cannot range round the intrenchments, as every shot can make a large opening in bad built houses, and may crush the besieged. The only means then to shun being massacred is to capitulate, or to rush out briskly upon the enemy when they least expect it. The first is not resolved upon but when the honours of war can be obtained, which is to march out with drums beating to return to the army with a proper escort. But if this capitulation cannot be obtained, the besieged have nothing left consistent with true bravery, but to rush out sword in hand, and cut their way through the enemy. The necessity of conquering changes the brave man into the determined soldier, which gives him the means of retiring to the army or some neighbouring post.

If a post is to be abandoned when it can be no longer held, and you are going to make the sally, you should continue to fire with spirit, taking away barricadoes from the door through which you are to pass with as little noise as possible. When they are assembled, the whole party should go out close together, rushing with their bayonets to the place the officer thinks the least guarded. You ought never (says Mr Folard) to wait for day to execute these sallies, which cannot succeed but in a dark night, by which you

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easily conceal from the enemy the road you have taken; for which reason you should not fire, but open to yourselves a passage sword in hand, lest the enemy come where they hear the noise.

Officers should be attentive to distinguish between the true and false attacks, and not despair when beat from their first intrenchments. The defence of posts is so easy, that it is surprising they do not hold out longer than they commonly do. There wants only resolution and vigilance, taking every advantage of the ground, and persuading the soldiers that nothing but the most manifest baseness can let the enemy penetrate. The example of Cremona, surprised by prince Eugene in 1702, will remain a proof to posterity of what determined bravery can do; and show, that though an enemy is master of half the ramparts, and part of the town, he is not master of the whole.

Prince Eugene having formed the design of surprising this town, which was defended by a garrison of French and Irish, got some thousand Austrian soldiers admitted at a secret passage by a priest. These troops seized the two gates, and a great part of the town; the garrison buried in sleep were awaked by the assault, and obliged to fight in their shirts; but by the excellent manœuvres of the officers, and resolute bravery of the men, they repulsed the Imperialists from square to square, from street to street, and obliged Prince Eugene to abandon the part of the town and ramparts of which he had been in possession.

Posts have often resisted the first and greatest efforts of the assailants, and have yielded or been abandoned to subsequent attacks, though much less spirited. How comes this? It is owing to an officer's not daring to abandon his post at the first attack: he repulses the enemy, because if forced they will be put to the sword with their whole party; but when the enemy comes back, he thinks he has nothing to reproach himself with, having defended it for some time, so retires, or surrenders. Since he could repulse the enemy when in good order and quite fresh, how much more easy and less to be dreaded when they return harassed with fatigue?

Is not the great cause of misconduct among military men the want of encouragement to excite emulation? An officer who is not protected, who is never sure of the least favour, neglects himself, and takes less trouble to acquire glory, rarely heard of, though merited by the bravest actions, than to enjoy the tranquillity of an ordinary reputation.

It is not expected that an officer who is placed in a post should seek to engage; but that he should steadily resist when he is pressed, and die rather than abandon his intrenchment.

Historians have been very silent about posts being well defended; though the lessons to be drawn from them may be more generally instructive, and as agreeable to read, as those left us of the best fortified places of a state. We are astonished at the account of 100,000 men perishing before Ostend in 1604, and their general, the archduke Albert, with the ruins of his army, not making himself master of it, till after a three years siege: nor is our wonder less, to see Charles the XII. of Sweden, in the year 1713, with seven or eight officers and some domestics, defend himself in a house of wood near Bender against 20,000 Turks and Tartars.

Several historians mention the defence of this house because it was done by a crowned head; but brave actions, whoever are the authors, should never be buried in oblivion, as they excite emulation, and are full of instruction.

Sect. VI. *Of the Attack of Posts.*

Although the taking of a post is always difficult when you have to do with people who know how to defend it, nevertheless you may succeed in attacking them by surprise and stratagem. We ought never to form a scheme for an attack upon simple speculation, because from reasoning we often think that things are feasible, which we find impossible in the execution. When you intend to undertake an action of this kind, you ought to form a just idea of it, by examining all the branches separately, and the different means you can use, so that, by comparing them together, you may see if they concur, and answer to the general purpose; and lastly, you are to take such measures as may in a manner render you certain of success before you begin.

As it is not the practice of the army to choose a particular officer for the attack of an intrenched post if he does not offer himself, so an officer should not embark in such an enterprise, without having examined the means of succeeding, and being capable of showing the general a plan of what he has projected, to see if he will consent to the execution of it. If the general approves the plan, he must beg leave to go to reconnoitre the post with a man or two, that he may take his measures more justly.

When he has been to reconnoitre, as is directed in a former section, and has got every necessary information, he should go to give the general an account of his discoveries, and receive his last orders for the attack, for the soldiers of his party, and for those who are to march to sustain him.

The choice of men that are to go upon the attack of a post, is so much the more essential, as the success of the enterprise depends on it. None but volunteers of determined bravery ought to be taken, men who are not stupid, and have no colds upon them; because he who does not attend to the orders of his officers, runs on with blind zeal; and he who coughs or spits, may discover the party to the enemy's sentries, and cause the best concerted scheme to fail. As to those who are to support them, they may be taken according to their rank in the guard or detachment, as the general judges proper.

The disposition for an attack must depend on the discoveries that are made, so as not to be obliged to return in the midst of the execution. The men being chosen, they must be inspected, to see that nothing is wanted which can contribute to their success; because, if the post is fortified with an intrenchment of earth or fascines, the two first ranks should be provided with spades and pickaxes beside their arms; if frailed or pallisadoed, they must likewise have hatchets; and if covered with masonry, they must have ladders.

The men should be in their waistcoats, to be less constrained. If they propose to make one or two true, and as many false attacks, so many platoons must be formed of the chosen party, as they are to make true ones, and the sustaining party to make the false attacks, so as to divide the enemy and share their fire. A man must be placed at the head of each platoon, who is capable of commanding them, and, if possible, the same who had been employed before to make discoveries, as he may more easily guide the division. The orders which should be given to those leaders, are to march together to the place where they are to separate, and then each to go to the spot which is appointed for him, in the neighbourhood of the post, and wait there, with their bellies on the ground, for the signal to jump into the ditch and scale the post.

If you are to be conducted by spies or guides, they should be examined about every thing that can be of use, before they are employed, especially about the road by which they propose to conduct you. The reason of this is,

is, because we often see simple people, animated with the hope of gain, imagine they can easily lead a party, when they have only a great deal of good-will; but if you find in those who offer all the necessary qualities, you must immediately secure them to you as much as possible, by making them dread the destruction of their houses, and pillaging their goods, if they lead the party into a snare; you may likewise ask their wives and children as pledges of their fidelity, and, the moment of setting out, place them between the corporals of the first rank, tied with a small chain; which precaution is the more essential, as traitors have often been known, on pretence of conducting a party to seize a post, to have led them where they have had their throats cut in the middle of the night, and have disappeared at the very moment of its execution. If you make your guides hope for a recompense proportioned to their services on one side, on the other you must make them fear the cruellest punishment if they betray you.

The night being the most proper time to march to the attack of a post, you should set out soon enough to be ready to make the attack an hour or two before day. Care must be taken that it is not moon-light when you propose making the attack; the soldiers ought to march two and two, with the least noise possible, especially when passing between the enemy's sentries: you must likewise recommend to them, neither to speak, spit, nor smoke. The detachments must get as opposite as possible to the salient angles of the intrenchment, as it is probable that they will be the least defended by the enemy's musketry. If a patrole of the enemy comes while you are on your march, or ambushed in the environs, you need not be alarmed, nor make the least motion which may make the enterprise fail, but remain concealed in the profoundest silence, that the patroles may pass without perceiving any thing, and afterwards pursue your design.

If the post which you want to carry is a redoubt with a dry ditch and parapet of earth, your two first ranks must have spades and pickaxes, with their arms flung, and, on the signal being given, jump into the ditch together; because it ought to be a general maxim in attacking a post, to strike all at once. When the first rank have jumped down, the second must stop a moment, that they may not fall upon the shoulders or bayonets of the first. The two first ranks having got into the ditch, they should immediately run to sap the angles of the scarp and the parapet of the redoubt, to facilitate the mounting of the rest of the party; the leaders of each division should observe at the same time, that the soldiers who remain armed with their firelocks, and who have likewise leaped into the ditch, do not interrupt those who are demolishing the scarp of the redoubt, but protect them by presenting their bayonets to the right and left, and be ready to repulse any of the enemy that happen to be placed in the ditch.

If the parapet is fraised, they should break as many of the fraises with hatchets as is necessary to let the men pass. When the breach is made, the workers should drop their working tools; and taking their arms from the slings, mount up with fixed bayonets, and rush upon the enemy huzzaing.

When you march to attack a redoubt or such post, where the enemy have a connection with more considerable posts, the commanding officer should charge on that side, so as to cut off the communication. People who see themselves briskly attacked without hope of succour or retreat, will very soon beg for quarter.

When the scarps and parapets are of stone, they can only be carried by scaling; but you may succeed by being brisk in surrounding and sustaining the attack. An officer who is to attack a post of this kind, should take care that his ladders are rather too long than too short, and to give them in charge only to the stoutest of the detachment. The soldiers should carry these ladders with the left arm passed through the second step, taking care to hold them upright at their sides, and very short below, that they may not dislocate their shoulders in leaping into the ditch.

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The first ranks of each division provided with ladders, should set out with the rest at the signal, marching resolutely with their firelocks flung at their backs to jump into the ditch. When they are arrived, they should apply their ladders against the parapet, observing to place them towards the salient angles rather than the middle of the curtain, because the enemy have less force there. They must take care to place their ladders within a foot of each other, and not to give them too much nor too little slope, that they may not be overturned or broken with the weight of soldiers mounting upon them.

The ladders being applied, they who have carried them, and they who come after, should mount up and rush upon the enemy sword in hand. If he who goes first happens to be overturned, the next should take care not to be drawn down by his comrade; but on the contrary, help him to pass between two ladders, and immediately mount himself, so as not to give the enemy time to load his piece.

As the soldiers who mount the first may be easily tumbled over, and their fall may cause the attack to fail, it would perhaps be right to protect their breasts with the fore-parts of light cuirasses; because if they can penetrate, the rest may easily follow.

The success of an attack by scaling is infallible, if they mount the four sides at once, and take care to shower a number of grenades among the enemy, especially when supported by some grenadiers and picquets, who share the attention and fire of the enemy.

During the siege of Cassel, under the Count de la Lippe, in the campaign of 1762, a young engineer undertook to carry one of the outworks with a much smaller detachment than one which had been repulsed; and succeeded with ease, from the use of grenades; which is a proof that grenades ought not to be neglected, either in the attack or defence of posts.

If the ditch of a post is filled with water, and but middle-deep, that should not hinder you from jumping into the ditch to attack, in the manner that has been mentioned; but if there is a greater quantity, and you cannot pass, the soldiers of each platoon should carry fascines, or faggots of small branches well bound, and made as large as possible, to fill up the ditch, and make a kind of ford, so as to get at the parapet, either to demolish or scale it.

Many ways of filling up the ditch, recommended by different authors, might be mentioned; but the fascines are preferable to them all, as the soldiers can easily carry them before them, and march quicker, and make use of them as a defence against musketry, and, reaching them from hand to hand, soon make a ford.

If the approaches of the post are defended by chevaux de frise, the first and second rank of each platoon must break them down with hatchets; or with iron graplings tied to ropes, they may pull them to them, and separate them. If it is a breast work of felled trees, you must have fascines thrown against the points, or upon the branches, upon which the soldiers can easily pass. If there are two or three rows, you may burn them with dry fascines lighted at one end, and thrown in the middle row. In case of trying this last scheme, the soldiers must retire to a little distance after throwing the fascines, that the enemy may not see to fire at them by the light of the fire, but place themselves

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selves so that they can fire upon any who may attempt to extinguish it. If there are chausse-traps, they must be swept away, by dragging a tree or two over the ground where they are scattered.

In the attack of detached buildings, you must seize the approaches, and strive to scale them; to get on the top, and crush the people who are below, with the tiles or slates; but if the enemy has uncovered the house, you must throw as many grenades as you can in at the windows and doors; or dry fascines, with lighted faggots dipped in rosin; or fire-balls, to endeavour to set fire to them, and smoke them out. If the weather is windy, you should profit by it to set fire to the house, and try to shut up the loop-holes which the enemy have pierced near the ground, with bags of earth, so as to sap the corners. If you have some cannon, you may shorten the ceremony, by planting them against the angles of the post. If you have none, you may successfully suspend a large beam by a rope, to three bars placed in a triange, in imitation of the Roman battering ram: this beam pushed violently against the walls, will soon make a breach; but you must oblerve, in suspending it, to do it in a dark night, so that the enemy cannot prevent it by firing at the soldiers who are employed in the work. If it is glorious to get out with honour on such an attack, it is no less so to make it so as to cost but few people. The blood of the soldiers is precious, and cannot be too much prized, and an able chief will neglect no means that can contribute to their preservation. The comparing of two examples will show the importance of what is advanced.

During the two sieges of Barcelona, by Monsieur de Vendome in 1697, and Monsieur de Berwick in 1713, the first of these generals caused the convent of Capuchins, situated out of the place, to be attacked sword in hand by several detachments of infantry, and carried it in three hours, with the loss of 1700 men. Marshal Berwick caused the same convent to be attacked in the year 1713. They were equally intrenched, and reckoning to make him pay as dear as Monsieur de Vendome had done; but this general having opened a sort of trench before the convent, they not expecting to be attacked in form, surrendered at discretion, after having held it 24 hours. The reader is left to judge which example to follow.

You should prepare for the attack of a village, or such like post of large extent, as has been directed in the section for detached posts: but as these sort of attacks are always more difficult than others, on account of the multiplicity of schemes they have to encounter at every step, an officer should not march there till he is acquainted with the strength of the intrenchments; the situation of the smaller posts; the obstacles to be met with in every street or square; and even what terms the inhabitants are on with the soldiers of the garrison.

While the assailants have penetrated into the village, the commanders of each division ought to take care to leave small detachments at all the churches and squares they find; to stand firm and sustain the main body in case they are repulsed. You must watch very carefully that the soldiers do not withdraw to pillage the houses of the inhabitants, as whole detachments have been driven from towns and villages where they had penetrated, from having neglected this precaution.

Three days after the surprise of Cremona in 1702, some Germans were found in the cellars, where they had got drunk, and were astonished when they were told that they must quit these agreeable retreats. An officer who would shun a disorder so fatal, should forbid his soldiers to stir from their party on pain of death; and by placing a serjeant in the rear of each division, take care that no one falls behind.

If you find cavalry drawn up in the squares or open places, the assailants should remain firm at the entrance of the streets that meet there, while some go up to the houses that are at the corners, and fire upon them from the windows; if this causes any disorder among them, they should be charged with fixed bayonets to make them surrender. If the interior part of the village is defended with cannon, you should march quickly to the place where they are, and take them, or nail them up, or turn them against the enemy or principal post of the village.

Polybius, in his seventh book, gives an account of an attack full of instruction for military men. The blockade of Sardis by Antiochus the Great, had lasted two years, when Lagoras of Crete, a man of extensive knowledge in war, put an end to it in the following manner. He considered that the strongest places are often taken with the greatest ease, from the negligence of the besieged, who, trusting to the natural or artificial fortifications of their town, are at no pains to guard it. He knew likewise that towns are often taken at the strongest places, from their being persuaded that the enemy will not attempt to attack them there. Upon these considerations, though he knew that Sardis was looked on as a place that could not be taken by assault, and that hunger only could make them open their gates, yet he hoped to succeed. The greatness of the difficulties only increased his zeal to contrive a means of carrying the town.

Having perceived that a part of the wall which joined the citadel to the town was not guarded, he formed the design of surprising it at that place: he observed that this wall was built on the top of a rock which was extremely high and steep, at the foot of which, as into an abyss, the people of the town threw down the carcasses of their dead horses and other beasts of burden; at which place great numbers of vultures and other carnivorous birds assembled daily to feed; and after having filled themselves, they never failed to rest upon the top of the rock or wall, which made our Cretan imagine that this place was neglected, and without any guard upon it.

On this thought, he went to the place at night, and examined with care how he could approach it, and where he ought to place his ladders. Having found a proper place for his purpose, he acquainted the king with his discovery and design; and the king, delighted with the project, advised Lagoras to pursue it, and granted him two other officers whom he asked for, and who appeared to him to have all the necessary qualities for assisting him in his scheme.

The three having consulted together, they only waited one night, at the end of which there was no moon; which being come, they chose 15 of the stoutest and bravest men of the army to carry the ladders, to scale the walls, and run the same risk that they did. They likewise took 30 others to place in ambush in the ditch, and to assist those who scaled the wall to break down a gate into which they were to enter. The king was to make 2000 men follow them, and favour the enterprise by marching the rest of the army to the opposite side of the town. Every thing being prepared for the execution, Lagoras and his people approached softly with their ladders; and having scaled the rock, they came to the gate which was near them, and having broke it, let in the 2000 men, who cut the throats of all they met, and set fire to the houses, so that the town was pillaged and ruined in an instant.

Young officers who read this account, ought to reflect on this attack. The attention of Lagoras, who went himself to

to examine the places proper for fixing the ladders; his discernment in the choice of the officers and soldiers who were to support him; and the harmony of the whole means that were employed on the occasion, afford very excellent lessons for any officer who may attempt such an attack.

SECT. VII. *Of Surprises and Stratagems for seizing Posts.*

ALL the environs that have any relation to the place the enemy occupies must be known; on what side lie the avenues, morasses, rivers, bridges, heights, woods, and all covered places that are in the neighbourhood, without which it is scarce possible to regulate approaches prudently. It is equally necessary to know nearly the number and kind of troops with which he possesses the post, that you may not attack him with insufficient force. It is likewise necessary to know if the enemy is careful or remiss in carrying on his duty. The knowledge of these circumstances contributes infinitely to form a project of surprise well, and to conduct the whole expertly.

As to the manner of surprising a post, it is impossible to establish certain rules on the subject; because, among a thousand means which chance offers, there are rarely two alike. It must, however, be observed, that there are stratagems with which it is impossible to succeed without a proper force to sustain them. A town or village, for example, where we are introduced by a secret correspondence, cannot be carried unless we be well seconded. The only means of managing the surprise of posts well, is to divide your force instantly, to seize the castle, church, church-yard, or public squares. It has been said, that troops so divided can act but weakly, and run a risk of being defeated separately. But by making as many detachments as the enemy has posts, in the dismay caused by surprise, it is easy to carry these posts before they who defend them have time to dispute them or even look round them. The enemy being likewise obliged to divide, and not knowing what side to prefer, there is almost a moral certainty, that, stupified with the noise which they hear all round, they are ready to let their arms drop out of their hands: beside, the horrors of a dark night, and the dread that cannot fail to seize a party who are surprised, represent objects much greater than what they are, so that they imagine they have to do with a whole army.

The bad success of the affair at Cremona mentioned in Sect V. makes nothing against this opinion. If instead of stopping to make prisoners, a detachment had gone directly to the citadel, which should be the way in all such actions, it would have been impossible for these brave officers who drove out the Imperialists to have made so glorious a defence.

M. de Schower did otherwise when he surprised Benevar in Spain in 1708, and did not fail. He learnt that the Spaniards neglected the guard of an old castle which was at the entrance of the place: and marching in the night he took it, and detached several parties to attack the town: Surprised with such a visit, they sought for safety in flight, and ran to take shelter in the citadel, but were scarcely entered when they were made prisoners. The enemy did not think of the attack being begun where they were strongest; but it is the best way, as it is to be presumed they have divided their forces to be able to defend every where.

M. Menard, in his history of Nismes, gives an account of the surprise of that town, which merits our attention. Nicholas Calviere, called Captain St Cosme, having resolved to make himself master of this place, engaged a miller whose mill was situated within the walls, at the side of the gate, to file the bars of a grate which shut up the entry of an aqueduct through which the water passed into the town, and to receive 100 men armed into his mill, while a considerable body of cavalry and infantry should arrive from different places to sustain the enterprise.

The day for the execution of his project being fixed for the 16th of November 1569, and proper orders given for the rendezvous of the troops, St Cosme came out of the mill with his party at three o'clock in the morning, and advancing to the guard at the gate, put them to the sword, and opening the gate let in 200 horsemen, with each a foot soldier behind him. These troops having entered the town, formed several detachments immediately: one of which went to block up the citadel; while the rest, scattering over the squares of the place, and sounding their trumpets, instantly made themselves masters of the town.

There are a number of circumstances mentioned in this surprise, which convey a great deal of useful instruction. Captain St Cosme knew how to profit by the negligence of the governor, who omitted to guard the entrance of the aqueduct: to make a proper choice of cavalry for advancing so readily with the infantry from different quarters; the justness of the orders given the troops which brought them 15 leagues from Nismes at the hour and place appointed for the rendezvous; the precaution with which he invested the citadel, to prevent his having to do with the garrison in the streets; his attention in dividing his troops into the different quarters of the town, and making them sound their trumpets, that the inhabitants might imagine they were very numerous.

But the active corps of the partisan, without trusting to the stratagems that others have succeeded by, must find other resources than those against which people are so prepared now-a-days; and as the surprising of the enemy is the great business of the partisan in carrying on the Petite Guerre, he must see what can be effected by his hardiness and activity.

The expedient which appears to be the most proper for an officer who has 400 infantry under his command, and is certain that the garrison is only 200 (for surprises should be always attempted with a double force), is to choose very bad weather; the strong winds, for example, and fogs in winter; or the storms and tempests in summer, when, after excessive heats, violent winds rise suddenly, and agitate the air.

When you have meditated such a scheme, then is the time to put a part of your infantry in covered waggons, which should be kept ready for the purpose. The whole party ought to be provided with dog skin covers for their gunlocks and cartouch-boxes, to take off readily when there is occasion; and the rest of the infantry to be mounted behind part of the cavalry. Both parties to assemble at some place a league distant from that which you would surprise, and there to stop; when, if you see the bad weather dissipating, you must retire till another occasion. If you renew it ten times, you need not despair; a strong place deserves this trouble, and success will overpay every fatigue.

But on the contrary, if the storm forms, and the wind increases, direct your approaches in such a manner, that you may always have the wind on your back; because if you have it in your face, the enemy's sentries can look forward and discover you; and likewise if it is in your face, your horses cannot be made to advance without a great deal of trouble. These precautions being taken, you advance more quickly as the storm increases, the horses and waggons going with great speed before the wind. You need be in no uneasiness about the enemy's sentries seeing you, or hearing the noise of your march; because the severity of the weather obliges them to enter their boxes, and turn their backs to the

the wind, to save their eyes from the dust and sharpness of the air.

At 200 paces from the place, the foot and part of the cavalry should dismount and fix their bayonets, the rest of the cavalry to remain with the waggons near some trees or houses, the waggons turned for a retreat. Divide your infantry into five detachments, and instantly run at a great rate, keeping your men as close as possible, and passing the barrier and gates, seize all the sentries and the guard without firing or making the least noise, which may be executed with an extreme quickness, to be acquired by practice. While the first detachment seizes the gate and all the sentries of its environs, the rest must run rapidly into the town. One must go quickly to seize the main guard: another to seize the governor or commanding officer; the fourth, which should be the strongest, should fly to the caserns or mens barracks, to seize their arms; the fifth to remain in the street near the gate for a corps de reserve.

Every detachment must be conducted by prisoners made at entering; and orders sent with all speed, to cause half the cavalry to advance and patrole the streets, as the infantry get forward.

As this kind of surprise can succeed only under favour of a storm, which rarely continues any time, it is evident that the march and execution must be conducted with inexpressible swiftness, and the orders be perfectly understood. It is true, that rain is inconvenient for the infantry, whose feet slip on clay-ground; but they must do their best, and frequently it is found that the roads which are most used are not therefore the most slippery.

If it happens that you are perceived in taking possession of the gate, and they take the alarm, you must quickly divide your party into two wings, mounting them on the rampart, the one to the right, the other to the left; and seizing the loaded cannon, turn them upon the town; and at the same time summon the garrison to surrender. If you happen to fail, and are obliged to retire, you do not risk much, as they will not care to molest your retreat.

There may be a reluctance in attempting such a surprise; it may appear to be hazardous and rash, and a conduct too nice not to despair of success: but Mr Jeney says that experience convinces him of the validity of the means proposed, and relates what happened to him upon two occasions, to prove that the cold east winds or storms are the most proper times for attempting surprises.

Being at the head of 30 hussars, says he, and willing to shun a storm which was gathering behind us, I pushed to get to a place which was well fortified and occupied by a numerous garrison: the wind was strong, and I passed the barriere and all the gates with my horses, which made a great noise, without any sentry either seeing or hearing; and though I called to the first guard to declare myself, no one perceived me. I crossed the whole town without seeing a soul in the street; and hurrying to an inn in the other suburbs, I went out at the gallop, and saw only the sentry at the last barriere, to whom I answered without our comprehending one another; nevertheless the rain had not begun to fall, but the wind was violent. I experienced the same during the winter, when the east wind was very proper to facilitate the surprise of a fortified town or post. On Christmas night 1757, I passed through the country of Hanover with 80 horse between two guards of the enemy without being perceived. I marched over the middle of a plain when the night was clear, with a violent east wind, which prevented any sentry from turning his head to look at me, and I went quietly to carry off horses in the rear of their army. The following night at my return, I passed two different posts of our army; the one guarded by a party of hussars, the other by a regiment of dragoons, without being seen but by one sentry in the middle of the dragoon post, who durst not challenge, because it was no longer time, having passed the first guards.

You may likewise take the advantage of bad weather to scale all sorts of posts surrounded with walls, as towns, abbeys, castles, &c. to do which, you must approach in the dark, and seize the moment of a great squall, or when a cold east wind obliges the garrison to take shelter from the rigour of the season: then there is no one upon the ramparts, and the sentries turn their back to the wind, or remain in their boxes, while your people are warm with marching, and animated with the hopes of success. You need not be apprehensive of the enemy seeing you if you advance on the side next the wind to place your ladders, because the sentries will cover their faces, and bend down their heads to save them from cold.

The time of a thick fog is not less favourable for approaching and forcing an intrenched post. When the fog is low, the infantry should creep on all fours, the better to conceal them from the enemy's sentries. These sort of surprises are the least dangerous, you run scarcely any risk; but if you cause some false attacks, the garrison will not fail to run to arms, and sometimes make you pay dear for failing.

When you would surprise the enemy in a village, farm, monastery, or some place detached from the army, you should divide your party in two bodies, each composed of cavalry and infantry; the one to take the enemy in the rear, the other in front, taking care to cause some waggons to follow, which may carry off the wounded in case of need. You must calculate exactly the time it will take the first detachment to go round the enemy. The two commanders should agree on a word for rallying, and the time of making the attack, which should be in the night, especially if the post is so distant from the army that they can receive no assistance; for in that case the time is favourable till day-break. They must regulate their departure according to the distance they have to go; and the detachment which goes round the enemy, ought to take no more infantry than can be carried behind the horsemen. This detachment having got round, should form about a quarter of a league from the post, and 100 paces out of the road.

When the other detachment has arrived within a quarter of a league of the post, your cavalry should form out of the road with the waggons and drums near them, who are not to advance till ten minutes after the departure of the infantry, who must advance towards the fires of the enemy, stooping as much as possible. They must take care to conceal themselves from patroles, as has been directed; and when they see them passed or entered the post, the infantry must hurry on to gain the village, and clear the entry by which the cavalry must pass, in case it has been barricadoed with waggons. You must run rapidly to the place where you see the fires lighted, and make as many detachments as you see fires, in order to surprise the whole at once.

The cavalry who followed slowly, must instantly join to the noise of your arms and cries their trumpets and drums, advancing with all speed, and leaving only a non-commissioned officer with some horsemen near the waggons. The detachment, which is advanced on the other side of the village to turn the enemy, on hearing the alarm, must immediately advance, sounding trumpets, beating drums, and attacking all who would save themselves on that side. You may rely on it as certain, that the enemy, seeing all his guards surrounded by your infantry scattered in the village, and hearing the march of different bodies of foot and horse who arrive on all sides, will not delay to surrender, or seek to save himself by a disorderly flight: it will be easy then for

for your cavalry to fall upon the flying, and stop them. The party should be forbid to pursue the enemy more than a quarter of a league in the night; but no pursuit at all should be attempted, if it is in an inclosed country. The post being taken, the booty and prisoners should be sent off immediately under the care of the infantry, putting the wounded in waggons, or on the horses that are taken, the cavalry making both the front and rear-guard, and taking care to have the last the strongest.

There is no time more precious for a partisan, or that merits so much attention, as that of a battle, when every one is attentive to the great firing which they hear on all sides; to the manœuvres of the armies that are engaging; to the decision of an affair of the greatest importance, upon which the fate of each depends. It is then that he can employ his skill to the greatest advantage; strike the severest blow that is possible; cause the ruin of the enemy; pillage the quarters of their generals; carry off their equipages; defeat their guards; set fire to their camp, and spread an alarm over all, which may contribute to the defeat of an army.

But measures must be taken to execute so great, so brilliant a project with success; and it should not be engaged in, till after having prudently regulated the design on three principal circumstances, viz. the situation of the enemy's camp; the means of approaching it; and the hour of engaging. When the enemy's camp is in the middle of a great plain, or on a height with an extensive view on all sides, it is certain that one cannot approach without being seen at a distance: and in that case, prudence will put a stop to zeal, and prevent rashness from attempting impossibilities; but when their position extends over a country covered with mountains, woods, or villages, the occasion is more favourable, and may almost ensure success.

It is then very advantageous for a partisan to be perfectly acquainted with the situation of places that are in front of his army; especially when he foresees that the enemy will sooner or later come to encamp there. What assistance would it not give for the direction of his project, if he knew how to take a plan of that part of the country which he proposes to invade beforehand? Then, without the weak and dangerous assistance of spies and deserters, he can by his own proper knowledge think of every means for executing a design, which ought to be regulated and conducted with impenetrable secrecy.

When he perceives by the motions of the armies that they are on the eve of an action, he must not delay to acquaint the general with his project. If he consents, he will regulate the rest, and the time of departure, according to the advices which he receives.

As these sort of expeditions cannot be made but by long circuits, they must take the time necessary for the march. In the campaign of 1757, the duke of Richelieu caused his army to advance near Zell to attack our army; and sent a partisan with 100 horse to the rear of the camp the day before, who, having made a march of 22 leagues, arrived without any accident: but the prudence of the prince of Brunswick defeated his design, and left him to admire his retreat; nevertheless, they picked up some stragglers, horses, and waggons.

Among the measures that ought to be taken to secure the blow, and strike it more effectually, it should not be forgot to distribute cockades like the enemy's to all the cavalry; and to give a stick of six feet long to 20 of each detachment, with a bit of torch fixed on the end, and covered with a little dry straw or hemp, to kindle instantly.

The whole party to set out from the camp A (fig. 1.), marching under the conduct of a good guide by covered ways, at a distance from the enemy. Being come to the place C, which ought to be in the environs, and as high as the field of battle, the infantry should be concealed out of the road far from the sight of passengers. This must be the centre of correspondence with the army; the rendezvous of the booty; and support the retreat of all the cavalry, of which there should be as many detachments formed as you purpose to make attacks. We shall suppose six of a hundred men each, and they must go secretly by particular routes to their respective post E, D, F, G, H, I. Neither trouble nor expence should be spared to procure good guides. Each detachment should lie in ambush half a league, if necessary, from the object of the attack, BKKKK.

Petite Guerre.

The noise of the musketry of the armies to be the signal for their irruption; and then bravery, intrepidity, and courage, will give wings to your people. The second detachment D will glance imperceptibly between the villages, and fall like thunder upon the camp B; and while 80 attack all whom they meet, the other 20 should light their torches at the fires that are to be found everywhere, and spread the flames rapidly to the straw of the tents. As they cannot fail to have the picquet of the camp soon at their heels, they must strike their blow with all possible quickness without stopping to plunder; being content with the glory of having excited a general alarm, capable of confounding the whole army, and contributing to the gaining of a battle.

At the same time that the detachment D attacks the camp B, the others E, F, G, H, must with equal violence attack the villages K, K, K, K, which they have in front, doing the same the first did in camp, except that they may plunder every thing which they can easily carry off of the generals equipages, with which these villages are commonly filled; seizing the best horses, hamstringing others with the stroke of a sword, and setting fire to all the places which contain the enemy's baggage. Each detachment should cause some horsemen to advance beyond the village, to observe the motion of the troops that will not fail to run to their assistance. As soon as they perceive them, they must make their retreat as fast as possible by the routes which the commanding officer has premeditated, and which are proposed to be represented by the coarser hatched lines. The sixth detachment I, in ambush on the side of the road leading from the camp, should remain there, to seize all the enemy who think of saving themselves by flight.

There is no danger to be apprehended in these expeditions, during the critical instant while the armies are engaged, and all the troops a great way in the front of the camp: you meet none but sutlers, servants, lame people, and some picquet guards scattered here and there, whom you may easily defeat as they advance. The commanding officer ought to have an eye over all; and as soon as he perceives some bodies of troops advancing upon him, he ought to retreat quickly, and at least gain the entrance of the wood in the neighbourhood of the enemy's camp; for without some such shelter enterprises like this can hardly be attempted.

Each detachment having rejoined the infantry, must there wait the fate of the battle; so that if it is decided in favour of their army, they may speedily regain the properest places for harassing the enemy on his retreat. These moments are the more favourable, as disorder, dread, and noise, render all defence impracticable. But all these sort of surprises require places proper to cover approaches and retreats.

The great importance of skill in the language of the enemy is apparent from the following exploit of the prince (now reigning duke) of Brunswick in the campaign of 1760. That excellent partisan was situated at some distance from

Zerenberg,

Petite Guerre.

Zerenberg, at that time in the possession of the French; and being informed by two Hanoverian officers, who had been in the town disguised like peasants, that the garrison were very remiss in their duty, trusting to the vicinity of their army, and the distance of ours, the prince was resolved to surprise them; and after appointing a corps to sustain him, he advanced in the night with Major Maclean of the 88th regiment; and 200 Highlanders, with bayonets fixed and their arms unloaded, followed at a small distance. Upon the first sentry's challenging, the prince answered in French, and the sentry seeing but two persons advancing (whom he believed to be French), he had no distrust; so that the major getting up to him, stabbed him, and prevented his giving the alarm. The Highlanders immediately rushing in, attacked the guard with their bayonets, and carried the town, having killed or taken the whole garrison of 300 men.

The French officer who commanded at that time in Zerenberg concerted a ſcheme for being amply revenged, which failed only by a moſt trivial accident. When almoſt every houſe in Bremen was filled with corn, being the grand magazine and grand hoſpital of our army, this officer held a ſecret correſpondence in the town, which informed him of the ſtate of the garriſon, and that there was a general order to let couriers going to the army paſs out at all hours. He diſpatched about 20 huſſars to ſcamper over the country, who were all that were heard of his party, while he marched 15,000 infantry from Duſſeldorp to Bremen (about 200 miles), concealing them in woods by day, and marching in the night. He arrived at the gate at the appointed hour; when a perſon on horſeback blowing a horn came along the ſtreet, and deſired to paſs out to the army. The officer of the guard had the keys, and happened to be out of the way; and while a meſſenger went for him, the people without growing impatient, began to break down the outer barrier, which made the ſentry fire at the place where he heard the noiſe; and the guard taking the alarm, got upon the rampart, and likewiſe fired at the ſame place: upon which the pretended courier galloped back; and the French, believing that they were diſcovered, relinquiſhed their ſcheme, and retired.

This example proves that no diſtance is a ſecurity from ſurpriſes, and that very conſiderable parties may paſs over a great extent of country without being diſcovered. The following inſtance of that preſence of mind ſo much the happineſs of all who poſſeſs it, and more particularly of a military man ſo expoſed to ſurpriſes, deſerves to be recorded.

In the month of February 1761, when Prince Ferdinand beat up the quarters of the French, they were obliged to retire a great way without being able to refiſt: However, when they came to collect their force, and to recoil upon our army, Sir William Erſkine with the 15th regiment of light dragoons was in a village in our front. In a very foggy morning, ſoon after the patroles reported that all was well, Sir William was alarmed by his vedettes having ſeen a great body of cavalry coming to ſurpriſe him. He inſtantly mounted his horſe, and ſallied out at the head of the picquet of 50 men, leaving orders for the regiment to follow as faſt as they could mount, without beating a drum or making any noiſe. He attacked their advance-guard in the curſory manner of the light cavalry, and continued to do ſo, while his men were joining him by tens and twenties, and the French cavalry forming to reſiſt an attack, till he collected the whole, and then retired, the ſurgeon of the regiment (Mr Elliot) having in the mean time carried off the baggage.

Strokes of this kind diſplay a ſuperiority of genius, and to that alone was the preſervation of the regiment owing. Had a drum beat to arms, the enemy muſt have known that they were unprepared, and probably would have ruſhed in and deſtroyed them; but the attack convinced them that they were diſcovered, and made them think only of their own preſervation.

Among many inſtances in the courſe of the war, the ſucceſs of this officer on another occaſion, where he diſplayed the moſt ſingular addreſs, likewiſe merits our attention. After a repulſe, and a march of 70 miles in one day, when the men were fatigued and ſcarcely a horſe able to trot, he ſaw a regiment of French infantry drawn up with a moraſs in their rear. He left his own corps, and advancing to the French, deſired to ſpeak with the commanding officer, whom he entreated to ſurrender to prevent their being cut to pieces by a large body of cavalry that were advancing. The French officer deſired leave to conſult with his officers, which having done, they refuſed to ſubmit; but upon Sir William telling them that their blood muſt be on their own heads, and turning to move off to his own corps, they called to him, and laying down their arms ſurrendered to his haraſſed troops.

Such ſtratagems overleap the bounds of inſtruction, and no author will preſume to propoſe them for imitation. Here was the reaching out the hand to fortune which Vigetius recommends: but there are few who have the requiſite talents from nature; and we may as properly ſay of the ſoldier as of the poet, *naſcitur non fit*.

Sect. VIII. *Of Ambuſcades from the Partiſan.*

An ambuſcade may be formed in any place covered by art or nature in which a party may be concealed to ſurpriſe the enemy in paſſing; and the proper uſe of them is, of all the ſtratagems in war, the beſt calculated to diſplay the genius, ſkill, ſpirit, and addreſs of a partiſan. They are eaſily carried into execution in woods, buildings, and hollow places; but require a more fertile imagination, and greater trouble, in a level country. Both ought to be regulated by the knowledge of the enemy's march, and the extraordinary means that may be employed to ſurpriſe them.

When a partiſan has information that can be depended on of the march of ſome part of the enemy; whether a convoy of artillery, baggage, or proviſions; a body of recruits, or horſes to remount the cavaly; an eſcort of a general officer going to rejoin, or reconnoitre ſome country; he ought to apply directly to procure a ſufficient knowledge of the route that the enemy is to take, the ſituation of the places he is to paſs, and of the poſt he goes to. The better to cover his deſign, he muſt get information of the roads that lead to oppoſite places, which he muſt pretend to be attentive about, as has been mentioned in the ſection of Reconnoitring.

Having perfectly concerted his plan, he ſhould ſet out at the head of his detachment if poſſible, and leaving his poſt on the ſide oppoſite to his true route, the better to conceal his deſign. If the place where he intends to plant his ambuſcade is not diſtant, he ſhould come into his true route about half way, and there place half his infantry in ambuſh to favour his retreat. But when the country where he propoſes going is diſtant, and the march requires at leaſt two nights, he muſt conduct his party by meandring from wood to wood, if there are any. He muſt not forget to provide neceſſary refreſhments for the day, which muſt be paſſed in ſome concealed place where he may not be perceived, and muſt cauſe three rations of oats to be carried for each horſe.

The firſt night you muſt make to ſome wood or other place proper for paſſing the day near ſome rivulet, and, if poſſible, on the road of your retreat to leave a part of your

infantry

Fig. 1.

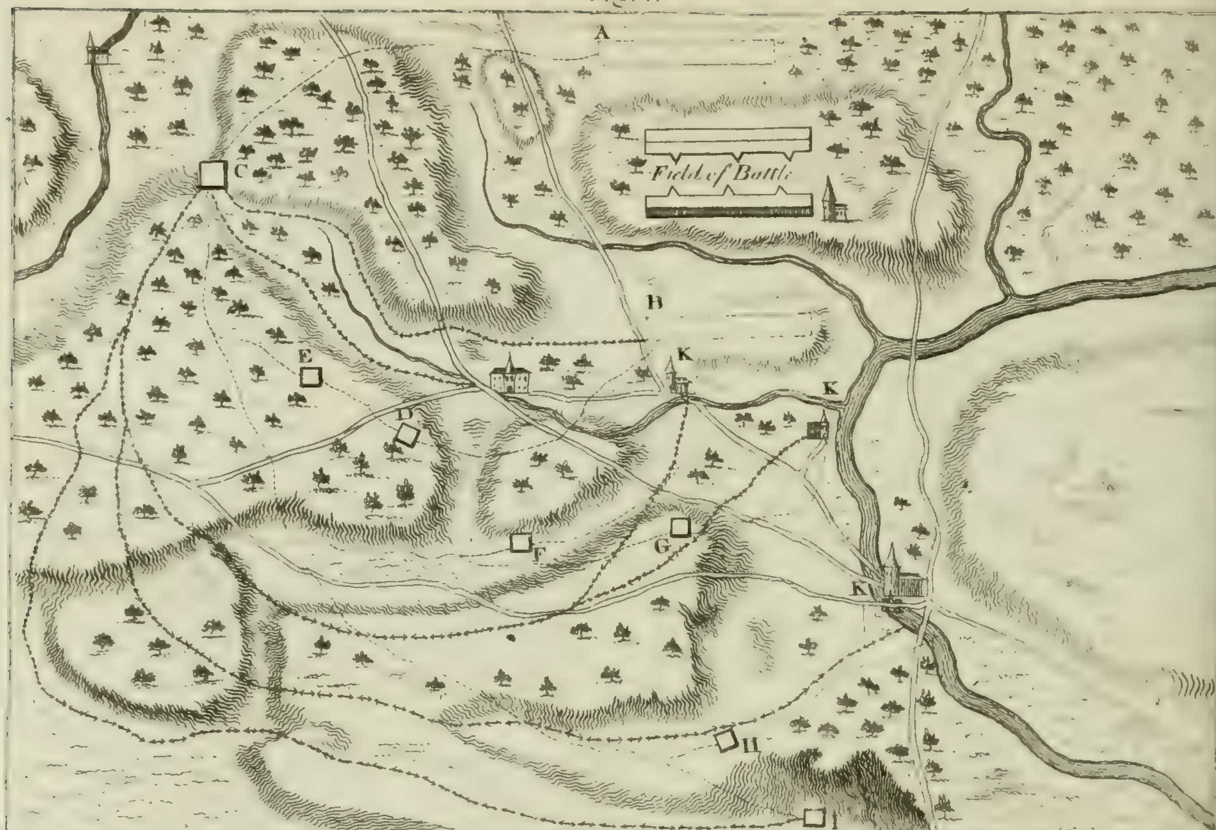


Fig. 2.

A. Bell. Prin. Wal. Sculpt.

infantry in ambush, in case there is no other water to pass till you come to the place of your principal ambuscade; for when there is still a river or canal to pass, you must conduct the infantry to the passage, and choose the most convenient place to fix them in an ambuscade.

If there is no bridge or ford, the cavalry must swim over, in which we suppose the horses are practised. When there is a ford, half the infantry should pass behind the cavalry, to go along with them. In case there is a bridge to pass near the village, the officer who is left in this post with some infantry, should be enjoined to allow no one peasant or soldier to leave the place; and for greater security, a small detachment of cavalry should remain with him, to stop any who may attempt to run away, before the return of the whole corps, who ought not to delay long. If the enemy come in the interval to attack the bridge, it must be defended till the return of the party, that their retreat may not be cut off.

Every precaution being thus taken to guard the bridge, the commanding officer should be diligent to arrive at the place of ambuscade two hours before the enemy is to pass, and place the ambuscade on the side he would retreat; never on the other side, if possible, lest the advanced guard happen to discover you, and oblige you to repass in sight of the corps, who, seeing your strength, may fall upon you and drive you back.

The infantry A (fig. 2.) ought to be ambushed at least 600 paces behind the cavalry B, so that if they are pursued, they can fall back to A, and both afterwards to the guard at the bridge, or to the infantry that are in ambush at half way.

If the ambuscade is placed in a wood, an intelligent non-commissioned officer should be chosen to get upon a high tree C, from whence he can see the march of the enemy, and give notice of the most essential circumstances. There are three: the first is, the seeing the advanced guard; the second is, the approach of the corps; and the third is, the time when their front is advanced as far as the ambuscade B: for which the commanding officer should instruct the observer what signals he is to make from the top of the tree, to communicate the necessary information without speaking, which may be done by the means of a small cord D, of a brown or green colour, so as to be least perceivable. Let this cord be placed as in the plan, so that no branch interrupt it, with one end in the hand of the observer, and the other in the commanding officer's in the ambuscade B.

As soon as the advanced guard appears, the observer must pull the cord, and the commanding officer cause the party to mount and remain in deep silence. If by a stratagem, which is frequently practised for particular reasons, the advanced guard is immediately followed by the corps, which may easily be known by their being more numerous than ordinary, and not followed by any other corps, that you may not be deceived by the enemy, the cord should be drawn a second time, and a third time when their front is advanced as high as the ambuscade; upon which you must rush out, and pour furiously upon the flank of their centre in the following manner.

If the advanced guard E is formed only of an ordinary number, they should be let pass; and at the approach of the principal party or convoy F, the chief to be informed by the second pulling of the cord. At the moment the head of the convoy shall be advanced as high as B, the cord must be pulled the third and last time; at which signal the whole party must rush out without being perceived, and suddenly attack the centre upon the flank, engaging only with their swords, and making such a noise as to prevent the enemy from hearing the orders of their officers. They must disarm all whom their bravery or chance throws in their way, taking care not to scatter or pursue too far, unless you are sure that they are so far from their army or other parties that they cannot be assisted; for in either of these cases, they will not fail to run at the noise, and disturb your retreat.

Petite Guerre.

In all secret expeditions you cannot be too circumspect that you may not be seen or betrayed. If the advanced guard discovers you before the blow is struck, abandon the enterprise immediately, and retire. When you [illegible] that you can-not catch him, think immediately of retreating, or placing your ambuscade [illegible] quently if they have all their people.

You should never [illegible] the enemy's retreat, as this manœuvre will give him an idea of rallying, and attacking you in despair; but the case is different when you are well informed that you run no risk in stopping his whole force, either from the nature of the defile where they cannot form, or from the smallness of the number which cannot resist.

It is equally difficult and dangerous to form several ambuscades at once: the greater number that are formed, the more they are exposed to be discovered, and less in a state to unite for a retreat. To this rule, however, there is one exception. When ambuscades are formed to seize foragers, it is very proper to have several, and to dispose them in such a manner that the sentries can see from one to another. These dispositions being made, they who chance to be next the foragers must strike the blow, while the others march to secure the retreat of their companions, as soon as they perceive it.

In all ambuscades, no sentries should be placed but officers, or non-commissioned officers. On downs, behind mountains, or in gullies, the sentries should lie with their bellies on the ground, and their feet towards the ambuscade, the body covered with a grey or green cloak, according to the colour of the ground, with their heads a little raised, and wrapped in a handkerchief of a straw-green colour, or white in time of snow, so as not to be perceived. The number of sentries cannot be determined; but should be disposed so as to watch on all sides of the ambuscade, and stop every one who from ignorance approaches too near. The sentries should give notice of what they discover by gestures, to which all the officers should be very attentive.

In countries where there are no woods, vineyards, or hedges, you may place an ambuscade in a field of hemp or corn, or some sort of grain, provided it be high enough to cover you, at least with the help of art. When the stalk of the corn, &c. is not high enough, you must get some of the infantry to work with spades and pick-axes, which they must have brought along with them.

The commanding officer must mark out the ground A (fig. 1.) which they are to prepare for an ambuscade, entering at the side B, and raising in the front and at the two flanks a kind of parapet C, made with an insensible slope outwards, covered with corn raised from the surface of the ambuscade in form of square turfs of a foot thick D. They should be ranged and placed one against the other till they have gained six feet and a half. If the grain is not more than three feet high, it is plain, that forming the slope imperceptibly to a foot and a half high, with the earth dug of the same depth, the grain which borders the ambuscade will be six feet and a half from the bottom, reckoning the thickness of the turf, which serves to show that such a work ought not to be declined in arable ground

Plate DXXVII.

Petite Guerre.

so easily worked. When the soldiers have finished the work, a subaltern officer must lead them back to the place destined for the infantry.

The ambuscade being thus made at 100 paces from the road where the enemy are to pass, they should lead the horses into it one after another by the bridle, so as not to enlarge the entry: the horsemen to range themselves standing, and holding the bridles in their hands, with the reins slackened on the horses necks. The officers should be continually employed in visiting the party, and waking those who sleep; and be equally careful to deface all traces of the entry, that none may appear near the ambuscade.

Ambuscades may be placed advantageously in hollow roads when they open obliquely behind that of the enemy, as the road K (fig. 2.) which enters by an acute angle upon the route F of the enemy; nor is there greater difficulty in concealing themselves in the gullies of some rivulet G, when the borders are of a sufficient height, or have shrubs that run parallel with the road of the enemy. It is extremely dangerous to fix there when the road of the enemy approaches towards, or crosses too near, the ambuscade, as they cannot fail to discover it.

Plate DXXVI.

As these gullies are not very large, it is necessary to have a number of ways to rush out quickly on the enemy: We suppose four, H, H, H, H, by which the cavalry can dart out suddenly upon the enemy at F.

It will be proper, before the placing the party, to cause the rivulet to be cut somewhat higher, to give it a new course I, so that the horses feet may be dry in the gullies, and make less noise; and the shorter way they have to go, they will more certainly succeed. The commanding officer will not fail to dispose them in such manner, that the whole can rush out at once by the four passages, and pour in great numbers upon the flank of the enemy.

In such sort of ambuscades, the commanding officer should himself be the sentry, leaning upon the edge, and covering himself, so that he may see every thing without being perceived

In deserted villages they may fix an ambuscade in the gardens G (fig. 1.), or in the barns H. The doors fronting the enemy must be shut up, and the passages which are marked by small dots made use of; for it is a general rule in all ambuscades, to sally forth in such manner as to take the enemy obliquely behind their front.

Plate DXXVII.

You ought never to employ infantry in the ambuscades we have been describing, where the cavalry act, unless to favour their retreat: but when you go at hazard, seeking to draw the enemy into an ambuscade, then the infantry should have their turn. Neither woods, villages, nor any places which are much covered, are proper for them; however unskilled an enemy may be, he will not follow a party on the skirts of a forest, or in the neighbourhood of some covered place: for which reason, there are no places fitter for succeeding with ambuscades of infantry, than heaths, hilly countries, hollow roads, corn-fields, ditches at the side of great causeways; provided always that you do not plant them on roads that lead to your army, for then the enemy will take care how he pursues you too far.

When you would place an ambuscade on a heath, or in a country full of little hills, your infantry must lie down with their bellies on the ground. If there is some water near them, it may suggest to them to wet their clothes and cover them with dust, to give them the colour of the ground: but that this party so laid on the ground may not be crushed or trod upon by the enemy's horse when hurried along with violence, they must preserve the flank of the ambuscade I, next the enemy, with a bar K, which may be made in a hurry with some stakes drove in the ground, at ten feet from one another, and above five or six feet high, held together by cross pieces tied above five feet from the ground, which can be easily done in the neighbourhood of a wood. The time for the infantry to fire is, when the enemy's cavalry L, passing before the front, stretch their flank the whole length of the ambuscade; then your cavalry M must quickly face about and attack the enemy. Their defeat will be so much the more certain, as the fire of your infantry happens to have driven their squadrons into confusion.

To ambush in the ditch of a great causeway, you must choose the deepest place, and at the edge of a corn-field which is pretty high, and there place your people sitting or kneeling. You should collect as many small round bushes as possible, which are to be found in plenty in the country, which should be planted, as if naturally, along the side of the road in front of your party, and beyond the ambuscade on the side you expect the enemy, and here and there so open, that the enemy being accustomed to them may pass without distrust. You should then make the corn lean over to cover the ambuscade; but if there is none near enough the ditch, you must have as many squares cut in the manner directed above as will cover the edge of the ditch. Some of the corn so transplanted should be beat down, but to appear as if done by hail or wind.

Mr Jeney ambushed in this manner with 50 men, when under the command of Captain Palasti, who advanced with his cavalry upon the causeway leading to Strasbourg; and as soon as he was perceived, 400 Bavarian dragoons advanced to attack him: he wheeled about, and the dragoons believing themselves masters of the booty, did not fail to pursue, and arrived before the ambuscade without suspecting. Mr Jeney let their front pass, and fired such a deadly fire upon their centre, that he brought to the ground 17 killed or wounded: at the same time, the cavalry who pretended to fly, faced about and attacked the enemy, and would have completed their defeat, if it had not been for the great support of cavalry and infantry hurrying out of Strasbourg to sustain the dragoons; nevertheless, he carried off more than 50 horses.

An officer having placed his infantry in ambuscade, ought to send on the cavalry at day-break, a non-commissioned officer with six of the best mounted horsemen making the advanced guard: they should advance as far before the party as the commanding officer can see. At sight of the enemy, they should begin to retire slowly without flying; at least till the enemy comes to pursue with keenness: in that case, the advanced guard makes the rear-guard, and may drop a few shot at the enemy, to harass them and draw them on, or make pretended delays to excite them to pursue, till they fall by degrees into the ambuscade.

When you cannot place your infantry in ambush without having a village between them and the enemy, the cavalry should not be sent beyond the village, because the enemy will never expose themselves to cross it in following your party, for fear of falling into some snare: but instead of going beyond it, your cavalry should enter the village, and demand refreshment for 50 men, if the party are 100; then make three or four peasants carry orders to the magistrates of the villages that are towards the enemy, to come to you, and regulate the delivery of waggons and forage, or some other pretence. As the peasants will not fail to acquaint the enemy, and to describe your strength and situation according to what they have heard, the enemy will certainly come with superior force; and that they may come more speedily, they will bring no infantry.

As soon as the peasants are gone, you must be careful to let

let none of the inhabitants leave the place, and fend continually fome ftrong patroles to the rear on the road of your retreat, and efpecially to the paffages by which they can cut off your communication with the ambufcade. Every horfeman holding his horfe by the bridle muft be ready to mount, fo that upon the enemy's appearing you may retire quickly from the village, and fall back one after another upon your ambufcade.

When a partifan has no infantry, he may form an ambufcade with cavalry, which fhould be as near as poffible to the enemy. In the night, he fhould fend out two or three waggons covered with white linen, that they may be feen at a diftance: care muft be taken that the harnefs be in good order, fo that no troublefome accident happen by the want of attention to it. Each carriage to have four horfes mounted by two dragoons difguifed like waggoners, with their arms in the hands of two or four comrades concealed in each waggon, fo that they may repulfe any patrole they chance to fall in with.

The waggons fhould go flowly on fome road parallel to the front of the enemy, and paffing at fome diftance from their poft (for it is not neceffary that they pafs through them), and regulate their march fo, that they may be within half a league of the ambufcade at day-break, and readily perceived by the enemy; then let them ftop while one mounts a tree or fome height to fee round them. When they perceive the patrole of the enemy, they muft move off, for the others will not fail to follow; but if the enemy appears not to be inclined to follow, which the non-commiffioned officer muft attend to, and make one of the drivers ftop, as if fomething were the matter with his waggon, which will draw them on till they fall into the ambufcade.

Among the thoufand opportunities that the different marches of the enemy offer for ambufcades, there is none more proper than the retreat of an army which decamps to fall back. When a partifan happens to get information of it on the eve by good fpies, he ought to fet out immediately with his whole party, making fuch a round as has been drawn in fig. 1. leaving his infantry in ambufcade at half-way.

The cavalry muft be diligent to arrive at the place of ambufcade by day-break, which ought to be placed on the route that the enemy is to take, and two or three leagues in the rear of his camp.

To be more fecure of his retreat, he fhould leave two or three detachments of cavalry between him and his infantry, at a good diftance from one another; the remainder to line the road in feveral ranks parallel to it, and 300 or 400 paces behind one another, concealed from the view of paffengers by the favour of hollows, woods, or hills.

The firft line being near the road, muft take care of futlers, equipages, &c. which are the forerunners of an army, and the firft to decamp when they are retiring. When they fecure fome waggons or mules, the firft detachment fhould pafs them to the fecond, and fo on till they come to the infantry.

You muft haften to carry off what you can for a full quarter of an hour; after which you muft prefs your retreat, expecting that the alarm will foon pafs to the army, and the light troops be inftantly at your heels.

SECT. X. *Of the Retreat.*

EVERY march in withdrawing from the enemy is called a *retreat*. That which is done in fight of the enemy, who purfues with a fuperior force, makes the prefent fubject; and is, with reafon, looked upon as the glory of the profeffion. It is a manœuvre the moft delicate, and the propereft to difplay the prudence, genius, courage, and addrefs of an officer who commands.

Petite Guerre.

The fuccefs of the retreat depends upon the knowledge of the country that is to be paffed over, and the goodnefs of the difpofition that is made for the troops to defend themfelves. The firft offers advantages, and contributes greatly to the feizing them; the fecond reftrains the ardour of the enemy, and keeps up the force of a party to its higheft pitch. Both deferve to be ftudied.

1ft, Every officer who commands a detachment ought to apply himfelf carefully to reconnoitre every ftep he takes, and examine perfectly every route that can conduct him from one place to another; he fhould obferve attentively all the ftratagems that can be employed for ambufhing infantry, or pofting cavalry; the courfe of rivers, their bridges and fords; the roads moft covered with woods, hills, gullies, and villages; and, in a word, he fhould know all the advantages, as well as the dangers, that lie in his way. It will be eafy for him to acquire a knowledge of all this, if he will ufe the method recommended in a former fection. With the affiftance of fuch a plan as is there defcribed, he may regulate his retreat with eafe, and put it in practice to advantage, profiting by every means proper for his defence, or furprifing the enemy.

2dly, The difpofitions that ought to be made for a party, to fuftain their retreat in the face of the enemy, depend upon the number and kind of troops in both corps; for they muft be varied according as they happen to be of cavalry or infantry united, or of either fingly.

Every forced retreat in confequence of an unfortunate action, would be almoft impracticable, if it were not premeditated before you come in prefence of the enemy, or when you are obliged to fly by unknown routes. That which can be made in a fog, or in the night, is eafieft, when your rear is fecured, as you can flip out of fight of the enemy without any difficulty, and they will be afraid of following you for fear of being furprifed in the dark: we fhall only therefore fpeak of that which is to be made in open day, and under the fire of the enemy.

To conduct it properly, you muft abfolutely know the ftrength of the enemy; for it is fhameful to be the dupe of a falfe alarm, and to retreat precipitately from an ill founded fear at the approach of an inferior enemy. You muft therefore be convinced of his great fuperiority, and know what his party confifts of.

If they come with a ftrong cavalry, united to a more numerous infantry than yours, you muft immediately render their acting ufelefs, by hurrying your infantry as quick as poffible to retreat to the firft place where they can lie in ambufh, and ferve the cavalry advantageoufly, if they can draw on thofe of the enemy, as has been faid in fpeaking of ambufcades.

To conceal from the enemy, and favour the departure of your infantry, you fhould caufe your cavalry to advance, and pretend as if they were going to attack the enemy A (fig. 2.), your party forming into two divifions B and C, each drawn up in two lines, the fecond double the firft, and difpofed as in the plan.

The divifion C is to retire firft 100 or 200 paces, and then fronting the enemy divide into two wings, leaving an interval for the paffage of the divifion B, who, in retiring, muft leave a rear-guard at 50 paces, which muft be divided into feveral parties D, to fcamper about the enemy's front; and in cafe they appear defirous to attack you, your fmall parties muft keep a conftant fire, particularly on the files that advance the moft; and continue this manœuvre till they have joined the divifion C, which fhould immediately detach fome fmall parties of the beft mounted to ferve for a rear-guard,

guard, and to harass the enemy, till the division B is drawn up in its place in the rear, and divided into wings, leaving an interval for the division C to pass through in its turn; and continue to manœuvre it in this manner, till you draw the enemy's cavalry under the fire of your infantry.

When the force of the enemy consists of cavalry alone, your infantry (marked in the plan by dotted right angles) should retire jointly with the cavalry, at least if the country does not expose you to be surrounded by some covered place; because in that case your infantry should go and occupy that place, and form an ambuscade.

The rest of the infantry should place themselves in the second line of each division. If the enemy approaches the first line too near, they should fall lightly back upon the two wings of the second, opening the centre quickly for the infantry to fire upon the enemy in platoons, at the same time that your cavalry detach several small parties to advance briskly to prevent the enemy's forming, who were thrown into confusion by the fire of the infantry. The division which retires will force its march, and go to a greater or less distance according to the pursuit of the enemy. The sustaining division must fall back afterwards till it has passed between the wings of the second division, who must then make the manœuvre of the first, continuing it alternately till the enemy desists from the pursuit.

To facilitate the retreat of the infantry, and gain some way on the enemy, many have been of opinion that they ought to transport them in waggons. But when the enemy is at our heels, the time is very ill employed in collecting carriages and harnassing them: those moments are too precious; and should be employed in causing the infantry to move off quickly, by which they will not be exposed to a train of waggons taken in haste, which may soon break, or be put out of order, and may stop the whole line; which not only retards the infantry, but likewise the cavalry, when they find the route they were to have taken blocked up with broken carriages.

When there happens to be a wood in your rear, you need not enter it if the enemy follows you close, and is prevented by your strength: it is better to coast along it by the route marked G, for fear of his coming round you; but if you cannot avoid crossing it, the division C should pass quickly, and at getting out face to the two flanks of the wood. The division B is to remain at the entrance of it, till they judge that the division C is sufficiently advanced, and then fall back, leaving the infantry for a rear-guard during the whole passage through the wood: at which time the whole should resume their first disposition.

In all defiles, and passages of bridges, the same manœuvre should be used as for woods: but the first division having passed, they should form facing the enemy; and the infantry likewise draw up on the other side upon the edge of the river.

When the country through which you are to retire happens to be mountainous, the division which falls back should guard the heights by small detached parties, or, if possible, guard them themselves.

A body of cavalry retreating without infantry, ought to form in three lines at 200 paces behind one another; the two last extending their front, that they may appear more numerous, and draw up on the two sides out of the road. The first line being attacked, the second is to sustain it, the third to wait the retreat of the first, and to sustain the second, and continue to do so alternately.

If the enemy seem to quit the pursuit, the whole corps must resume the order of an ordinary march; with this precaution, that the rear-guard be reinforced, and the advanced guard weakened.

As to the retreat of a small detachment of cavalry, such as go to reconnoitre the enemy, to discover their march, to carry off some officer, or for some other commission, as they are not numerous enough to skirmish and retreat by rule, they have but two ways to choose; either to fly, or break through the enemy. They ought to determine for the last, when their retreat is cut off on all sides, so that they have no other way to escape but by cutting their way through the enemy sword in hand: but flight is always less hazardous when it is practicable.

If the officer is certain of the fidelity of his men, and their attachment to him; and sees that they cannot get out of sight of the enemy, but are ready to fall into their hands; he ought to try one means still, which has been known frequently to succeed. He should disperse his party by two and two, by the favour of the first covered place, where they may be at liberty to take so many different routes. It is evident that two men may wind from right to left, and escape more easily than a party of 12 or 20, who cannot move so freely.

Mr Jeney made use of such an expedient successfully in Italy, when the Spaniards having advice of his detachment having slipped to the rear of their army, they cut off his retreat on all sides. The whole party being dispersed, he took two hussars with him, and was followed so close, that every instant he thought he must be taken; however, he saved himself by crossing a marshy pond. The enemy ran to turn him, but he got so far before them, that they could not take him. He got safe to his post, and in three days the whole detachment met without the loss of a man; which will prove, that in such a situation we need not despair, and that in extreme necessity the passage of a river or morass ought not to be declined.

Part IV. Of SIEGES.

Sect. I. *Of Attack.*

§ 1. *Maxims or Principles to be observed in the Attack of Places.*

1. THE approaches ought to be made, without being seen from the town, either directly, obliquely, or in flank.

2. No more works should be made than are necessary for approaching the place without being seen; that is, the besiegers ought to carry on their approaches the shortest way possible, consistent with being covered against the enemy's fire.

3. All the parts of the trenches should mutually support each other, and those which are farthest advanced ought not to be distant from those which are to defend them above 120 or 130 fathoms, that is, above musket-shot.

4. The parallels or places of arms the most distant from the town, ought to have a greater extent than those which are nearest, that the besiegers may be able to take the enemy in flank, should they resolve to attack the nearest parallels.

5. The trench should be opened or begun as near as possible to the place, without exposing the troops too much, in order to accelerate and diminish the operations of the siege.

There

Plate DXXVII.

Fig. 1.

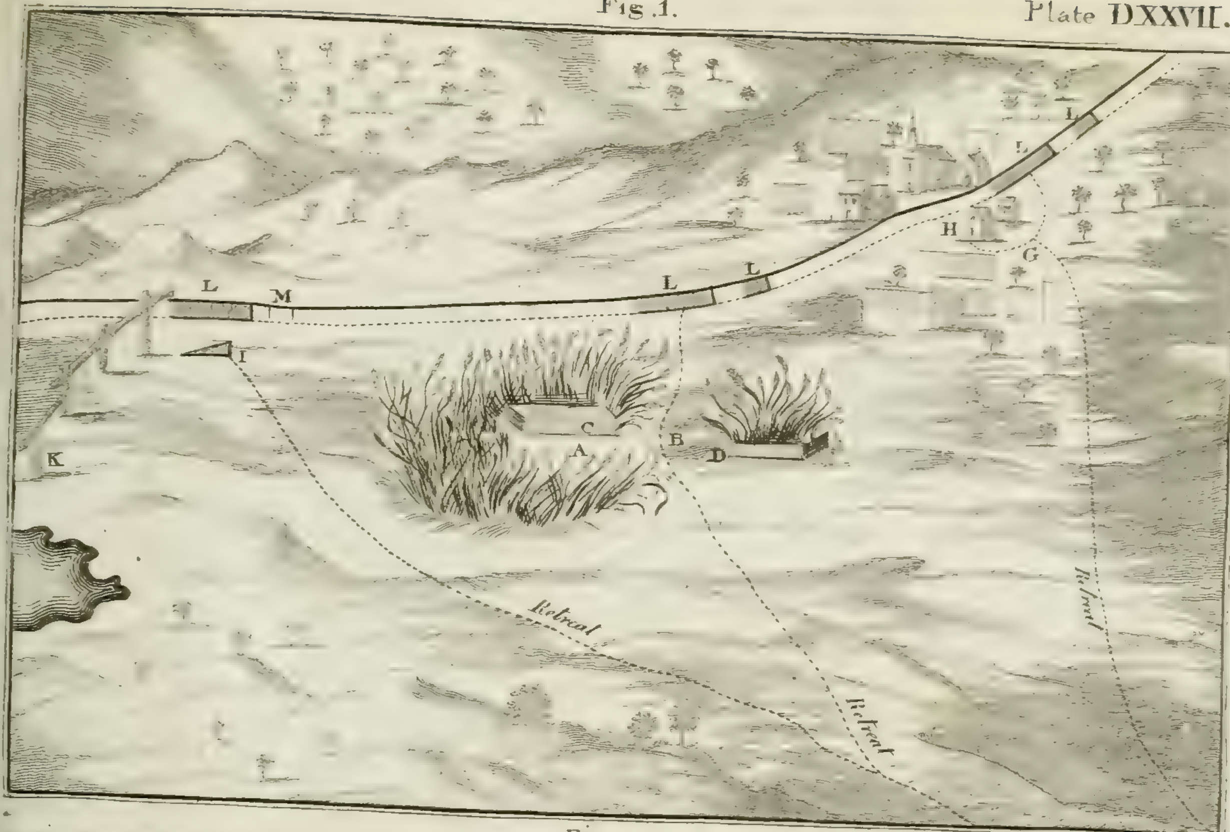


Fig. 2.

A. Bell Prin. Wal. Sculpt. fecit

There is no such thing as fixing any exact rule in regard to the distance which ought to be observed upon opening the trenches. On level ground the distance may be 800 or more fathoms; but if there should be a hollow way in the neighbourhood of the place, the besiegers are to take advantage of it, and open the trenches nearer. In general, they are to regulate themselves upon this head according to the nature of the ground, more or less favourable to the opening of the trenches.—We shall suppose, in the present work, that the opening ought to be made within 600 fathoms of the covert way; the first parallel within 300 fathoms, the second within 150, and the third at the foot of the glacis.

6. Care should be taken to join the attacks; that is, they ought to have communications, to the end that they may be able to support each other.

7. Never to advance a work, unless it be well supported; and for this reason, in the interval between the second and third place of arms, the besiegers should make, on both sides of the trenches, smaller places of arms, extending 40 or 50 fathoms in length, parallel to the others, and constructed in the same manner, which will serve to lodge the soldiers in who are to protect the works designed to reach the third place of arms.

8. Observe to place the batteries of cannon in the continuations of the faces of the pieces attacked, in order to silence their fire; and to the end that the approaches being protected, may advance with greater safety and expedition.

9. For this reason the besiegers should always embrace the whole front attacked, in order to have as much space as is requisite to plant the batteries on the produced faces of the works attacked.

10. Do not begin the attack with works that lie close to one another, or with rentrant angles, which would expose the attack to the cross-fire of the enemy.

§ 2. *Of Investing.*

The first operation of a siege is investing. The body of troops investing a town ought at least to be as strong again as the garrison; they are to divide themselves into several parties, in order to take possession of all the avenues leading to the place. By day they should keep themselves out of the reach of cannon-shot; but as soon as it is dusk they must approach much nearer, the better to be able to support each other.

The investing is generally made by cavalry; but when the country is cut with ravins or hollow ways, or when there are woods in the neighbourhood of the place, then there must be likewise a body of infantry to guard all the avenues, and even to stop up, by a kind of retrenchments, such as might be the easiest to penetrate.

A few days after the investing, the army arrives, and is disposed round the town, according to the ground taken up by the line of circumvallation, and assigned by the engineer who has the direction of the siege. As soon as the place is invested, they begin to trace the line of circumvallation, and afterwards they set about its construction.

§ 3. *To trace out the line of Circumvallation.*

Before a general begins the attack of a place, he must endeavour to have as exact a plan of it as possible, by which he forms a design of the circumvallation and the attacks. The plan is rectified after the investing, as much as the vicinity of the enemy will permit; and thereby he may correct the design traced at first, as far as there may be occasion for correction. It is upon such a plan, so rectified, that we suppose a general to proceed. We shall therefore begin with explaining or tracing the oper[illegible]. We [illegible] shall exhibit the progress of these operations from the investment to the taking of the place, in the [illegible] are really executed. The line of circumvallation being a fortification intended against the enemy from without, who should attempt to succour the town, its defences ought to be directed against that enemy; that is, they ought to be opposite to the town; and the besieging army should, as we have already observed, be encamped behind that line, that is, between it and the town. The camp should be, as much as possible, out of the reach of cannon-shot: therefore, as the line of circumvallation should be at a greater distance from the place than the camp, the reason is still stronger for its being also out of the reach of the cannon-shot; which, whether fired horizontally, or at an angle of 10 or 12 degrees, may be reckoned about 1200 fathoms. As the rear of the camp should not be incommoded by the cannon, this part ought to be above 1200 fathoms distant from the place; and we shall suppose that the distance ought to be fixed at 1400 fathoms from the covert way. The depth of the camp may be estimated at about 30 fathoms. From the front of the line of circumvallation there should be a space of 120 fathoms, to draw up the army in battalia behind the circumvallation; which space added to 30 fathoms, supposed for the depth of the camp, gives 150 fathoms; and this added to the distance from the covert-way to the rear of the camp, gives 1550 fathoms for the distance from the circumvallation to the covert-way.

This being laid down, if the place be a regular octagon, fortified according to M. Vauban's first method *, the radius thereof will be 234 fathoms. This distance being added to the 1550 fathoms, then we shall have 1784. Or we may make it a round number by adding 16 fathoms, which are here of no manner of consequence, and we shall have 1800 fathoms for the distance from the centre of the place to the line of circumvallation.

* See Fortification.

The radius of the circumvallation being thus settled, from the centre of the place, with the distance of 1800 fathoms, you are to describe the circumference of a circle round the place. The diameter being 3600 fathoms, the circumference will then take 11,314; then take the distance of 120 fathoms, which you are to carry to the circumference above described. This distance will be in this example 93 times, and something over, which differs very little from 120 fathoms; so that you may look upon the polygon of this circumvallation as a polygon of 93 sides, of 120 fathoms each.

The polygon of the circumvallation being traced, take on each of the extremities of its sides the lines BD and BE, each of 15 fathoms; and from the points D and E, taken for the centre and distance of 25 fathoms, describe two arcs which cut one another at the point F; from whence draw the lines FD, FE, for the faces of the redans of the line of circumvallation: thus it is we form the saliant parts EFD of this line, which serve to flank it. Perform the same operation on every side of the circumvallation, and then you will have its principal line traced. Plate DXXVIII. fig. 1.

The parapet within must be six or eight feet deep; and without make a ditch parallel to all its parts, three or four fathoms in breadth. The parapet of the circumvallation will be seven feet and a half high, and the depth of the ditch equal to the height of the parapet.

To make the profile of the circumvallation, let AB fig. 2. be the line level with the country, and CD the scale of the profile. Let A be the side of the town, and B that of the country: take AE, of six feet; from the point E, raise the perpendicular EF, of three feet, and draw the line AF, which will be the talus of the banquette.

Draw

Of Sieges.

Draw FG parallel to AB, three feet from F to G, and the line FG will be the breadth of the banquette. On the point G raiſe the perpendicular GH, upon the line FG, four feet and a half. Draw from the point H, HK, parallel to AB. Make HK ſeven feet and a half, HI a foot and a half, draw GI, which will be the inſide of the parapet of circumvallation.

From the point K, let fall on the line AB the perpendicular KM; take KL a foot and a half, and draw IL, which will be the upper part of the parapet of the line of circumvallation. Take MN five feet, and from the point N draw the perpendicular NO, and ſet off ſeven feet and a half from N to O. Draw OR parallel to AB, making the diſtance three fathoms or 18 feet from O to R; draw the line LN and produce it to P, and LP will be the ſcarp, or the outſide of the parapet of the line of circumvallation. From the point R raiſe RS, perpendicular to OR, or parallel to ON. Make QR equal to OP, and draw QS, which produce beyond S three feet to V; then take SX ſix feet, and draw VX, and the profile of the circumvallation will be completed.

This kind of glacis, VX, will ſerve to raiſe the enemy, and to expoſe them more to the fire of the line, ſhould they attempt to make themſelves maſters of it, and to cover the parapet of the circumvallation, in the ſame manner almoſt as the glacis of a place covers the top of the rampart.

The dimenſions above given may vary a little without inconvenience; but it would be to no manner of uſe to make the lines ſtronger; only you may reduce the ditch to ten or twelve feet in breadth at the top, and five or ſix feet in depth. A ditch of leſs breadth and depth, beſides its not allowing ground enough to form a good parapet, would have the inconvenience of being too eaſy to paſs over by the enemy. The lines may be fraiſed (ſee FRAISE); which is done when they are to laſt for ſome time, and the neighbouring country furniſhes wood enough for the purpoſe.

Sometimes a fore-ditch is dug before the lines, 12 or 15 feet in breadth at the top, and ſix or ſeven feet deep; it is made about 12 or 15 fathoms from the ditch of the line. The deſign of it is to ſtop the enemy when they attempt to attack the lines, and to make them loſe both time and men in paſſing over it. As it is expoſed to the fire of the lines, the time the enemy muſt neceſſarily ſpend in croſſing will of courſe occaſion their loſing a great many men; and beſides, the paſſage itſelf may throw them into ſuch diſorder, as ſhall prevent their attacking ſo advantageouſly as they would otherwiſe do, were it not for this obſtruction. Between this fore-ditch and the ditch of circumvallation, at the ſiege of Philipſburg, in order to ſtrengthen the defence of the circumvallation, there were likewiſe dug wells, which were ranged chequerwiſe, of about nine feet diameter at the mouth, and ſix or ſeven feet deep. They were ſituated near to each other, to prevent the enemy from paſſing eaſily through the intervening ſpaces. The Spaniards practiſed ſomething of this kind at the ſiege of Arras in 1654. Before the circumvallation, they dug a number of holes two feet diameter, and a foot and a half deep; in which they faſtened ſtakes that were capable of greatly obſtructing the paſſage of the cavalry. See Plate DXXIX.

A line of circumvallation requires a ſtrong army to defend it. We have found the circumference of the line which we have been now tracing, namely, of 94 ſides, each of 120 fathoms, to be 11,280 fathoms; out of this number the gorges of the redans are to be deducted, but then their faces are to be added. The gorges have 30 fathoms; and the two faces which have 50, give an overplus of 20 fathoms on each redan; that is, to the number above mentioned of 11,280 fathoms, add as many times 20 as there are redans, in order to have the entire circumference of the circumvallation. This circumference has 95 redans; therefore we muſt add 94 times 20, or 1880, which will make 13,160 fathoms for the whole circumference. This number being divided by 2282 (which is the number of fathoms contained in a French league) gives about five leagues and a half. Now it is clear, that ſo great an extent of ground requires a very numerous army to guard it. We may make a calculation pretty near, by ſuppoſing that every ſoldier drawn up in a line occupies a ſpace of three feet, that is, half a fathom; that the ſoldiers are four deep; and that the army is drawn up in two lines, which will give eight ranks of ſoldiers. Each rank containing 26,320 ſoldiers, the circumference of the circumvallation being 13,160 fathoms, the eight ranks will therefore make 210,560 men.

To theſe we ſhould likewiſe add about 12,000 or 15,000 men for the works of the attack, which would form an army of about 225,000 men. And as it is not cuſtomary, at leaſt in Europe, to ſend ſuch ſtrong armies into the field, from thence it follows, that the circumvallations, and the lines in general, when they are of a very great extent, are extremely difficult to guard. And indeed the moſt celebrated generals have been divided in their opinions upon this ſubject. They all agree that there are certain caſes in which they may be of ſome advantage, eſpecially when they are of a narrower compaſs, and the deſign of them is to ſtop up the entrance of a country of a ſmall extent; but if they are very large, it is extremely difficult to defend them when attacked by a ſkilful enemy.

It was heretofore the cuſtom to add great outworks to the lines, ſuch as horn and crown works, tenailles, &c. All the circumvallations of the towns that were beſieged during the wars between Spain and Holland, under the princes of Orange, were remarkable for this ſort of works. Theſe have been ſince laid aſide, becauſe we find that even a line, with its ſimple redans, is very difficult to guard; and ſuch a number of outworks does but increaſe its circumference. The modern lines have only a few ſmall half-moons A, before the gates of the circumvallation, placed, like thoſe of the towns, againſt the middle of the curtains; the entrance is ſhut up by wooden barriers, and ſometimes by chevaux-de-friſe, and other contrivances, which will hinder the paſſage from being eaſily forced.

The lines having very little elevation, ſtand in no need of baſtions to be flanked in all their parts, like thoſe in the circuit of a town. Redans, which are of more ſimple and expeditious conſtruction, are ſufficient. The angle they make with the curtain is always very obtuſe, to the end that the ſoldier being placed on the face of the redan, may be the better able to defend its approach. It is cuſtomary indeed to make baſtions in thoſe parts where the lines form ſuch angles as could not be ſufficiently defended by redans. Yet, whenever it may be judged neceſſary, the line of circumvallation may be fortified with baſtions. The greateſt part of the lines at the ſiege of Philipſburg was flanked in this manner, as may be ſeen in Plate DXXIX. The baſtions increaſe the circumference of the circumvallation; and probably the reaſon why they were uſed at the ſiege of Philipſburg, was becauſe the circumvallation was of a very ſmall extent.

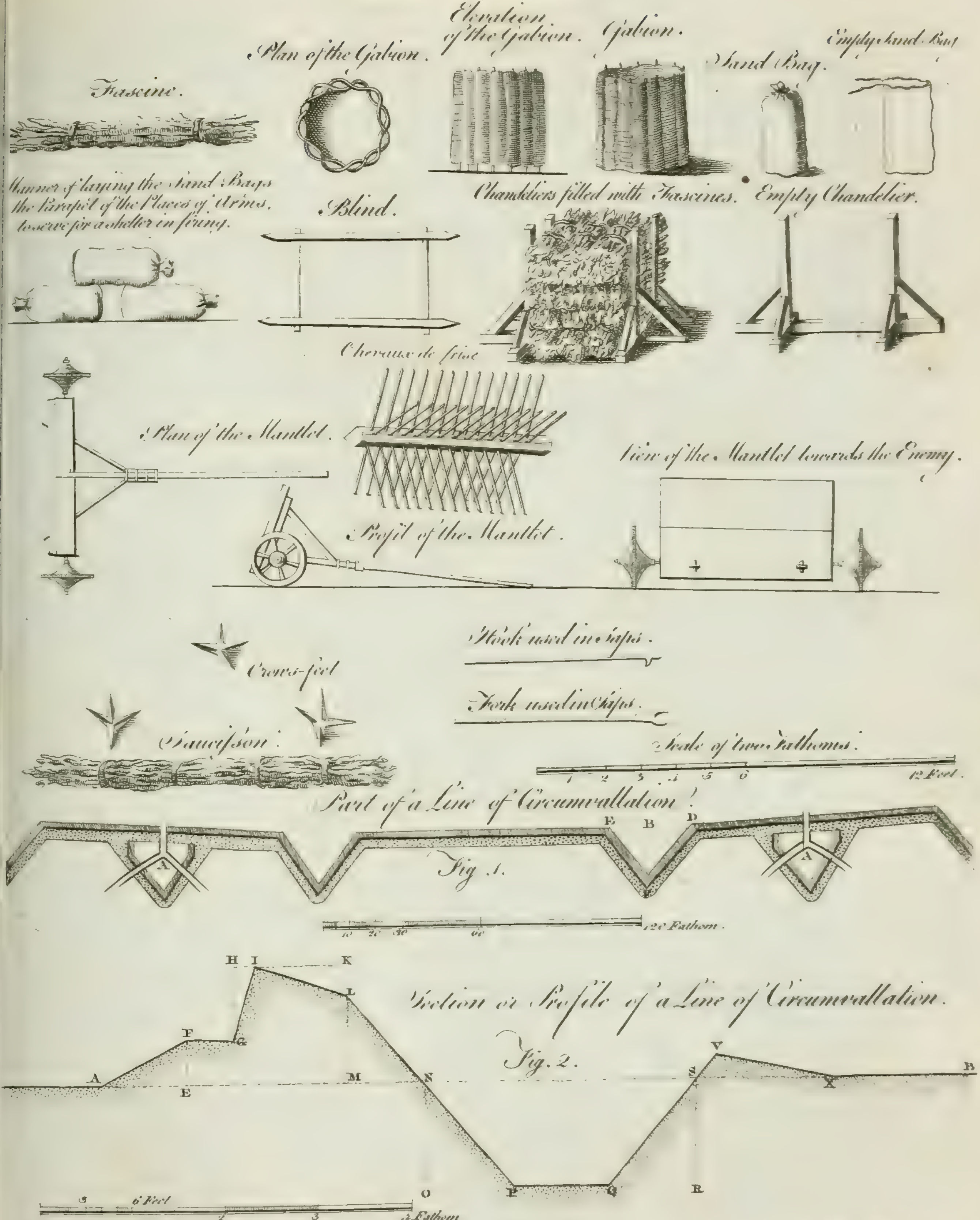
At the point of the redans, batteries are erected to fire the cannon a barbette over the parapet; and the ſame is practiſed wherever the cannon are placed on the line of circumvallation.

Hitherto we have ſuppoſed that the circumvallation was regular; but even were it irregular, the conſtruction of it would differ very little from that which we have juſt now given.

A general ought to poſſeſs himſelf of all places from which

WAR.

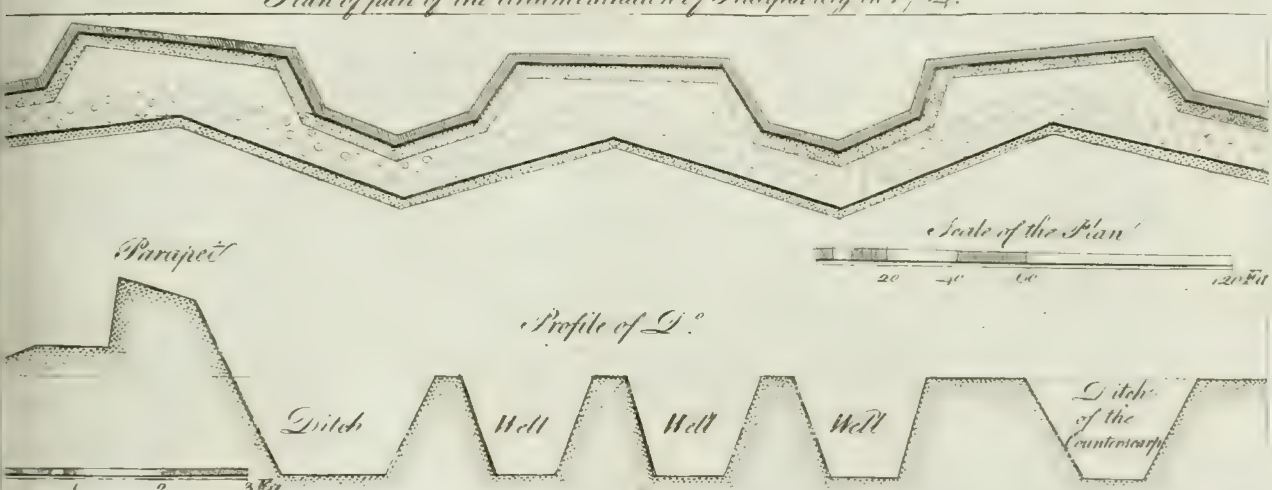
Attack of Fortified Places.



A. Bell Prin. Wal. Sculptor fecit

Plan of the Circumvallation and Attacks of PHILIPSBURG in 1734. Plate DXXIX.

Plan of part of the circumvallation of Philipsburg in 1734.



Plan of part of a Line of circumvallation of Arras in 1654.

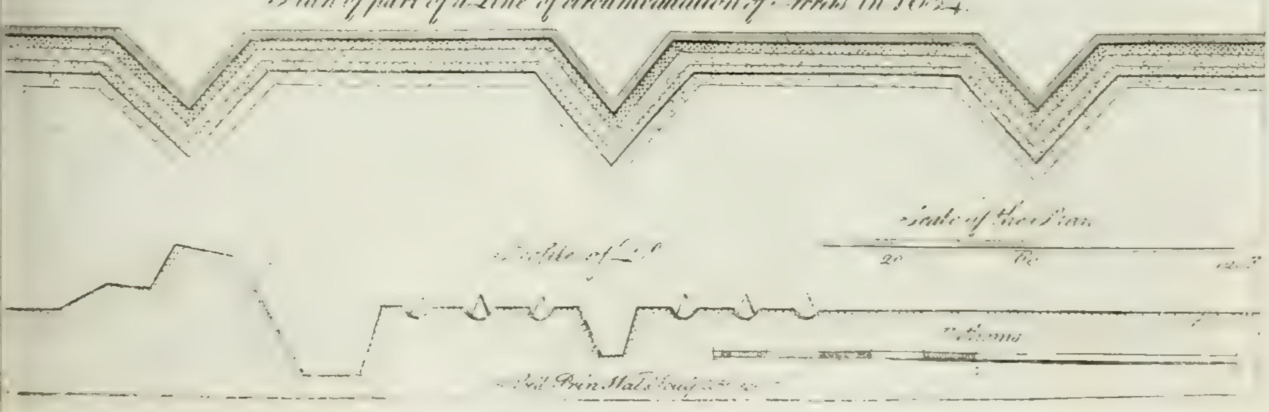
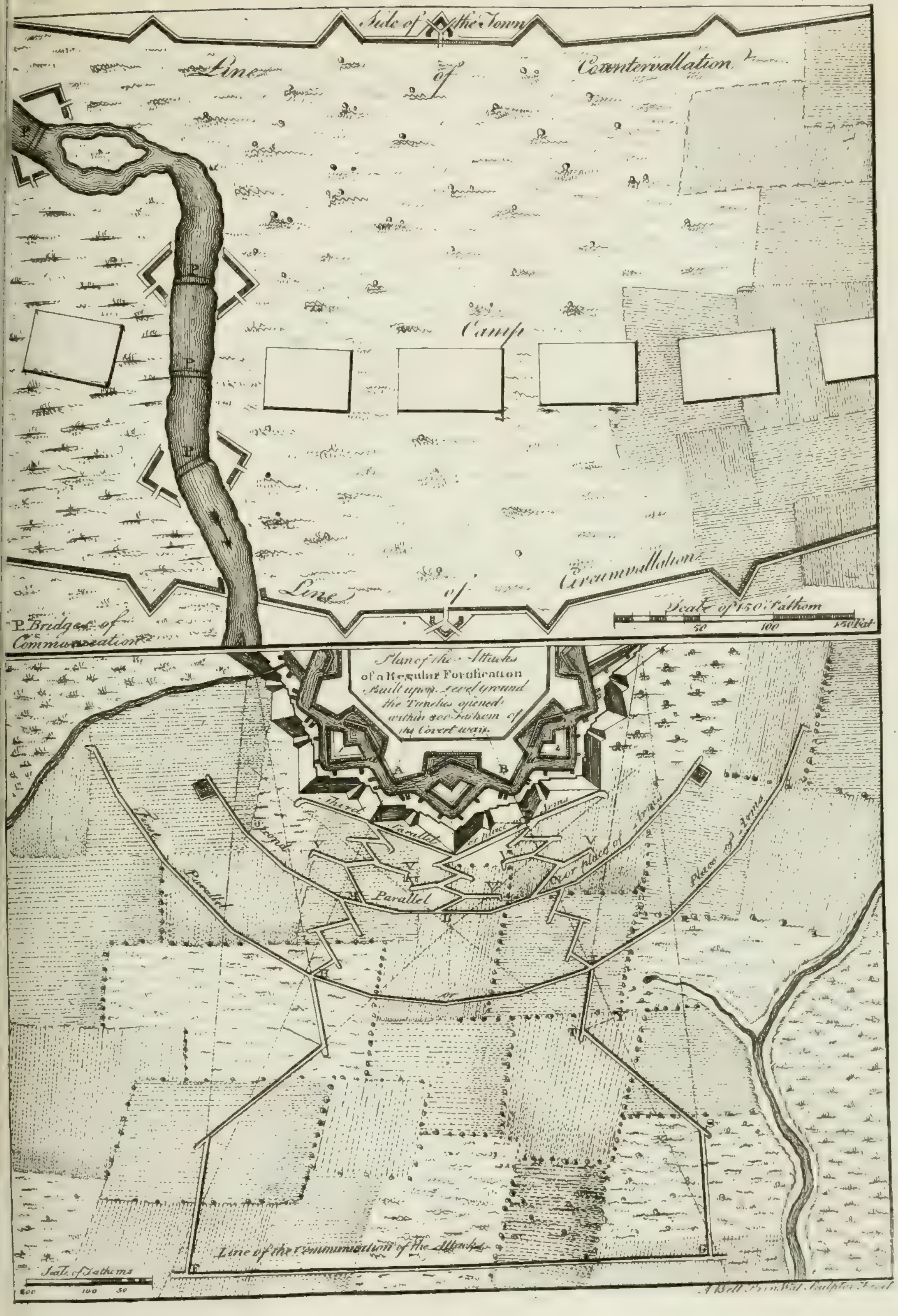


Fig. 1.


Side of the Town
Line of Countervallation
Camp
Line of Circumvallation
Scale of 150 Fathom
50 100 150
P. Bridges of Communication
Plan of the Attacks of a Regular Fortification Built upon Level Ground the Trenches opened within 300 Fathom of the Covert way
Third Parallel or place of Arms
Second Parallel or place of Arms
First Parallel or place of Arms
Line of the Communication of the Attacks
Scale of Fathoms
200 100 50

which the lines may be commanded, when it is poffible to do it without carrying the circumvallation to too great a diftance. He fhould likewife take all advantages arifing from the nature of the ground, as precipices, eminences, rivers, brooks, morafles, and, generally fpeaking, whatever is capable of rendering the camp of difficult accefs. If there are any woods or bufhes within its inclofure, it will be right to cover it in thofe parts by felling the trees, and therewith making a proper fence.

The tracing of the lines is a matter of no difficulty, if you have a good map of the adjacent country; fince you have only to bring the feveral parts of the line nearly within 1800 fathoms of the centre of the place, and to take care that there fhall be about 120 fathoms from the point of one redan to another.

Nor is there any difficulty in transferring this line to the ground; the operation is too eafy to thofe who know a little of practical geometry, to lofe any time in explaining it here.

When the garrifon is numerous enough to difturb the befieging army, another line is traced in the rear of the camp, called the *line of countervallation*. As it is intended to oppofe a far lefs confiderable body of troops, it is never made fo ftrong as the line of circumvallation; but it is conftructed on the very fame principles, as the figure will fufficiently fhow.

§ 4. *Of the Park of Artillery.*

The park of artillery is the place which contains the cannon, bombs, powder, and in general all military implements and machines that have any relation to the artillery. This park fhould be placed where there is leaft danger of being infulted by the enemy. It ought to be without the reach of cannon-fhot, and inclofed within a particular fpot, which fhould be fortified alfo by a line, confifting of a ditch and a parapet, flanked with redans in the fame manner as the circumvallation. Nothing fhould be neglected that is capable of fecuring it either from the attacks of the enemy, or from any other poffible damage.

§ 5. *Of the Trenches and Parallels.*

While the line of circumvallation is finifhing, all the materials neceffary for the conftruction of the trenches are got ready, and the engineer, who has the direction of the fiege, examines on the fpot the moft proper place for the attacks, and the figure they ought to have; and of thefe he makes a particular plan.

We have fuppofed that the place is regularly fortified, and on level ground; fo that here it is indifferent on which fide the attack is begun. It is fufficient to explain the rules that are to be there obferved; and afterwards to apply them to irregular towns, and to uneven grounds. Let C (fig. 2.) be the place befieged, and A and B the baftions attacked. Begin with indefinitely producing towards the field the capitals of thefe two baftions; in like manner produce the capital of the half-moon oppofite the curtain between thefe two baftions; fet off 800 fathoms from the faliant angles D and E of the covert-way to F and G. This done, take DH, and EI of 300 fathoms; and from the centre C, with the radius CH or CI, defcribe an arc, which produce beyond the points H and I; and on this arc HI conftruct the firft parallel. Then on the fame lines, DF, EG, take the points M and N 140 fathoms diftant from the points H and I; and through thefe points defcribe from the centre C another arc, on which the fecond parallel is conftructed. This fecond arc will cut the produced capital of the half moon in the point L, which is to be obferved, in order to begin from hence a trench, which fhall extend to the faliant angle of the covert-way before this half-moon. Laftly, through the points O and P, the diftance of 20 or 25 fathoms from the angles D and E, defcribe from the centre C a third arc, on which the third parallel is conftructed.

Of trenches.

Terminate the firft parallel by producing the faces *a b*, *a b* of the half-moons 1 and 2, collateral to the baftions A and B; but extend the parallel 15 or 20 fathoms beyond the interfection of this prolongation. The fecond parallel will be lefs extended than the firft, by about 30 fathoms on each fide; and the third alfo lefs extended than the fecond, by about 30 fathoms on each fide.

This being done, you have a fketch of the trenches and the places of arms. The bufinefs now is to trace the trenches, or approaches, without being feen or enfiladed.

Take a long ruler, and lay it on the point G, fo that it fhall make, with the produced capital EG of the baftion B, an angle EGS, whofe fide GS being produced, fhall meet no part of the covert-way, and fhall be diftant about 10 or 12 fathoms from the angles to which it approaches neareft. Take GS of an arbitrary extent, as of 200 or 220 fathoms, and put the ruler on the point S, fo that it fhall make with GS fuch an angle GST, as that the fide ST produced fhall not fall on any part of the covert-way, but be 10 or 12 fathoms diftant from the moft faliant parts. Terminate this fide in T, and there make alfo a new angle STI, whofe fide TI fhould terminate at the point I, where it meets the firft parallel. Perform the like operation on FH, and it will give you the outline of the trenches as far as the firft parallel.

At this part of the trenches you may make a greater number of turnings; you may likewife carry it in a direct line to the firft parallel. The moft important article is, to take care not to let it be enfiladed from any part of the covert-way; and the fewer angles and turnings it makes, the quicker it is conftructed, which in transferring it to the ground is worthy of great attention. Take care alfo, that its extremity, I, do not fall far from the point where the produced capital of the baftion meets the firft parallel.

By the fame method trace the trenches between the firft and fecond parallel, as may be feen in the figure; but as this part is nearer the place than the former, in order to avoid being raked, it muft have a greater number of angles. All its fides ought to cut the prolongment of the capital of the baftion B, as appears by the figure. In like manner trace the trenches betwixt the fecond and third place of arms, by making as frequent turnings on the produced capital of the baftion B, as fhall be neceffary, in order to its defiling from the covert-way. By the fame method trace the trenches on the capital of the baftion A; trace alfo a trench on the produced capital of the half-moon, between the fecond and third parallel, to reach the flanked angle of its covert-way.

When the garrifon happens to be ftrong and enterprifing, it will be proper, between the fecond and third parallel, to make parts of trenches V, V, &c. parallel to the places of arms; they are to be 30 or 40 fathoms long, and to communicate with the trench, as may be feen in the figure. Thefe parts of the parallels are what we have diftinguifhed by the name of *half parallels* or *places of arms*. At every angle of the trenches obferve to produce the part of the trenches in thofe places, fo that this prolongation fhall cover that part of the trenches which it terminates.

This will be illuftrated by an example.

Let ABCDFGNQ be a part of the trenches, and let AB be one of the fides oppofite to the enemy; produce AB, fo that BE fhall be five or fix fathoms; and in FG take alfo five or fix fathoms from I to L, which will give the

Plate DXXXI. fig 1.

of Sieges. the end of the trench BFLI, the use of which is to cover the *boyau* or branch IOMG, whereby the enemy will not know the place where it falls into the trench AB, and to make room for withdrawing those who are in this part of the trenches, and that the passage may be free at all the angles. In like manner produce the side GM from M to N, and the side IC from O to P, and you will have the end of the trench MNOP, which will cover the branch DCOQ. Do the same at all the angles of the trench.

The parapet of the trench being made to cover it, ought to change sides alternately. If, for instance, AE, in the preceding figure, is towards the place, it is evident that the side GN will be towards it also, and likewise the side CD; and therefore the parapet of the trench is successively constructed from the right side to the left, and from the left to the right. In the plans of attacks, the side of the parapet of the trench, as also that of the parallels, are distinguished by a stronger line than any of the rest; but the latter admits of no difficulty, because we may easily conceive that, being parallel to the place, its parapet must necessarily be on the side that faces it. Care has been likewise taken to express, as we have already mentioned in the figure, the parapet of the branches, by a stronger line than the other lines of the attacks. The side of the trench opposite to the parapet is called the *reverse of the trench*.

The trenches are generally no more than three feet deep; and their parapet, beginning from the bottom of the trench, is six feet and a half high, or thereabouts. The parallels have a parapet like the trench, and of the same height; but as they are intended for firing over, they are made with a kind of banquette, as may be seen Plate DXXXI. fig. 3. to raise the soldier, to the end that he may fire over the parapet. On the parapet of the places of arms are put baskets, fascines, or sand-bags, ranged in such a manner that the troops may be able to fire without being too much seen by the enemy. The third parallel, or place of arms, is generally wider than the rest. Sometimes the inside of its parapet is likewise made with steps or banquettes, to the end that the soldiers may conveniently pass over it in case of an attack. See fig. 4.

There will never be any great difficulty in tracing the attacks, from an exact plan, by observing the method we have made use of to make its parts defile properly. But the difficulty is to transfer the works from the plan to the field; for doing which the following plan has been recommended.

In the first place, the engineer must from all the angles of the branches of the trench, upon the plan, draw perpendiculars to the produced capitals; observing the distance of each of these perpendiculars and their length. He is then to walk about the place in the day-time, at a sufficient distance to be without the reach of musket-shot. It is not usual to fire cannon against a single man, because the shot is very uncertain, especially against a person who does not stand still for any time; therefore, without any great danger, he may only keep himself out of musket-shot. It is easy to discover the flanked angle of the bastions against which he wants to direct the attacks, and the saliant angle of the covert-way opposite to them; which gives two points, and these the direction or the prolongation of the capitals of those bastions. Consequently he has only to plant some picquets on the direction of these points, in order to have the prolongation of the capitals of the bastions. These picquets can only be put out of the reach of musket-shot; but by day-light he may observe something of the ground lying in the direction of these picquets, and he may afterwards reconnoitre it in the evening, in order to place picquets there also. In this manner he may have the prolongation of the capitals pretty exact.

In order to conduct the trench by these capitals, the following method has been pointed out by marshal Vauban.

Examine upon the plan of the attacks what distance there is from the beginning of the trench to the first perpendicular; measure this perpendicular and the side or part of the branch corresponding to it; take cords of equal length with these lines, and fasten the extremities of the two cords, one representing the length of the line of direction, and the other that of the branch which makes an angle with it, to a picquet at the point of the produced capital where the trench begins, and make two men walk, each of them holding one end of these cords, viz. one in a direct line towards the place, the other also advancing towards the place and walking alongside of the former. When the first comes to the farthest distance betwixt the opening of the trench and the first perpendicular, he must plant a picquet on this point, to which he is to fasten the cord which expresses the perpendicular. He must take the other end of this perpendicular, and afterwards turn off to the right or to the left, according to the side where the perpendicular ought to be, till the part of the cord expressing the perpendicular is well stretched, and joined to that end of the cord of the trench carried by the other man: at their meeting they are to plant a picquet, by means of which the triangle, thus transferred to the ground, will be like that which was taken upon the plan; and this part will be traced on the ground in the same manner as on the plan. In like manner may every part be traced in the beginning, when the trench is yet at a distance from the place.

Let the trenches be traced upon the plan (fig. 2.), and let C be the place against which you are to direct the attacks, transferring the plan to the ground: let BG be likewise equal to the line of direction of the plan; you are to plant along this line a sufficient number of picquets, with burning matches tied to them, in order to discover them the more easily.

To begin the tracing of the trenches, tie to the picquet G a cord of the length GS, and to the same picquet another cord of the length GX: let there be two men, and each take an end of these two cords, and let them walk, the one at a venture towards S, and the other directly to X towards the place along the line of direction BG; and having reached the end of his cord, let him fasten it with a picquet, after having drawn it very straight; and to this picquet let him tie one of the ends of the cord, which is to mark the perpendicular XS. Let him take the other end, and walk towards S till his cord XS is stretched very tight, and then let him join the man who holds the end of the cord GS, and let them fasten a picquet in S, where both the cords join. Let them afterwards take away the cord XS, the perpendicular which is of no use, and the cord GS which remains will mark the real tracing of the trenches. In order to have the line ST, you come to the picquet X; to which you tie a cord of the length of XY, and another to the picquet S of the length of ST. Let two men, as before, take each an end of these two cords, and let them walk, the first who holds the end of the cord XY directly towards B, and the other who holds the end of the cord ST obliquely towards T: he who holds the cord XY, having reached Y at the end of his cord, shall place a picquet there; to which let him tie the end of the cord of the perpendicular YT, and let him walk towards T, holding the end of this cord, till he meets or joins the man who holds the end of the cord ST; and at the point T of their meeting let them place a picquet, to which let them tie the end T of the cord ST.

4 After

After this take away the cord of the perpendicular, and thus continue the same operation as long as you please, or are able, in order to trace all the other turnings or windings of the trenches.

This whole operation supposeth that you know exactly the distance of the point G, the extremity of the line of direction to the top E of the saliant angle of the covert-way. This distance may be found by the common rules of trigonometry, or by the following simple method pointed out by marshal Vauban: Let A (fig. 5.) be the vertex of the saliant angle of the covert-way, and AB the line of direction of the trench whose length you want to take. At the point B, draw BC perpendicular to AB, to which give what measure you please, as 80 or 100 fathoms, and at the point C draw CD perpendicular to BC: In CD take any point E, and in the line of direction between it and the angle A place a picquet G in the line BC. Measure GC and CE, and say, as GC : BG : : CE : AB.

When once you have found out by this, or such other methods as you may make use of, the length of the line of direction EG (Plate DXXX. fig. 2.), you will be always able to know the distance that remains to the saliant angle of the covert-way, and to the points I, N, P, through which the parallels or places of arms are to pass. These points being determined, it would be an easy matter from geometry to find out a method of describing the parallels that are to pass through them, if their situation admitted the engineers to perform the operation quietly by day-light; but they are to be traced in the dark, and under the fire of the place; so that there is no other way to trace them than by approximation, that is, to move as nearly parallel to the circuit of the place as you can by your judgment; and to plant picquets, with cords tied to them at proper intervals, the whole length of the line. But you can trace with cords only the first parallel; for the others are too near the place to permit you to perform this operation: you are therefore to proceed in tracing them almost in the same manner, as we shall observe when speaking of the sap, to which they belong, and which is carried on by that method.

§ 6. *Observations on the properest Part for making the Attacks.*

While the lines are perfecting, the necessary materials are to be got ready for the construction and operations of the attacks. The materials consist of fascines, picquets three feet long and about an inch or two in diameter, gabions, and picquets for gabions. There must likewise be a provision of the several instruments or tools necessary for these operations.

The engineer, who has the direction of the siege, will likewise make use of this time to examine into the parts most convenient for carrying on the attacks, and where they will be most simple and expeditious. There are few fortresses in Europe of which plans are not to be had; but as it is presumed that the enemy hath increased the fortifications of a town which is threatened with a siege, care should be taken to get intelligence thereof from some skilful person that has been in the place, and made all the observations possible in regard to the works lately raised, without giving any suspicion of his intentions. The danger of such an undertaking is very well known, so that the person employed cannot be too cautious in keeping himself concealed.

While the circumvallation is making, the engineers may at a distance, or, as we have already observed, out of musket-shot, examine some part of the out-works; and afterwards, from the report of the person sent into the place, and from what they know themselves, they may settle with the general the properest and fittest place for carrying on the attacks. On this occasion there are many things to be observed, as well with regard to the ground as to the fortifications; but in a work of this nature, it is sufficient to consider the points of most importance. Of Sieges.

First of all, the nature of the ground about the place must be well observed, Whether there are any ditches or hollow ways, that may serve as a cover to guards of horse and foot against the cannon of the place; whether there are any parts that command the town, and may serve for the erecting of batteries; and whether the ground is fit for the works. The most favourable circumstance is to find a soil easy to dig; then the works advance with ease and less loss, because the soldier is soon under cover, and the cannon does not do half the mischief as in stony places. If the ground about the place is a pure rock, or a morass, the operations are extremely difficult; and there will be occasion for a vast quantity of fascines, sand bags, wool-packs, &c. because the workmen are in much greater danger.

The rivers which run through the town, or in the neighbourhood, likewise deserve consideration; for they separate the attacks, and it may happen by some stoppage of the water, or other accident, that the bridges of communication being broke down, the separation of the attacks will expose the army of the besiegers to be defeated, by which means the place may be relieved. It is proper also to inquire, whether those rivers are not subject to inundations, which, if they were to happen during the siege, and to break in upon the attacks, would oblige the besiegers to abandon the trenches, and to raise the siege. In a word, whether the town can command any quantity of water so as to make an inundation round the place, and to lay the ground appointed for the attacks under water. All these points, and a great many others which we do not mention, deserve the most serious attention.

After choosing the properest ground for the attacks, a general is to consider the front which is least fortified and least covered with outworks. All other things being the same, it is evident, that the fewer outworks there are, the easier will be the attack. But if the place be situated in a morass, or upon an eminence, then he must necessarily make his attack on the accessible side, be its outworks what they will. In a word, the whole choice of the attacks consists in finding out the properest ground, and the weakest side; but as it is to be presumed that the enemy are acquainted with the nature of the ground about the place, and therefore have taken care to fortify more exactly those parts which are most favourable to an attack, the besiegers should not hesitate to make their approaches on that side; where, by the situation of the ground, they may gain, what the increase of the fortifications might otherwise make them lose.

§ 7. *Of opening the Trenches.*

Every thing being ready for opening the trenches, the ground pitched upon, the attacks settled and drawn upon a plan, and stores or magazines of all the materials necessary on the occasion being within reach of the place where the pioneers propose to work; the general having also settled the round of duty for the guard of the trenches, both of horse and foot, as likewise the number of horse for bringing the fascines, with the number of pioneers and troops to support them; and the chief director of the engineers having acquainted the rest of the corps with his plan of attack, and the manner they are to act; in a word, every thing being ready for execution, the troops designed for the service of the first night being prepared and drawn up in battalia at the place of rendezvous, and the pioneers provided with fascines, picquets, shovels, and pick-axes;—in the dusk of the evening

Of Sieges

evening they all begin to advance, every ſoldier being obliged to carry a faſcine, together with his arms, in order to reach the place deſigned for opening the trenches. The guard of horſe march at the ſame time to their aſſigned poſts, to the right and left of the attacks, ready to ſupport the troops for the guard of the trenches in caſe of any ſally from the enemy. All this is to be done with the greateſt ſilence poſſible, and nothing ſhould be neglected to conceal the deſign from the enemy.

The pioneers are, according to marſhal Vauban, divided into brigades of 50 men each, commanded by a captain, a lieutenant, and two ſerjeants. They advance four or ſix abreaſt, near the place where the trenches are to be opened; after which the reſt of the troops that are to ſupport them, being come up, the engineers charged with the tracing of the trenches, and who are to place the pioneers, make them come forward where the opening is to commence, while the battalions that ſupport them are drawn up to the right and left in the places aſſigned them, where they unload their faſcines, and ſilently wait for further orders. In the meanwhile the engineers trace the branches of the trenches, and the firſt parallel in the manner already deſcribed, and the work is advanced as faſt as poſſible.

As much work is undertaken as the pioneers can be expected to perform this firſt night: and in proportion as the tracing goes on, the engineers place the pioneers, making them file off one by one, each carrying his faſcine under the right arm if the place is on the right, or under the left if it is on the left, to the end that by the poſition of their faſcines, which they lay on the ground along the tracing, and on the ſame ſide as they carry them, they may be enabled to diſtinguiſh the ſide of the place, that is, the ſide towards which they ought to throw up the ground in order to cover the trench from the fire of the town. As faſt as they are placed, they are ordered ſilence, and made to lie down with their face on the faſcines, and not to begin to work till commanded. The whole operation begins at the ſame time, that they may advance equally. When every thing is ready, and the pioneers are all placed along the tracing which is purpoſed to be made this firſt night, orders are again given for them to work; and then they all ſet about it with all the diligence poſſible till day light, that they may be covered againſt the fire of the place, which is ſtill very dangerous in the morning, conſidering that the trench has not had time as yet to be rendered ſo perfect as it ought. The troops that are to ſupport the pioneers are put under cover on the back of that part of the trench which is finiſhed; that is, on the border of the trench oppoſite to that on which its parapet is raiſed; they are made to lie on their faces; after which the pioneers, who have been upon duty in the night, begin to file off, and others fill up their places. It is very difficult this firſt day to render the trench as complete as it ſhould be; but no pains are ſpared to make it as complete as poſſible.

As the deſign cannot be now concealed from the enemy, the guard mounts the next day with drums beating about noon; and care is taken to continue the work of the trenches the ſecond night, in the ſame manner as the firſt, that is, by placing the pioneers uncovered, becauſe they are at ſuch a diſtance from the town, that the fire is not yet dangerous enough to require their being placed otherwiſe: the work goes on quicker in this manner; but it muſt neceſſarily be altered as ſoon as the workmen come within muſket-ſhot of the place.

The firſt night is the beſt adapted for advancing the works of the trenches, becauſe of the diſtance from the place, which is too great to apprehend any danger from the enemy's fire. Sometimes it happens ſo, that the enemy is not appriſed of theſe works; eſpecially when all the neceſſary precautions have been taken to conceal them, and in that caſe the buſineſs is done in a manner without loſs or danger. It is of importance to advance them with ſuch expedition, that they may be fit to receive the troops, who are to ſupport the pioneers, in order to cover them againſt the fire of the place; and as the firſt parallel is deſigned for this purpoſe, therefore it cannot be perfected too ſoon.

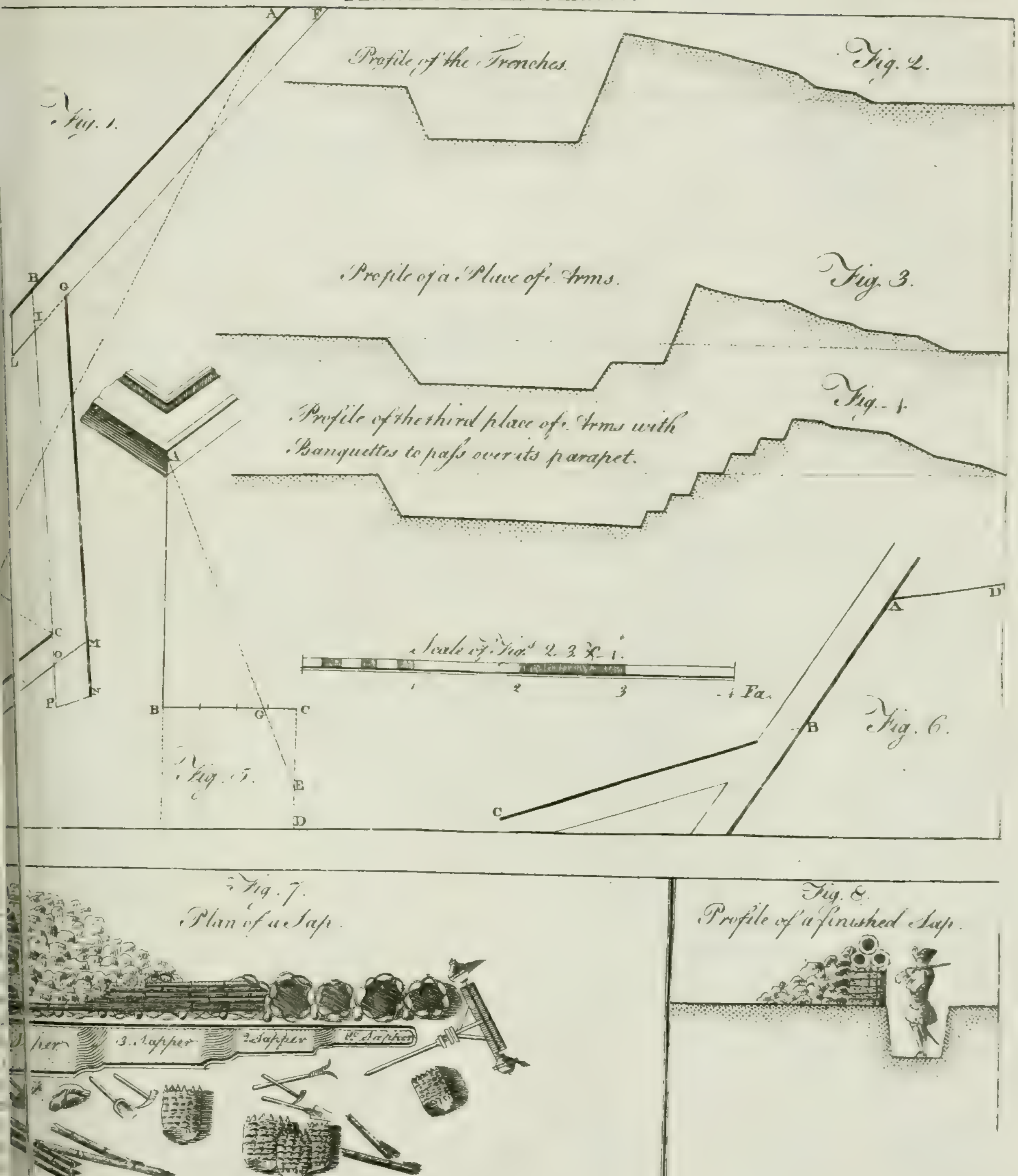
According to marſhal Vauban, the firſt place of arms, though begun the firſt night, has need of a ſecond and a third, before it can be completely finiſhed and in condition to hold the troops that are to guard the trenches; but the works for perfecting this line will not hinder the beſiegers from advancing to the ſecond parallel, which ought not to be begun till the fourth night. It is to be obſerved, that the guard who mount the trenches are changed every day; they mount about noon, and they are to be as ſtrong as ſhall be requiſite for oppoſing the ſallies which the garriſon of the place may make againſt the workmen. They are generally equal to two-thirds of the garriſon, becauſe the enemy may fall upon the trenches with that number, reſerving the other third to guard the town. But as it is poſſible that the beſieged may think proper to ſally forth with their whole force, and fall upon the workmen, together with the troops that ſupport them; therefore, in order to guard againſt every accident of that ſort, the troops in the trenches ought to be nearly equal to thoſe of the place, eſpecially in ſmall towns, where a few are ſufficient to guard the poſts, or where the burghers are ſo well attached to the prince, that the commandant may depend upon their fidelity in guarding the town; becauſe in that caſe he may make a general effort with his whole garriſon againſt the troops in the trenches.

We have obſerved, that the ſecond night the pioneers may ſtill be placed uncovered; but the third it would be very dangerous to do it, becauſe of the enemy's fire being too near. When the engineers are of this opinion, they take care not to expoſe the men any longer uncovered, and then the works are carried on by ſap.

§ 8. *Of the Sap.*

Let ABC be the part of the trenches advanced to A, ſo near the town as to render it impoſſible, without evident danger, to work any longer at the approaches, unleſs the men have ſome cover againſt the fire of the place: and let the branch AD be traced by the engineer, not with a cord, as at the opening of the trenches, but with ſome picquets, which he has taken care to place in the direction this branch ought to have, to ſerve as a guide to the workmen. A cut is made in the parapet BA of the trenches; and then the men deſigned to work by ſap, who are therefore called ſappers, will move forward through the opening A, ſucceſſively eight in number. The firſt is to roll before him a mantlet to cover him againſt muſket ſhot. He advances as far as is neceſſary to place a gabion on the line AD; and this gabion being ſet on its baſe, in the proper ſituation, with the picquets uppermoſt, the ſapper makes a little trench behind, about ſix inches diſtant from the gabion, of a foot and a half in depth, and as many in breadth, and he empties the earth of this ditch into the gabion. This done, he places a ſecond gabion near the firſt, in the ſame manner, and always under the cover of his mantlet; in like manner he makes a ditch behind, the earth of which ſerves to fill his gabion. Thus he places a certain number, till he grows tired of the operation.

The ſecond ſapper, who immediately follows him, widens the ditch made by the former by ſix inches, on the oppoſite ſide to where the gabions are placed, and makes it half a foot deeper. The earth he digs up ſerves to fill the gabions of

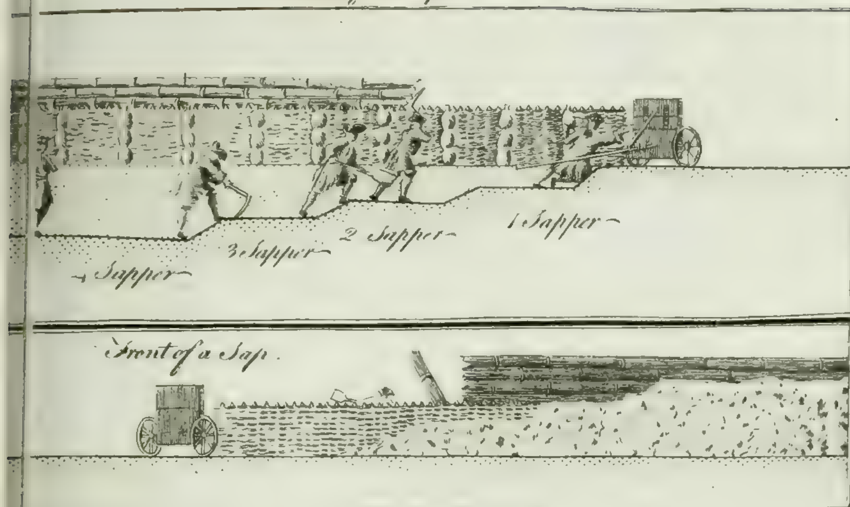


A. Bell. Prin. Wal. Sculptor Fecit.

Plate DXXXII.

Fig. 1.
Back of a Sap.

Fig. 2.
Profile representing the excavation of a Sapper



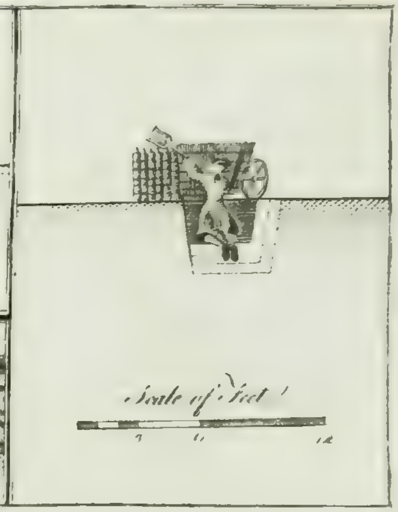
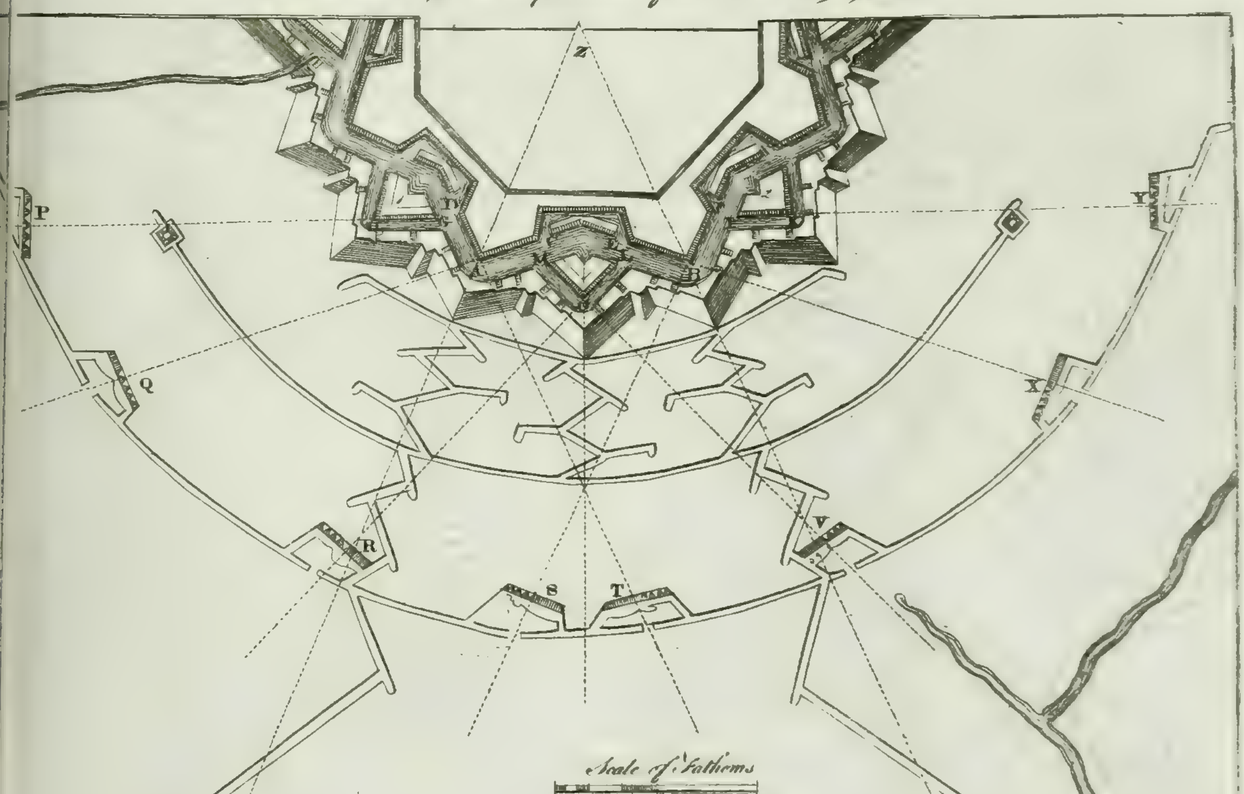


Fig. 3.
Plan shewing the disposition of the Batteries.



A. Bell Prin. Wal. Sculptor fecit.

of the firſt ſapper. The third ſapper widens the ditch of the two firſt likewiſe half a foot, and he deepens it in the ſame proportion.

At length the fourth enlarges it alſo in the ſame proportion, in breadth and depth; and then the trench is three feet wide, and the ſame in depth, which is as much as it ought to be. The earth dug up on this occaſion is ſufficient, not only to fill the gabions placed by the ſappers, but likewiſe to make a parapet of the reſt, which is thrown up, and is ſtrong enough to reſiſt muſket-ſhot. The third and fourth ſapper lay the faſcines over the gabions, with their hooks, or otherwiſe; then they preſs them down, ſo that the ſtakes of the gabions ſhall keep them firm. As the ſappers are ranged by brigades of eight each, while the firſt four are working at the ſap, in the manner above deſcribed, the other four furniſh them with gabions, faſcines, and whatever other things they want. But when the firſt four are tired, the four laſt take their places, and work in the ſame manner; after which they are relieved by the firſt, and ſo alternately, till each has performed his part at the head of the ſap.

When the firſt gabions are placed, and the ſap is not as yet perfected, the part in which the gabions touch one another being leſs ſolid than the reſt, their joints are filled up by ſand-bags, which are taken away when the work is completed, or thoſe interſtices are filled up with ſmall faſcines called *ſap-faggots*.

This is the nature of the ſap; a work ſo much the more conſiderable, as it is performed by day as well as night. Several ſaps are carried on at the ſame time; and there is one to both ſides of each of the attacks for the ſecond and third parallel. There are likewiſe ſaps to each of the advanced parts, and to the half-places of arms or parallels.

We have ſuppoſed that the firſt ſapper covered himſelf with a mantlet; this was the cuſtom formerly, and an excellent cuſtom; but now it is more uſual to have a ſtuffed gabion. He rolls this gabion before him, and uſes it in the ſame manner as he would the mantlet. Though care be taken to give a ſtuffed gabion to the directors of the ſaps, yet it happens ſometimes that the ſappers will not make uſe of them: for as the weight of this gabion renders it ſometimes troubleſome to roll, they chooſe to do without it; and are ſatisfied with rolling ſeveral gabions before them, near one another, and with working behind them. Theſe gabions are indeed of little defence, but are ſufficient to conceal them from the enemy, who cannot tell the gabion behind which the firſt ſapper is. But as the preſervation of theſe men is of great importance, they ought to be obliged to work behind the ſtuffed gabion: for the ſame reaſon, the firſt ſappers ſhonld have a cuiraſs, and even a head-piece, muſket-proof.

There are three ſorts of ſap; the ſimple, viz. that which we have been deſcribing, the double, and the flying ſap.

1. The ſimple ſap, or the ſap without any other appellation, is made on one ſide, or, which is the ſame thing, has only one parapet. 2. The double ſap has a parapet on each ſide, and is carried on wherever its two ſides are ſeen from the place. 3. The flying ſap is that in which they do not give themſelves the trouble of filling the gabions with earth; it is made where the workmen are not much expoſed, and in order to accelerate the approaches.

As ſoon as the men have brought the ſap to its proper perfection, the pioneers are ordered forward, and theſe make it of the ſame width as the other parts of the trenches; upon which it changes its name of ſap to that of trench. It is called a *trench*, if it ſerves as a way to the town; and a place of arms, if it be parallel to it, and deſigned to lodge troops. See Plate DXXXI. fig. 7, 8. DXXXII. fig. 1. 2. See alſo the upper compartment of Plate DXXVIII. for figures of the different inſtruments uſed in this and other operations of a ſiege.

§ 9. *Of Batteries.*

Cannon is made uſe of at a ſiege for two different purpoſes; the firſt to drive away the enemy from their defences, and the ſecond to diſmount their guns.

To produce theſe two effects, the batteries ſhould not be above the mean reach of cannon ſhot from the place; that is, above 300 fathoms. Therefore there is no poſſibility of conſtructing them till the firſt parallel is formed; and as the diſtance of this firſt parallel from the place is generally 300 fathoms, the batteries muſt be on this line, or beyond it, nearer the town. They muſt always be placed, when the ground will permit, on the produced faces of the works attacked, as we have mentioned in the maxims of attack.

Let Z be the centre of the place attacked, and the trenches, as well as the parallels, completed. To find a proper poſition for erecting batteries, produce the faces AD, AC, BE, BF of the two baſtions attacked, till their prolongation cuts the firſt parallel. Produce alſo the two faces OM and OL of the half moon MOL of the front attacked, and the faces HG and IK of the two collateral half-moons 1 and 2, to the firſt parallel, and erect batteries on theſe produced faces, as you ſee in P, Q, R, S, T, U, X, and Y. Plate DXXXII. fig. 3.

They are advanced beyond the firſt parallel 40 or 50 fathoms; and are parted from the trenches, to the end that they may be uſed with greater eaſe and convenience, and leſs trouble to the workmen.

§ 10. *Of Sallies.*

That we might not interrupt the making of the trenches, we conducted them to the foot of the glacis, without taking notice of ſallies; that is, attacks which the garriſon may make againſt the trenches, with a view of ruining or retarding the works. As it is not to be preſumed that the enemy will ſuffer themſelves to be ſtraitened in the town without uſing ſome endeavours to prolong the ſiege, and as ſallies ſeem to be one of the principal means they can employ, it is proper to point out the conduct to be obſerved, not only for preventing their effects, but likewiſe for rendering them diſadvantageous to the enemy.

Sallies can be attended with no ſucceſs, unleſs they are made at a time when unexpected. When the workmen are ſuddenly fallen upon, they are ſcattered, and obliged to fly; which muſt occaſion confuſion and diſorder among the troops that are to ſupport them; and it requires ſome time before they can be brought again to order, and made to charge the enemy. In the meanwhile the latter avail themſelves of the opportunity to fill up the trenches, and to do all the miſchief poſſible: but when the troops are upon their guard againſt every deſign of the enemy, if the latter ſtir out of the place, they are ſuffered to advance; and care is taken to cut off their retreat, by means of the cavalry and the picquet, in caſe they ſhould advance too far into the field: otherwiſe they are fired at from the places of arms, and other works within reach; and then they are briſkly attacked by the grenadiers and the troops upon duty in the trenches. Care, however, muſt be taken not to purſue them too far, for fear of the fire of the place, which never fails to be extremely ſharp when the enemy have got back to the covert-way.

In proportion as the works advance towards the town, ſallies become more dangerous to the beſiegers, becauſe the enemy may fall upon the trenches more readily; for which reaſon,

Of Sieges.

reason, double care should be taken to straiten them more closely, and to prevent their sallying out with impunity. As the works carried on beyond the second parallel are more exposed than the rest, because of their proximity to the covert-way, no part should be advanced without being well supported. Hence, as we have already taken notice, half-places of arms are formed, in order to support the head of the trenches, till they reach the third place of arms; which must be set about with the greatest care and expedition possible. When this is done in the manner it ought, there will hardly be any farther danger from the sallies.

Sallies are seldom made in the day-time but by a presumptuous enemy, who imagine they may safely attack and defy the troops on duty in the trenches: but they are easily repulsed, unless the besiegers are so weak as not to be able to furnish a sufficient guard for the trenches; in which case they ought not to continue the siege, lest they run a risk of being at length entirely defeated.

At the opening of the trenches, and when the besiegers are at a good distance from the place, there is little occasion to be afraid of any sallies in the day; for there would be full time enough to prepare to receive them before they reached the works. If the enemy are disposed then to issue forth, they will do it by night; but it will be an easy matter to get intelligence of any attempt they may make, by ordering parties of 10 or 12 men, headed by a serjeant, to range in the night between the trenches and the town.

These men may lie on their faces as near the place as possible; remaining in profound silence till they hear or perceive some motion in the covert-way; then they should send one of their own body immediately to acquaint the lieutenant-general who that day commands the trenches, and the rest should continue there as long as they can be concealed, to see which way the enemy direct their course. This caution is not only simple and easy, but sufficient to guard the besiegers against surprise, and to enable them to give a warm reception to the enemy.

When the works are advanced pretty near to the place, for instance, to the third parallel, if the enemy should then sally out and fall upon the workmen, the latter must be ordered to retire quickly to the back of the third place of arms, and let the guard fire briskly upon them, without minding the overturning of a dozen or two of gabions; for the galling fire of the small arms, to which the enemy are exposed during this expedition, will make them pay dearly for what little disorder they occasion.

§ 11. *Of the Lodgments on the Glacis, and the taking of the Covert-way.*

We left the works at the foot of the glacis, and at the third parallel; our business is now to make a lodgment there, and to go on with them till we have driven the enemy from the covert-way.

Our being then so near the covert-way, renders it impossible to defile from it; but in order to prevent the effect of enfilading, it is necessary to make the trenches much deeper in the glacis; the fire of the covert-way being very near, cannot plunge into those deep trenches, which renders it less dangerous to abide there than it would otherwise be were it not for this precaution: or they are made with traverses much in the same manner as in the covert-way, by which means the enfilading will be prevented in part, though not entirely.

In regard to the figure of the lodgment on the glacis, it varies according to the different circumstances or position of the works by which it is defended. The common way is to make several short turnings or zig-zags upon the ridge of the glacis, in the direction of the saliant angle of the covert-way, and continued to this angle; or you begin with making two or three short turnings towards the foot of the glacis, from whence you ascend afterwards by a direct trench, or sap, in the following manner.

Two sappers roll each a mantlet, or stuffed gabion, before them on the ridge of the glacis; each making a sap, one on one side of the ridge, and the other on the other. The ditch is dug deeper than usual, in order to cover them the better against the fire of the place. This work, which advances on both sides at the same time, and both sides covered, each with a parapet, is what we called a *double sap*. In the middle they make traverses three fathoms thick, and of the same breadth as the trench. On each side small passages are made like those overagainst the traverse of the covert-way, to the end that the communication thereof be not interrupted.

These traverses are constructed so near to each other, as to be a sufficient cover, by their elevation and distance, against the fire of the place. In order to guard against the effect of the grenades, upon coming within their reach, that is, within 14 or 15 fathoms of the covert-way, care is then taken to cover this trench with blinds, or, which is the same thing, to cover the upper part of it. The first and second figures of Plate DXXXIII. will show this direct trench. The first exhibits the plan, and the second the profile, which passes over one of the traverses.

All this being done, and the third parallel finished in the manner we supposed, they advance from this parallel upon the glacis to each of the saliant angles of the covert-way of the front attacked, and they begin with making two or three short turnings, as marked on Plate DXXXIII. fig. 6. along the ridge of the glacis, so as to occupy about one-third thereof. These are to be made as deep as is necessary, to be a shelter against the fire of the covert-way; afterwards they may proceed directly along the ridge of the glacis, by a deep ditch, to the saliant angle of the covert-way. M. Vauban observes, that if we follow directly the ridge of the glacis, this trench is made without much danger: for the palisade which is placed at the saliant angle of the covert-way, and the other two next it, do not present directly to the ridge, but only opposite to the faces; where at the most there is only room for one or two fusileers to see the head of the trenches, and who are easily silenced by the fire of the third parallel, which ought to be well served, and likewise by that of the ricochet.

Upon coming to the middle, or two-thirds of the glacis, two new saps are made, *b b*, *ibid.* which embrace both sides of the covert-way, to which they are almost parallel. Their length is 18 or 20 fathoms, and about five in breadth. They are covered at the end with crochets and winding traverses, which prevent the fire of the covert-way from enflading them easily.

The parapet of these saps is raised about eight or nine feet above the glacis; and by means of gabions, three banquettes are made, as may be seen Plate DXXXIV. fig. 5. The soldier placed on the upper banquette is thereby raised high enough to plunge into the covert-way, as appears from the same figure. When this work, which Marshal Vauban calls the *cavalier of the trench*, is once finished, it is very difficult for the enemy to remain anywhere in the covert-way; for they would be too much exposed to the fire of the soldiers placed on these cavaliers. But these places of arms or cavaliers cannot be made without being protected by the ricochet batteries, which enfilade the covert-way.

These cavaliers being once finished, it is easy to carry on the direct trench, as far as the saliant angle of the covert-way,

way, and to establish at the point of this angle and on the head of the glacis a small lodgment bounded by a circular arc; whence the enemy may be entirely driven from the saliant place of arms of the covert-way. Afterwards this lodgment may be widened on branches of the covert-way, by digging into the upper part of the glacis, at the distance of three fathoms from the inner side of the covert-way; to the end that this thickness may serve as a parapet to the lodgment, and screen it from the cannon.

The operation we have been describing, to reach from the third parallel to the saliant angle of the covert way, is formed at the same time against all the saliant angles of the front attacked: hence the enemy is obliged to abandon them almost all at the same time; and the lodgment on the glacis is afterwards advanced on both sides of these angles, towards the re-entering places of arms of the covert-way.

As it is impossible to make this lodgment defile from the works of the place, there is no other way to guard against the enemy's fire than by many traverses. The 5th figure of Plate DXXXIII. shows the plan of part of this lodgment with its traverses; which are made with chandeliers and gabions. If the enemy, notwithstanding the cannon and bomb-batteries *à ricochet*, and the fire of the cavaliers of the trenches, should obstinately continue in the re-entering places of arms of the covert-way; in order to compel them to remove, batteries for throwing of stones are raised over against those places of arms: and with this view, as soon as the lodgment of the glacis is brought within one-half or two-thirds of the branches of the covert-way, on both sides of the re-entering angle, a sap is carried on opposite to the place of arms; and on this sap batteries for throwing stones are erected, as may be seen in *cc*, Plate DXXXIII. fig. 6. These batteries being finished and ready to play, they discharge a shower of stones into the place of arms (fig. 6.), which will not suffer the enemy to maintain themselves there any longer. The lodgment continues to advance; and as soon as the enemy is driven from the place of arms, it is continued all round the faces thereof. This lodgment being properly finished, will hinder the enemy from venturing to return to the covert-way; and of course will secure the possession of it to the besiegers. These lodgments are made with gabions and fascines; the gabions are filled with earth, fascines are put over them, and the whole is covered with earth; they sink into the glacis as deep as is requisite to be covered against the fire of the place.

In the whole of this account we have not made use of mines; because we were willing that the description of the works, which are carried on from the third parallel, in order to become masters of the covert-way, should be as plain as possible. This omission we shall now supply, by making mention of the principal difficulties occasioned by mines, in endeavouring to drive the enemy from the covert-way.

Without mines the enemy would find it very difficult to retard the works we have been describing; because the ricochet batteries must gall them excessively, and break up their defences, so as to deprive them of all shelter: but they may have some resource left in works under ground, where their miners can proceed with more safety; while those of the besiegers, not having the same knowledge of the ground, can only grope in the dark; so that it is altogether a mere chance if they find out the enemy's galleries, and succeed so as to destroy them. If information is received that the glacis is countermined, there can be no manner of doubt but the enemy will avail themselves of their countermines, to carry branches forward into the field; and then to avoid, as much as possible, the mischief that may be done by those subterraneous fires. In the third parallel shafts or pits are sunk 18 or 20 feet deep, if the ground will permit, in order to get below the galleries of the besieged: and from thence galleries are carried on towards the covert-way, to meet with those of the enemy, by boring the earth with a long iron needle or augre, to find them out. If they are found underneath, an opening is made down upon them, and shells are thrown in, to drive away the enemy and to ruin their gallery. If, on the contrary, they are found above them, a small mine must be sprung to break them: but if none of the enemy's galleries can be found, in that case branches must be carried to the right and left; at the end of which are made small chambers, to shake the neighbouring ground, which can hardly miss destroying the galleries and chambers of the besieged.

Of mines.

Notwithstanding all the care that can be taken in this case, it is not to be presumed that the mines of the besieged under the glacis should be rendered absolutely ineffectual; but as soon as any of them are sprung, workmen are immediately sent to make a lodgment in the pits. In some grounds, the mines of the besieged may be spoiled, by letting in a brook or rivulet into the galleries; for which purpose you have only to dig pits in the neighbourhood, and let the water run in. The expedient was made use of at the siege of Turin in 1706, whereby a great many mines of the besieged were rendered useless.

The enemy should have mines placed, to hinder the lodgment on the head of the glacis, within four or five fathoms of the palisades of the covert-way; to the end that in springing them the palisades may not be hurt, but that they may be under the lodgment which the besiegers make there. When they have sprung the mines, they make lodgments in them; and the besiegers likewise on their part spring mines, with a view to destroy the palisades; but nothing that is not very general can be said on this sort of contests. They depend on the situation of the ground, and upon the capacity and understanding of those who attack, and those who defend the place.

Before we made mention of mines, we supposed, when treating of the lodgment on the top of the glacis, that the fire of the cavaliers of the trenches, together with the cannon and ricochet bomb-batteries, had obliged the enemy to quit the covert-way; but if, notwithstanding these fires, they should obstinately continue in the places of arms and behind the traverses, the way to drive them entirely from thence, and to make the lodgment we have been speaking of upon the glacis, is as follows.

Whether the enemy has sprung a mine near the saliant angle of the covert-way, or the besieged have blown up some of the palisades near it, as soon as the mine is sprung, workmen must be sent to the excavation; where they are to cover themselves with all possible expedition, and afterwards to extend their lodgment in the covert-way on both sides of its saliant angle.

The double trench, or the double sap on the ridge of the glacis, must be made to communicate with this lodgment, in order to be able to sustain it if there should be occasion, and to communicate with it more safely. Particular care must be taken to cover the extremities of it, that is, to make traverses everywhere, in order to be sheltered from the fire of the other parts of the covert-way, where the enemy still maintain themselves.

When this lodgment is extended to the first traverses of the covert-way, if the enemy keep their ground behind it, as there can be but few under cover there, considering the space they have to occupy, a company of grenadiers must make a brisk attack to drive them away: this done, some of those grenadiers should endeavour to find out in the part abandoned

Of Sieges. abandoned by the enemy the entrance into the mine, and the Saucisson; and upon finding it, as there is great probability that they will, they are to cut it off, and thereby render the mine useless. Workmen may be likewise sent into the passage round the traverse, and there make a small lodgment, which will be the safest that can be contrived when the enemy is so very near. After this an entrance is to be dug in the covert-way opposite these traverses, and continued towards the bank of the ditch, under cover of the traverse: then a sap is to be made from each of the extremities of this passage, that is, near the border of the counterscarp; which are to be carried along the rounding of the counterscarp towards the middle, where they are to meet. This lodgment must be made very deep, that it may be no hinderance to that on the head of the glacis; and it is to be managed so as to leave between it and the border of the ditch a breadth of earth sufficient to resist the cannon of the flanks and the curtain. This lodgment must be also covered with blinds, to prevent the effect of the grenades; and it is of great use towards an opening into the ditch.

During the whole time that the besiegers are working upon this lodgment in the interior part of the covert way, they are to continue the lodgment on the top of the glacis, as far as the re-entering places of arms; from whence the enemy may be driven by ordering a few companies of grenadiers to attack them, supposing they should be so obstinate as to continue there, notwithstanding the fire of the ricochet batteries, and of the shells and stones. As soon as the enemy have entirely withdrawn themselves, a lodgment must be made there, as we have already mentioned.

§ 12. *Attack of the Covert-way sword in hand.*

There is another method of driving the enemy out of the covert-way, more expeditious indeed, but at the same time more bloody, more precarious, and infinitely less skilful. This consists in making a sudden attack on the whole front of the covert-way, in driving the enemy from thence by main force, and afterwards making good a lodgment.

There may be circumstances that shall absolutely require this method of attacking the covert-way; as when there is no possibility of erecting ricochet batteries to fire at its branches, nor at the faces of the works in the front of the attack; or when it is presumed that the enemy are not in a condition to withstand an attack of this sort; or, in fine, when it is thought expedient to run any hazard in order to be masters of the covert-way a few days sooner: on such occasions it is usual to take this method of attacking it, which is conducted thus:

When the resolution is taken to attack the covert-way sword in hand, the third parallel should be made to advance as near as possible to the glacis; and the more forward it is brought, the safer the attack. All along this parallel banquettes are to be made, step-fashion, to the top of its parapet, that the troops designed for the attack may pass over it with ease. At the back of this line, and in the very line itself, a great quantity of materials, as tools, gabions, fascines, sand-bags, &c. must be got ready, that nothing may be wanting to make the lodgment with all expedition, after driving the enemy out of the covert-way. A strong party of grenadiers is ordered, and placed along the third parallel, four or six deep, and the workmen behind them on the back of this parallel with their tools, gabions, fascines, &c. Care, moreover, is taken, that all the other parts of the trenches be well furnished with troops to support the grenadiers, if there should be occasion; and to fire at the enemy's defences wherever they appear: the grenadiers must also be provided with hatchets, to cut down the palisades of the covert-way.

Plate DXXXI fig. 4.

The guns and mortars must be ordered to be ready to support the attack with their whole fire.

A signal is to be agreed on for all the troops that are to commence the attack, to move at the same time, and to fall upon the enemy. This signal is to consist in firing a certain number of cannon, or a certain number of bombs, and at the last cannon-shot, or at the last bomb, the troops are to move.

The signal being given, all the troops of the third parallel are to move at the same time, and to pass quickly over the parapet of the parallel, and to march directly to the covert-way; which they enter either through the sally-ports or passages made by the guns, or else the grenadiers cut down the palisades with their hatchets. As soon as they have entered, they charge the enemy vigorously; and when they have obliged them to abandon some of the angles, the engineers set the workmen about making a lodgment on the ridge of the glacis, opposite to that part of the covert-way which the enemy have abandoned, and within three fathoms of the inside of it. This lodgment, as we have observed, is made with gabions, which workmen lay on the glacis on the side of one another. The joints are covered with sand-bags, or with sap-faggots. These gabions are filled with earth and covered with fascines; and a-top of all you are to throw earth taken out of the glacis, by digging and widening the lodgment; and of this a parapet is raised to screen the troops as quick as possible from the direct fire of the place, and traverses are to be made everywhere to prevent the enfilades, as may be seen in Plate DXXXIII. fig. 5. While this is doing, the batteries of the trenches are to fire incessantly upon the defences of the place, in order to disturb the enemy, and to abate as much as possible the briskness of their fire upon the workmen and the lodgment.

When the troops employed in the attack have driven the enemy from the covert-way, or from their places of arms, they retire behind the lodgment, where they kneel down till it is in a condition to cover them. Sometimes it shall happen that the enemy, who was supposed to have been driven from the covert-way, will return to the charge, and oblige the besiegers to renew the attack, by overthrowing the lodgment and falling upon the troops unawares. This attack may be renewed several times, and vigorously disputed, when there happens to be a strong garrison. In this case the besiegers must exert their bravery, and resolutely encounter every obstacle raised by the enemy.

It must be allowed that this manner of attacking is very bloody: for the besiegers must move almost the whole breadth the glacis uncovered and exposed to the whole fire of the place. It is indeed in every respect so inferior to the former, that, according to M. Vauban, it never should be attempted but for the most essential reasons. Night is the best time for it, because the besiegers are less seen from the place, and of course the fire of the besieged is less dangerous: yet there are generals who undertake it by day. There is nothing settled in regard to this article; they are at liberty to act as they judge most proper, according to the circumstances of time and place.

§ 13. *Of the Batteries on the Covert-way.*

When the enemy are entirely driven out of the covert-way, the next thing to be done is the erecting of batteries, in order to ruin the defences of the place, and to make a breach.

As it is necessary for the besiegers to make themselves masters of the half-moon C (Plate DXXXIII. fig. 6.) before they can come to the body of the place, which is flanked or defended by part of the faces of the bastions A and B opposite to its ditch; they must begin with erecting batteries on

on the covert-way oppofite thofe parts. They are marked on the plan e, e. Batteries muft be alfo erected to make a breach in the half-moon. But before they are erected, it will be proper to confider what part of the face of the half-moon is to be attacked; or, which is the fame thing, what part the half-moon is to be entered. It muft not be at its flanked angle, becaufe an opening towards the point would not afford a fufficient fpace to make a lodgment able to withftand the enemy, and moreover the troops would be feen in their paffage by the two faces of the baftions by which its flanked angle is defended. The moft favourable paffage is towards the third part of its face, reckoning from its flanked angle; becaufe by battering at the fame time the two faces near this part, the whole point of the half-moon may be deftroyed, and a large opening made there eafier than anywhere elfe. Thus the batteries for making a breach in the half-moon C will be placed in d and d, and will occupy almoft the third part of each of the faces of the half-moon from its flanked angle. Thefe batteries are each to confift of four or five pieces of cannon.

When the faces of the baftions A and B are well enfiladed by the ricochet batteries, there will be no occafion for the batteries e and e; for thofe which are to batter the half-moon in breach will be fufficient; and after it is taken, if there is any neceffity for ruining the faces of the baftions A and B, you may make ufe of the batteries d and d, by placing them in e, e. Batteries muft alfo be erected to ruin the flanks of the demi-baftions in the front of the attack. It is evident that they cannot be placed but in i, i, on the covert-way oppofite to them. They ought alfo to contain as great a number of guns as the fpace of ground will permit.

For the fame reafon that batteries have been erected to make a breach in the half-moon, oppofite the third part of the face joining to its flanked angle, thofe alfo are to be erected which are to make a breach in the baftions; they are marked h, h, and are each of feven or eight pieces of cannon. Batteries are likewife erected to ruin the flanks of the demi-baftions bordering upon thofe of the front attacked, in order to favour the paffage over the ditch which is made on the fide, upon a fuppofition that the baftion is entered at both faces, as we fuppofe in this example. The attacking both faces of the baftion renders the taking of it more certain and eafy; but, generally fpeaking, it is looked upon as fufficient to make only a breach in the face of the earth of the demi-baftions towards the front attacked.

Befides all thefe batteries, others are erected in the re-entering places of arms of the covert-way, as in k, and in k; they ferve to batter the tenaille when there is one, the curtain, and the faces of the baftions, &c. Sometimes they are of mortars for throwing of ftones.

All thefe batteries fhould have 24 pounders; fometimes larger pieces are ufed, efpecially when there is any work of extraordinary ftrength and folidity to be demolifhed.

They are all to be placed on the parapet of the covert-way; and the outfide of their epaulement is to graze the infide of the covert-way. It is in order to have room enough for this epaulement, that the lodgment is made on the ridge of the glacis at the diftance of three fathoms from the infide of the covert-way.

The only effential thing to be obferved in thefe batteries, is to open their embrafures, fo that they fhall perfectly difcover every part of the place they are to batter, and have a fufficient floping from the back to the fore-part, to fire as low as the bottom of the revetements (c), which they are intended to deftroy. It is alfo proper to prevent the enemy's blowing them up with mines: for this end it will be requifite to dig wells deep enough round the batteries, fo as to be fure of being lower than the enemy, and to make fmall galleries round the batteries, in order to difcover the branches the enemy have underneath to blow them up.

As the conftruction of this fort of batteries is very dangerous, being abfolutely to be made under the fire of the rampart of the place, they are fometimes masked; that is, before the part where they are erected, fand-bags or fome other materials are placed, with a view to fhelter the workmen from the enemy.

In order to batter in breach, all the guns fhould fire together, and towards the fame part. They fhould fire as low as they can, and continue to batter the fame part, till the earth of the rampart behind the revetement begins to fall, which is a fign that the revetement is entirely deftroyed. This united firing, repeated in this manner againft the fame place, is productive of a much better effect than if the guns were to be fired one after the other; for not only a greater quantity of the wall is fhaken at the fame time, but, moreover, the fhaking is far more confiderable.

§ 14. *Of the defcent, and paffage over the Ditch of the Half-moon.*

While the batteries on the covert-way are erecting, preparations are made for the defcent and paffage over the ditch of the half-moon.

The ditches are either dry, or filled with water, which may be either ftagnated, or running; and even into dry ditches the enemy may let in water, only opening the fluices by which it is withheld. Each of thefe forts of ditches requires a different manner of paffing.

Firft of all, if the ditch be dry, and very deep, as from 25 to 30 feet, the defcent may be made by one or feveral fubterraneous galleries, paffing under the covert-way, and terminating at the bottom of the ditch: the entrance is to begin about the middle of the glacis. Thefe galleries are made like thofe of miners, and the earth is fupported by boards and timber frames. They are directed in fuch a manner, that the opening in the ditch fhall be oppofite to that part of the breach where the paffage is intended.

As this gallery is made floping, the bufinefs is to have fome rule for directing the flope, fo as to prevent its being too fmall or too great: too fmall, if it terminated above the bottom of the ditch; and too great, if it terminated below it.

The following is a moft fimple way to find it out: Firft of all, it is requifite to take the depth of the ditch; which is done by letting fall a plummet, with a ftring tied to it, from the border of the covert-way to the bottom of the ditch. It is requifite alfo to know the diftance from the entrance of the gallery to the border of the covert-way, which may be eafily meafured thus: Suppofe the depth of the ditch is 30 feet, and that the diftance from the entrance of the gallery to the border of the ditch is 90 feet, then by advancing fix feet towards the counterfcarp, the flope muft fink two; that is, there muft be always the fame proportion between the length of the paffage made to approach the counterfcarp and the depth of the flope, as between the diftance from the entrance of the gallery to the border of the

(c) The revetement is a ftrong wall built on the outfide of the rampart and parapet, to fupport the earth, and prevent it from rolling into the ditch.

Of Sieges. the counterfcarp and the depth of the ditch : fo that if the diftance from the entrance of the gallery to the border of the counterfcarp is four times as much as the depth of the ditch; then for every four feet advanced horizontally towards the ditch, there muft be one funk perpendicularly, &c. When the ditch is not deep, as of 12 or 15 feet deep, inftead of a gallery under ground, the defcent is made by a fap only, which cuts the parapet of the covert-way, and finks therein as deep as is neceffary for the defcent to terminate at the bottom of the ditch. This fap muft begin at the lodgment on the ridge of the glacis; it is fecured on both fides with blinds, to fupport the earth, and it muft have a good epaulement on the fide expofed to the place. Above it is covered with fafcines and with earth, to avoid the fhell-ftones and grenades that may be thrown in by the enemy. Upon advancing to the foot of the counterfcarp, an entrance is made into the ditch. There are generally two or three defcents made for the fame paffage of the ditch, near enough to fupport each other for greater fafety.

It is in the paffage of the dry ditch that the enemy has the advantage in making ufe of various artifices to retard it. In thefe they are chiefly affifted by their miners, who blow up the faps by means of fmall mines, and fally out at the fame time, neglecting nothing that can delay the progrefs of the work. They may likewife order 12 foldiers to fall at once upon the head of the fap : this number is fufficient to drive away the fappers, and to do fome damage to that work. A few companies of grenadiers fhould be placed near at hand, to attack thefe men as foon as they appear ; and the cannon muft be kept continually firing againft every part, from whence the enemy may poffibly fally out. As the batteries of the covert-way command all their communications, they may deftroy them, or at leaft render them very dangerous.

In order to protect the fap at the bottom of the ditch, the befiegers may likewife make ufe of a kind of fmall galleries behind the counterfcarp, near the place where the entrance is effected; and they may pierce fome loop-holes, from whence the enemy may be fired at, and a check put to their fallies, at leaft by day : and in regard to night, the befieged ought to be more circumfpect than by day, fince they can neither fee the difpofitions nor the troops that are ordered into the ditch to fupport the fappers; fo that they can only raife a falfe alarm, without doing any great mifchief. Yet we muft obferve, that this paffage can be made only fo far as it is protected by the battery placed on the ridge of the parapet of the covert-way oppofite the ditch : for as the cannon of this battery keeps continually playing againft the defences of this ditch, they muft ruin them of courfe, and deftroy their parapet, fo that the enemy fhall no longer be able to keep any cannon there; the confequence of which will be, that the befiegers have only to fcreen themfelves from mufket-fhot, which is an eafy matter.

The paffage of the ditch is made on each fide of the faces of the half-moon, as may be feen in *m*, *m*, fig. 6. Plate DXXXIII.

If the ditch is full of ftanding water, and the furface of it be raifed to three, four, or five feet, below the upper border of the counterfcarp, the defcent will be eafier; becaufe as the fteps are to have but a very fmall flope, they may begin nearer the border of the ditch, as in the lodgment on the ridge of the glacis, and be directed in fuch a manner as to terminate at the furface of the water. They are to be covered on the fide expofed to the place, and ftrongly fecured with blinds, placed within five or fix feet of each other. Blinds are likewife to be laid over the defcent, which is to be covered with fafcines, and thefe with earth, to prevent the enemy from fetting them on fire.

In order to pafs this ditch, a bridge muft be made with fafcines; for which end, after breaking the counterfcarp, a number of men, fufficient to occupy the whole length of the defcent, are ranged at the diftance of two feet from each other: thefe men muft be covered by the parapet, and to forward the fafcines from hand to hand, from the head of the paffage to the opening into the ditch. The fapper in this part (for all thefe works relate to the fappers) will throw them into the ditch, in order to make an epaulement or covering on that fide of the town which looks towards the paffage.

As foon as he has flung in a fufficient number of fafcines to fhelter himfelf, and to advance a few paces into the ditch, he muft throw a great number of them into the paffage, in order to fill the ditch up entirely in that part.—They are laid different ways, and ranged in different beds; which are covered with earth, in order to make them fink to the bottom. All thefe different beds of fafcines muft be fixed with long ftakes, that they may keep clofer together: and as the work advances, the parapet muft be pufhed forward, otherwife it would be impoffible to effect the paffage without the utmoft danger.

When the paffage is commanded, or fired into from the oppofite parapet of the place, or from any other part, the foremoft men muft be covered with a great heap of fafcines, or by fome other contrivance; but whatever cover it be, in that cafe the paffage of the ditch is extremely difficult and dangerous.

After what has been faid concerning the paffage of dry ditches, and thofe which are full of ftanding water, it remains to take notice of thofe which are full of running water, and thofe that are dry but may be filled at any time with water. Thefe forts of ditches are extremely difficult to pafs, unlefs the current can be turned and made to take a different courfe from that which carries it to the town ditches, or unlefs the befiegers can contrive to break down the fluices which keep up the water referved by the enemy for filling the ditch.

A great deal might be faid, were we to enter into the whole detail of the works neceffary for paffing thefe forts of ditches; we fhall only touch upon the fubject.

Suppofing the ditches to be filled with running water, or with a river, the channel of which can be diverted no other way, which is called *draining the ditch*, it will be requifite then, generally fpeaking, to throw into the ditch a large quantity of fafcines, loaded with earth and ftones, faftened together with long ftakes: thus the paffage is to be pufhed on, till the ditch is contracted to the breadth of 20 or 30 feet; and then fmall beams may be laid acrofs, to join the bridge of fafcines to the rubbifh of the breach. The filling up, and confequently the paffage of the ditch, may be alfo forwarded, by ordering the miners to advance to the rubbifh, and to fpring a mine, in order to blow up part of the revetement of the work into the ditch.

Should the enemy happen to have refervoirs of water which they may open, and thereby deftroy the lodgments in the ditch when they are no longer to make a ftand there, the befiegers muft endeavour during the fiege to deftroy the fluices, that is, the ftone-work or timber that ferves to keep up the water. This may be done by throwing a great number of bombs towards that part where the fluices are known to be fituated; if they fhould be broke down by that means, then the water will have a free current; and after it has run off, the paffage of the ditch muft be attempted in the fame manner as if it was ftanding water; if there remains only a very fmall current, a paffage muft be left to drain it, as was mentioned before.

This whole operation is very tedious, difficult, and dangerous;

gerous; nay, it is impossible to be done at all without being protected by a very brisk firing, not only from all the cannon of the covert-way and the ricochet batteries, but moreover from the lodgments on the glacis and those on the covert-way.

Plates DXXXIV. and DXXXV. will illustrate all that we have been saying upon this head, concerning the descent and passage over the ditch.

Plate DXXXIV. fig. 1. exhibits the plan of the descent under ground, and that of its opening into the dry ditch. Fig. 2. represents the profile of that descent; the opening of which is made at the lower part of the ditch. Fig. 3. is a perspective view of the opening of this descent, seen from the bottom of the glacis: and fig. 4. shows in perspective the opening of the same descent, seen from the top of the breach.

Plate DXXXV. fig. 1. is the plan of the passage over a wet ditch in the open air; that is to say, the gallery of which is an open sap. A is the opening of it. You see in B, towards its opening, the blinds that are laid on its upper part, to support the fascines with which it is covered. On these blinds, at first, is laid a bed of fascines, ranged according to the length of the gallery: over this first bed is laid a second, wherein the fascines are ranged according to the breadth of the gallery, as you see in B and C. D is the epaulement of fascines, which covers the passage against the fire of the place, by which it is flanked. E is part of the bridge of fascines; and F is an elevation also of fascines, intended to cover the head of the work, and to secure it from the immediate fire of the place. Fig. 2. represents the profile of this descent into the ditch. Fig. 3. gives its opening seen in perspective from the country; and fig. 4. its opening into the ditch, also in perspective, as it appears from the top of the breach.

§ 15. *Of the attack of the Ravelin, or Half-moon.*

The passage over the ditch before the half-moon being effected on both sides, and a breach made 14 or 15 fathoms wide, preparations are made for the assault. For this purpose a large quantity of materials is collected from all the neighbouring lodgments. Endeavours are used to render the breach practicable, by making the slope easy. The cannon continue playing, in order to throw down the parts of the revetement that may be yet standing. Very good use may be also made of shells fired point blank; for they are easily buried in the breach, the earth of which has been already broke up and shaken by the cannon; and as they burst upon that earth, they produce the effect, as it were, of small mines. Howitzers may likewise be used with success on these occasions.

In order to render the breach more practicable, some miners, or a serjeant with a few grenadiers, are sent to level it with hooks. The fire from the lodgments and batteries will hinder the enemy from appearing on their defences; or if they should, they must do it with great circumspection, which renders their fire less dangerous.

If the enemy have made any galleries along the face of the half-moon, and opposite the breaches, the miners may go and discover them, in order to stop them up, or to cut off the match, or to drive away the enemy: if they cannot find them, they spring several mines; which being often repeated, must needs occasion some disorders in the galleries and mines belonging to the besieged. Every thing being ready for making a lodgment in the half-moon, that is, for taking possession of the breach; the materials being at hand, in order to be removed hither with ease and expedition; the batteries and lodgments of the covert-way being in a condition to fire away briskly;—a signal is agreed upon with the officers that command those batteries and lodgments, to give them notice to fire, and to leave off whenever it is thought proper. This signal is generally a flag raised in the former case, and lowered in the latter. All this being settled, and the breach, as we observed, made practicable, two or three sappers are sent to the extremity of the breach next to the place, there being generally a kind of small cover or cavity in this part; there they begin a lodgment for themselves, and for some more, who are sent after them; when there is room to receive them, they make them mount, and insensibly extend the lodgment upon the top of the breach; and thus they proceed till they make a lodgment towards the point, which is generally called a *magpye's nest*. While these sappers are at work, the fire of the batteries and the lodgments ceases; but when the enemy attempts to attack the workmen in order to destroy their lodgments, they must retire as quick as possible; and then the colours being raised, the batteries fire upon them with the utmost vivacity, to oblige them to quit the upper part of the breach.—Upon this the colours are lowered, the fire ceases, the sappers return to repair the mischief that was done to their lodgment, and try to enlarge and strengthen it.

This way of proceeding must be continued till the lodgement is in a state of defence; that is, till it can hold a number of troops sufficient to awe the enemy, and to withstand any attack that may happen to be made against it. The besieged, before they entirely quit the half-moon, will spring what mines they have ready there. As soon as this is done, the besiegers should directly lodge themselves in the excavations made by those mines, or at least some defence should be made there, to hold a few sappers, and to forward the lodgments of the inside of the work.

The lodgment of the point is made in the form of a small arc, the concavity of which is turned towards the place. From each of its extremities a lodgment is carried along the faces of the half-moon, on the platform of its rampart, at the foot of its parapet. This lodgment is sunk deep in the earth of the rampart, to the end that the soldiers may be the better covered against the fire of the place; there must be also traverses to secure it from the enfilades, as was done in regard to the lodgment on the glacis. Withinside the half-moon lodgments are also made, which traverse the whole breadth thereof, as may be seen in the half-moon *C*, Plate DXXXIII. fig. 6. They serve to command the communication between the tenaille and the place; of course to render that communication more difficult, and to hold a sufficient number of troops to resist the enemy, should they have any design to return and repossess themselves of the half-moon.

What we have been observing, in regard to the attack of the half-moon, is only when the besiegers intend to take it by the sap, or with pick-axe and spade: But sometimes they go about it in a more expeditious manner: for when the breach is made so as the troops may mount to enter the half-moon, they advance boldly to the assault, just as in the attack of the covert-way, sword in hand, and endeavour to come up with the enemy, and to drive them entirely out of the work. This attack is very dangerous, and may cost a great many men, when there happens to be a brave garrison, who will not easily yield their ground. But there are frequent cases in which it may be thought prudent to adopt this measure, in order to accelerate a few days the taking the half-moon. As soon as the besiegers are masters of the upper part of the breach, they make a lodgment there in a hurry with gabions and fascines; and while it is making, as also while they charge the enemy, and oblige them to abandon the upper part of the breach, some soldiers are sent to discover the mines, which the besieged are supposed to have made within

Of Sieges.

within the rampart of the half-moon, and to cut off the faucisson. If they cannot find them, they muſt advance with great circumſpection, and take care not to keep all together, that the mine may have leſs effect. Oftentimes the enemy will ſuffer the beſiegers to carry on their lodgment without making any great oppoſition, becauſe it cannot be effected without a conſiderable loſs of men; but when the lodgement is advanced, the enemy ſpring their mines, and return afterwards to the half-moon, in order to take it amidſt the confuſion which thoſe ſubterraneous fires muſt unavoidably occaſion among the troops in the lodgment; in that caſe, it will be requiſite to renew the charge moſt vigorouſly with freſh troops, which ſhould be at hand to ſupport thoſe of the half-moon, to place themſelves in the excavations made by the mines, to render the lodgment ſufficiently ſtrong, and to ſecure it with a proper number of ſoldiers, ſo as to be able to withſtand any further attempt of the enemy.

This work can hardly be diſputed in this manner, except when the half-moon has a reduit (D), as it affords a ſhelter or retreat to the garriſon, and enables them more eaſily to fall upon the half-moon. For if there ſhould be no reduit, and the enemy are driven out of the half-moon, they can ſcarce attempt to return, eſpecially if the communication between the place and the half-moon is diſcovered by the batteries and lodgments of the covert way: becauſe, if the ditch is filled with water, this communication can hardly be made but with boats, which may be eaſily ſeen from the lodgments of the covert way, and may be overſet by the cannon of the batteries; and if the ditch be dry, and there happens to be a caponnier, the communication, though more ſafe, is not without danger, by reaſon of the fire that may plunge into it from the lodgments of the covert-way; ſo that it will be extremely difficult for the enemy to advance quick enough to repoſſeſs themſelves of the half-moon; beſides, they want room to aſſemble in a large body, and fall all at once upon the lodgments of that work.

There is only one caſe in which they may do it; that is, when in the angle of the gorge of the half-moon they have made a ſpace, nearly as large as the places of arms in the covert way. This ſpace cannot be ſeen from the covert way, nor from its lodgments; and as there are generally ſteps to aſcend from the bottom of the ditch to the half-moon, the enemy might take advantage thereof to try to enter it; but if the beſiegers are upon their guard, they will find it eaſy to repulſe them, even with loſs.

The beſt time for attacking the half-moon ſword in hand, is by night, for the enemy's fire is not ſo ſure then as by day.

§ 16. *The attack of the Baſtions.*

WHILST the beſiegers endeavour to poſſeſs themſelves of the half-moon, they work the ſame time at the deſcents into the ditch, which are made nearly towards the third part of the faces, reckoning from the flanked angle of the baſtion. A deſcent may be effected at each face of the two baſtions in the front of the attack, as in *n*, *n*, Plate DXXXIII. fig. 6. or, according to the more general cuſtom, only oppoſite the faces in the front attacked. The manner of proceeding is much the ſame as in the deſcent and paſſage over the ditch of the half-moon, whether it be dry or wet; that is, if it be dry, a ſap is carried into the ditch, from the opening of the deſcent to the foot of the breach, and ſtrongly covered towards the oppoſite flank. If the ditch be full of water, it is paſſed over on a bridge of faſcines, conſtructed in the ſame manner as in the paſſage over the ditch of the half-moon.

The batteries erected on the ridge of the glacis for making a breach in the face of the baſtions, muſt fire againſt that part of the faces where the breach is to be effected, and fire all together, as was mentioned in the article of the attack of the half-moon: and when they have made a breach ſufficient to attempt the attack in front, ſome of the guns muſt be kept to batter the upper part of the breach, and ſome muſt be removed to the back of the platform, and diſpoſed in ſuch a manner as to be able to annoy the enemy, whenever they preſent themſelves towards the upper part of the breach. All this is done during the deſcent and paſſage over the ditch. Mines are alſo made uſe of to widen, and ſometimes even to make the breach.

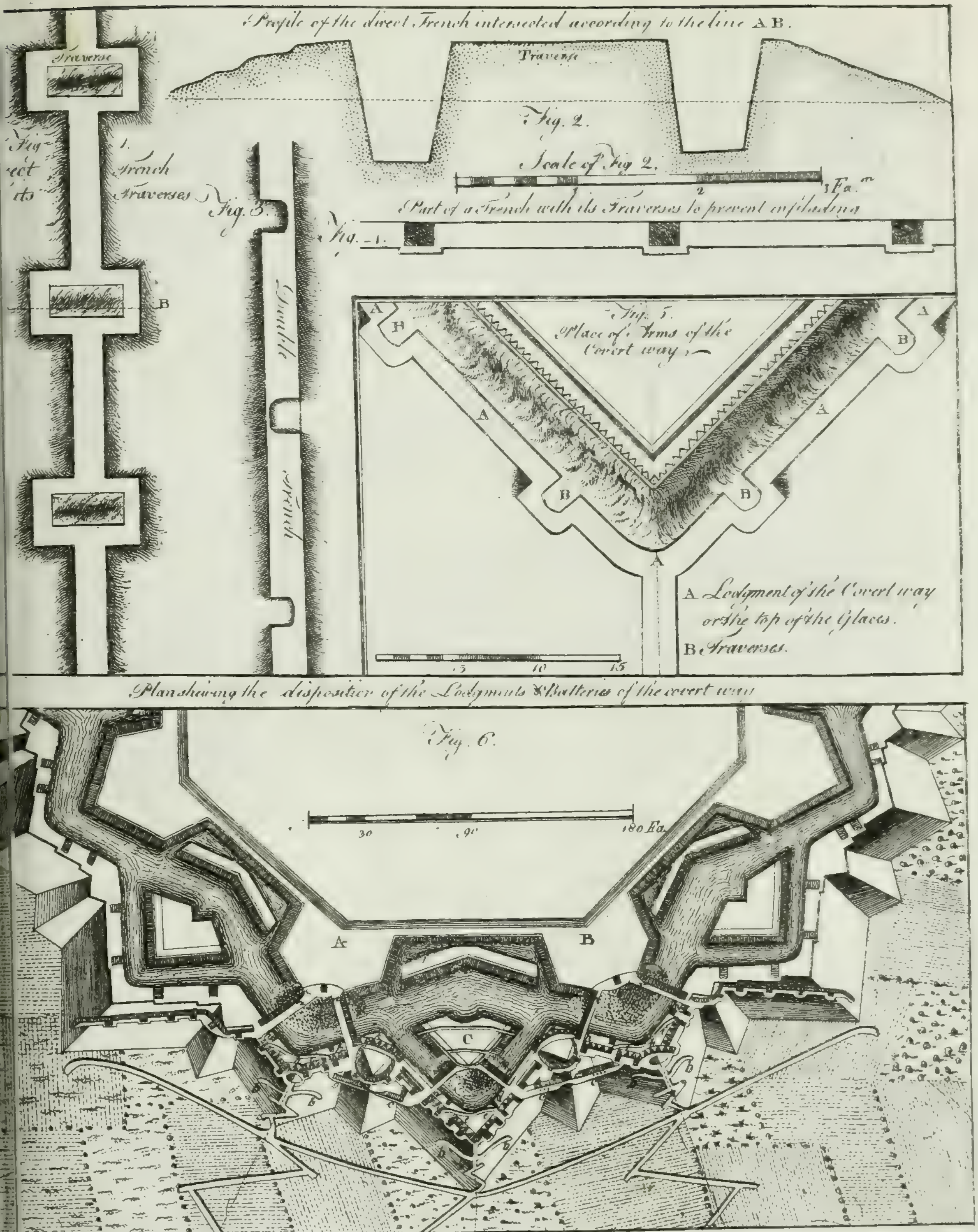
To fix the miner to the wall when the ditch is dry, a lodgment is made near the opening of the deſcent, to protect him from thence againſt the ſallies of the beſieged. Then the wall is broke with cannon, as near as poſſible to the bottom of the ditch, in order to get under the galleries which the beſieged may have built withinſide the baſtion. An opening of five or ſix feet may be made with the cannon, to lodge the miner that removes the rubbiſh, and makes room for one or two of his comrades, who are to aſſiſt him to get rid of the earth in the gallery. When the ditch is dry, and the ground will admit of it, the miner ſometimes gets under it by a ſubterraneous gallery, which leads him to the foot of the wall; but if the ditch be filled with water, it is not always the cuſtom to wait for the completing of the paſſage over the ditch, before the miner is fixed to the face of the baſtion. The wall is pierced with cannon, in the manner before mentioned, but a little above the ſurface of the water, to the end that the miner may not be incommoded in this gallery; and he is ſent over in a little boat, to place himſelf in the hole. The miners relieve one another every two hours, to carry on their work with more ſpeed; that is, to complete and finiſh their mine. At the ſame time, the enemy will uſe various artifices to obſtruct them.

When the miner has pierced the wall, he makes behind it, on both ſides of him, two ſmall galleries, from 12 to 14 feet, at the end of which he places, on both ſides the galleries, two mines, namely, one within the breadth of the wall, and the other ſunk 15 feet under the rampart. A common train is given to theſe four chambers, which taking fire at one and the ſame time, will produce a very large and ſpacious breach.

When there are countermines under the rampart, and along its revetement, care muſt be taken to ſeize them, and to drive the miners from thence. For this purpoſe M. Goulon propoſes to ſpring four fougaſſes* near them, in order to burſt them; when this is done, he is for entering it with 10 or 12 grenadiers, and as many ſoldiers, commanded by two ſerjeants; part of theſe grenadiers ſhould have each four grenades, and the reſt ſhould carry four or five bombs, of which three only ſhould be charged, the other two with fuſees only. The two ſerjeants ſhould begin with attacking the countermine ſword and piſtol in hand, and the grenadiers ſhould follow them. If the beſieged do not appear to defend their countermine, a lodgment is quickly made with ſand-bags. This lodgment conſiſts of no more than a good traverſe,

(D) The reduit is a ſmall half-moon conſtructed within the other. It uſually conſiſts of a ſingle wall with loop-holes; but in Landau, Neufbriſac, and ſome other places, the reduit is conſtructed with a rampart and parapet like the external half-moon.

Attack of Fortified Places.



A Bell Prin Wal Sculptor fecit

Attack of Fortified Places.

Fig. 1.

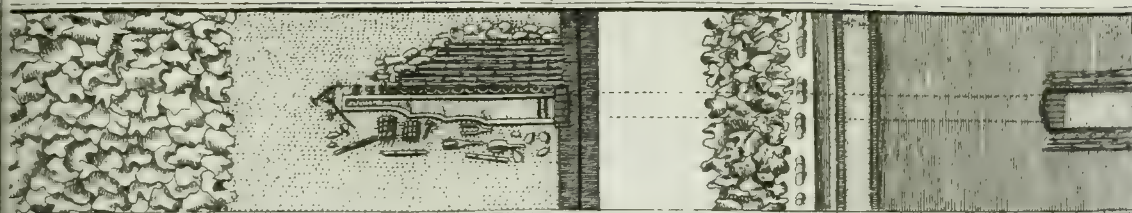
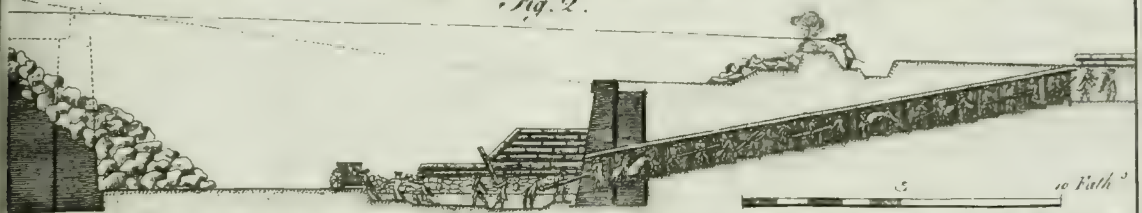


Fig. 2.



...of the descent into the dry Ditch viewed from the Country.

Entrance into the descent of a dry Ditch viewed from the top of the Breach.

Fig. 3.

Fig. 4.

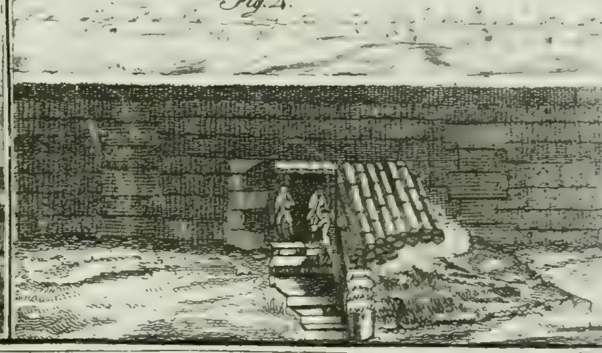
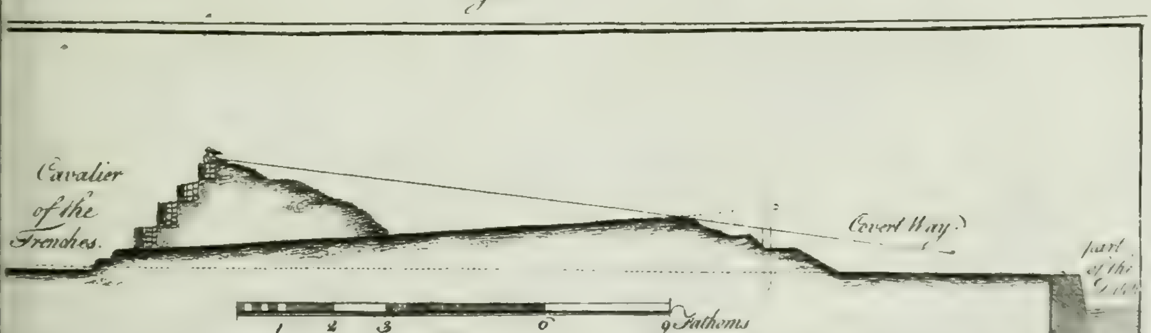


Fig. 5.



Attack of Fortified Places

Fig. 1.

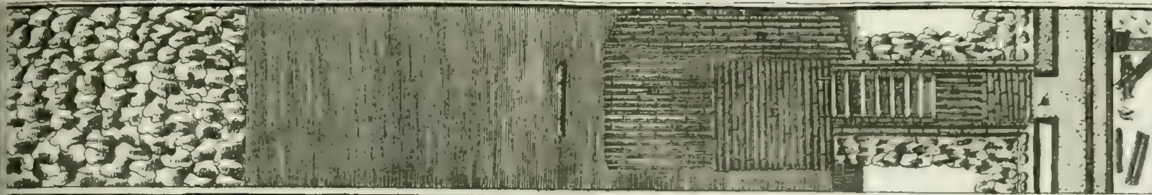


Fig. 2.

Opening of the descent into a wet ditch viewed from the Glacis.

Fig. 3.

Entrance into the descent of the wet ditch viewed from the Breach

Fig. 4.

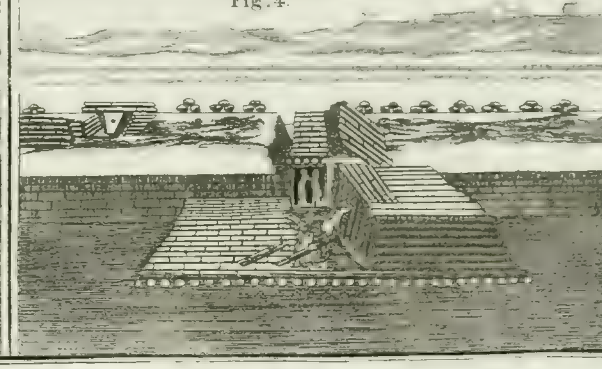
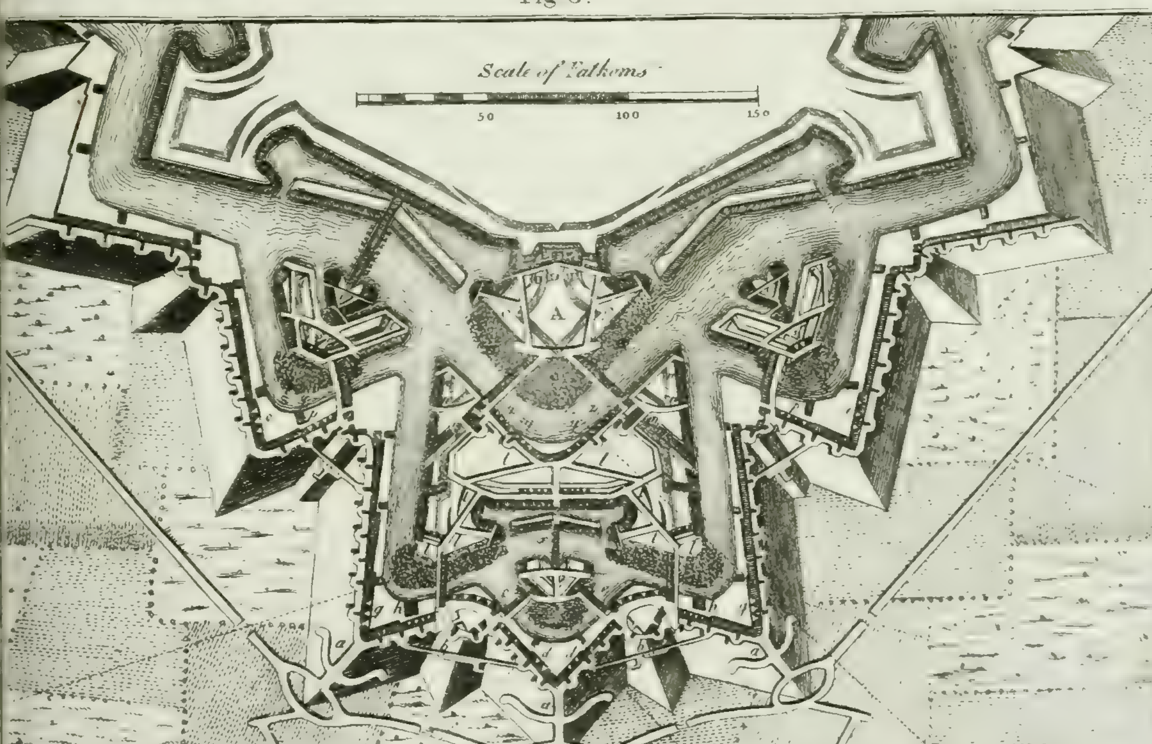


Fig. 5.



A. Bell Prin. Wal. Sculptor Fecit.

traverse, which entirely stops up the gallery of the countermine, towards the side from whence the enemy may come. If they attempt to oppose this operation, the grenadiers should throw their three loaded shells, and retire quickly with their comrades, to prevent being hurt by the effect of those shells; for the smoke they make in bursting, together with the splinters, must unavoidably oblige the enemy to quit the gallery for some time: but as soon as they have produced their effect, the serjeants and the grenadiers, with their comrades, must immediately return, and work as hard as possible upon the traverse, in order to stop up the gallery. If the besieged still persist in interrupting this work, the grenadiers must throw the two shells with fusees only, which will oblige the enemy to retire quickly; and as no harm is to be apprehended from them, which is more than the besieged can tell, the besiegers continue to finish the traverse. Even openings or loop-holes are made, in order to fire upon the enemy, in case they should appear again in the part of the gallery opposite the traverse.

When there is no gallery or countermine behind the walls, or when there is one which cannot easily be come at, the miner should have no means untried to discover it; and at the same time he ought to use the utmost precaution to prevent being surprised himself by the enemy's miners, who will attempt to smother him in the gallery, and to destroy his works: therefore the business of a miner requires great art and cunning to avoid the snares of the enemy. "A miner (says M. de Vauban in his Memoirs) ought to listen frequently to discover whether there are any at work under him. He ought to sound with his augre towards the place he hears the noise come from; but the enemy often make a noise on one side, while they are at work on the other." If their miner draws too near, a small mine must be made to stifle him in the gallery; which may be effected thus: A hole of five or six inches diameter, and six or seven deep, is made on that side of the gallery where the enemy is heard; a cartridge of the same size, and containing about 10 or 12 pounds of powder, is put into it: the hole or opening towards the gallery is stopped close with a strong tampion, which is immediately applied to the cartridge, and supported by strong planks well buttressed: this powder is set on fire by a fusee, which passes through a hole made in the tampion, and communicates with the powder in the cartridge. If the gallery of the enemy's miner is within four or five feet of this powder, it will undoubtedly burst, and the miner will be either killed, or obliged by the smoke to retire.

Another way of bursting the gallery of the besieged, when it is at no great distance, is to put several shells on the side where the enemy's miner is at work, and to range them in such a manner that they shall have their effect.—When the miners are at work in search of one another, they have great iron borers, with which they pierce the interval betwixt them, to find, as near as they can, their distance from one another. The miner must be very vigilant, and as soon as the borer is withdrawn, he should clap a pistol into the hole, which, when well directed, and fired by a man of resolution, seldom fails, as M. Vauban affirms, to kill the miner. The first shot ought to be followed by three or four more; then the hole should be cleaned with the borer, to prevent the enemy from stopping it up on their side: and this is a matter of importance, for it will hinder their miner from continuing his work in that spot, and oblige him entirely to abandon it. These and many other stratagems, which may be seen in the Memoirs of M. Vauban, plainly show that the business of a miner requires not only address and cunning, but likewise great courage and resolution, to guard against and remove the several obstacles that may be thrown in his way, with a view to prevent the progress of the works committed to his direction: he may easily guard against them when he is underneath; but if it be otherwise, his situation is extremely bad. In order to know for certain whether they are at work under the gallery, the miner generally makes use of a drum with something upon it, and then the shaking of the earth must occasion a kind of trembling, which will discover that they are at work underneath. Sometimes he listens with his ear to the ground; but the fluttering of the drum is the surest way.

While the miner is working upon the construction of his gallery, the besiegers must be employed in demolishing all the works of the enemy, and disabling them from defending or repairing the breach. With this view a continual fire is made against the breaches, which will hinder the besieged from showing themselves in that part, and from advancing to see the works which may be made in the ditch or at the foot of the breaches. If there is a tenaille before the curtain, batteries are placed in the re-entering places of arms of the covert way of the half-moon, which plunge into the tenaille, and hinder the enemy from making use of it to disturb the passage over the ditch. And in order to silence them farther, another battery of mortars may be erected, in the most advanced lodgment of the gorge of the half-moon; which battery being well served, will render it too dangerous and inconvenient for the besieged to abide there, so as to have the attention requisite for obstructing the passage over the ditch.

But sometimes the enemy will make oblique embrasures in the curtain; and from thence they fire on the lodgments of the covert way, so as greatly to incommode both those lodgments and the opening of the descent into the ditch. The way to prevent the effect of those batteries, is to endeavour to destroy them with shells: and, when the ground will permit, to enfilade the curtain with ricochet firing. Four or five pieces may be also placed on the upper part of the flanked angle of the half-moon; in which position they can fire directly upon the curtain, and plunge into the tenaille and the postern, by which the enemy keep a communication with the ditch when it is dry.

Let us suppose that the passages over the ditch are finished, so as to be fit to walk over; that the cannon or the mines have made the breaches sufficiently wide for the assault; that the ascent is made smooth, and that the besiegers can easily mount to the top of the breach; then they may lodge themselves there, by following either of the two methods mentioned in the article of the half-moon.

If the enemy have made no retrenchments in the inside of the bastion, they will hardly venture to stand an assault, as this would only expose the place to be carried sword in hand, themselves to be taken prisoners of war, and the town to be plundered. Therefore every thing being ready for the assault, they will beat the chamade, that is, they will desire to surrender on certain terms.

When a resolution is taken to attack the bastions while the mines are making and charging, a considerable heap of materials is laid up in the lodgments nearest the breaches, that they may be handed readily for the construction of the lodgment, as soon as the enemy is driven away. Every thing being prepared to set fire to the mines, all the grenadiers of the army are ordered to march to the assault; and they are to be supported by a sufficient number of detachments, that the enemy may not be able to make a stand. These troops being ready, the mines are sprung; and as soon as the dust is a little laid, the grenadiers, commanded to march and to mount foremost, move on to the foot of the breach; and when they get there, they mount immediately with their bayonets fixed, and are followed by the

Of Sieges.

the reſt of the troops that are to ſupport them. The enemy will not fail to make uſe of their mines, if they have any left; and will likewiſe throw all kinds of combuſtibles, to make the beſiegers pay as dear as poſſible for the ground which the beſieged will be obliged to yield in the upper part of the breach; for yield at length they muſt, and the ſuperior numbers of the beſiegers muſt ſurmount every obſtacle.

As ſoon as they are beaten away, and have abandoned the upper part of the breach, the beſiegers muſt ſet about making a lodgment; which will conſiſt at firſt of a kind of arc of a circle, the convexity whereof is turned towards the enemy, if there is a breach in the faces of the two baſtions, otherwiſe it will only be made on the upper part of the breach. The breaches are to be all ſtormed at the ſame time, by which means the reſiſtance of the enemy will be divided. This whole time the batteries and lodgments are to fire with all the vivacity poſſible againſt the ſeveral defences of the enemy, and againſt every place they are in and that can be fired againſt, without annoying the troops that are ſtorming the breaches.

The lodgment on the breach being made, the ſaps are carried on to the right and left towards the centre of the baſtion, and diſpoſed in the manner as in Plate DXXXV. fig. 5. baſtion A. Cannon are brought upon the breach to batter the inner retrenchment, the ditch is paſſed over here alſo, and a lodgment is made upon the breach in the manner mentioned in regard to the baſtions.

If behind this firſt retrenchment there be a ſecond, the enemy, after being forced to quit the former, retires to the latter to capitulate. There they are to be attacked as in the former retrenchment, and at length they will be forced to ſurrender. It is very rare to ſee a defence carried ſo far as we have here ſuppoſed; but it was incumbent upon us to make this ſuppoſition, in order to give an idea of what is proper to be done, ſhould the enemy reſolve to defend the place to the laſt extremity.

§ 17. *Attack of a place covered with Fore-ditches, Lunettes, and other Outworks*, &c.

In order to give a more ſimple idea of the operations of a ſiege, we have explained and applied them to a place that had no other outworks than half-moons and a covert way: but a greater number of works will make no alteration in the principles here eſtabliſhed: to take and keep poſſeſſion of thoſe works, the beſiegers have only to follow the ſame rules; which we ſhall ſhow in a few words.

Let us ſuppoſe a place ſurrounded by a fore-ditch, and a ſecond covert way, ſtrengthened with lunettes, and ſuppoſe the front by which it may be attacked is covered with a horn or crown work, &c.

Firſt of all the trenches are to be opened as uſual, in order to come to the foot of the glacis of the ſecond covert way; the ricochet batteries are to be placed on the produced faces of the works attacked, and of their defences; the faces of the lunettes of the front attacked ought to be enfiladed by the ricochet batteries.

The ſecond covert way is taken in the ſame manner as the common covert way; and then, if the fore-ditch is full of water, a good lodgment is to be ſecured along this ditch, and batteries are to be erected to make a breach in the lunettes, if the enemy do not think proper to quit them. It is very difficult for them to maintain themſelves in thoſe works, when their communication is ſeen; and they can hardly avoid being ſeen, when a lodgment is made all along the fore-ditch. Be that as it may, ſuppoſing that they are lined with ſtone-work, or only with turf, that they are fraiſed and palliſaded, and that the enemy are obſtinate in their defence, a breach may be made in them, by placing ſome cannon oppoſite the middle of the faces, and the ditch may be paſſed over by filling it with faſcines or ſome other materials. As it is a great deal ſmaller than that before the body of the place, it is much eaſier to paſs.

When the beſiegers have made themſelves maſters of the lunettes which cover the front attacked, they begin to think of paſſing the fore-ditch. This is a very difficult taſk, becauſe it is performed under the grazing fire of the covert way; but this fire ought to be checked by the ricochet batteries, which ſhould plunge into the covert way on every ſide. This ditch is croſſed near the ſaliant angles of the glacis. It is always to be underſtood, however, that there is no poſſibility of croſſing any ditch without a good epaulement of faſcines, to cover the paſſage on the ſide which is ſeen by the place, or by the works that defend it.

When the lodgment is entirely finiſhed on the covert way, then the other attacks are carried on in the manner before explained.

There are places which, without any fore-ditch, have lunettes oppoſite to the ſaliant and re-entering angles of the glacis, which are alſo enveloped by a ſecond covert way: ſometimes they are vaulted and bomb-proof, as at Luxemburg; and ſometimes they have only a ditch, a parapet, and a covert way.

Thoſe which are vaulted and bomb-proof are very difficult to take; becauſe the ricochet firing and the bombs can do them no miſchief. In that caſe they muſt either be turned, or be taken by mines.

A work is ſaid to be turned, when the beſiegers get between that work and the place, and ſo cut off their communication. Sometimes the lunettes have communications under ground, and then there is hardly any other way of driving out the enemy but by mines. This is tedious work; but there is no remedy for it.

The lunettes and the ditch are always defended by branches of the covert way, with which they have alſo a communication, like thoſe of the lunettes, A, A, Plate DXXXVI. fig. 1.

This plate, which repreſents part of Landau and its attacks in 1713, may ſerve to give an idea of the manner in which a work is turned. The advanced lunette B, as well as the work C, called a *tenaille*, are turned; that is, the trenches cut off the communication betwixt them and the place.

When this communication cannot be cut off, there will be often a neceſſity for attacking the lunette and covert way at the ſame time; and the reaſon is, becauſe though the enemy ſhould be obliged to abandon the lunette, yet ſo long as they are maſters of the covert way, they have it in their power to return and retake it. Therefore, the ſure way of keeping poſſeſſion of it is to drive the beſieged out of the covert way, at the ſame time that they are forced to quit the lunette.

The garriſon may avail themſelves greatly of mines for the defence of theſe ſmall outworks, ſo as to oblige the beſiegers to pay very dear for their acquiſition, and be a long while in making it. But they muſt purſue the ſame methods as the beſieged; they muſt dig deep into the earth, they muſt endeavour to deſtroy the enemy's mines, to blow up their galleries, and to make themſelves maſters of the lower ground. This is an eſſential point, without which the enemy may blow up and deſtroy the lodgments ſeveral times. The celebrated M. de Valiere, in a Diſſertation on Mines, at the end of the third volume of M. Folard's Commentary on Polybius, ſhows, that in a ground 25 or 30 feet deep, the enemy may be blown up twenty times. Therefore it is impoſſible to be too cautious in endeavouring to get

get under the gallery of the befieged, in order to prevent the mifchief they may do by their great number of mines.

In the neighbourhood of fome pieces there are a fort of fmall half-moons, called *reduits*. When they are diftant from the place, the enemy cannot maintain themfelves there without expofing their troops to be taken prifoners of war; but when they are covered and defended as they ought to be, and judicioufly fituated, they are an object worth attention. Endeavours ought to be ufed to cut off the communication between them and the place, and to oblige the enemy to abandon them by throwing in fhells; it may even be proper to affault them and drive them out fword in hand, provided they are not fo near the place as to receive powerful fuccours, and be able to withftand the attack. It is a matter of confequence to get rid of thefe fmall outworks as foon as poffible, becaufe they may be of great hinderance to the progrefs of the attacks, by having a view of the trenches from the flanks, and enfilading them, &c.

In fome fieges, when the garrifon are obftinate in their defence, fmall outworks are made at the foot of the faliant and re-entering angles of the glacis; thefe confift only of a parapet raifed at the foot of the glacis upon thefe angles, each fide of which has about 10 or 12 fathoms. Thefe fmall works are called *arrows*. They may be feen in A, A, A, Plate DXXXVI. fig. 2. They communicate with the covert way by a paffage pierced on the ridge of the glacis, and pallifaded on both fides. At the entrance of this paffage is conftructed a traverfe B, generally called the *tambour*, which hinders the befiegers from being mafters of the arrow, or difcovering the infide of the place of arms belonging to the covert way.

To prevent the effect of thefe arrows, the beft method is to ply them well with ricochet batteries, and with fhells thrown in alfo *à ricochet*. Stone mortars may likewife be made ufe of, to annoy the enemy in their arrows; for as thefe works are but fmall, the ftone mortars produce a very good effect. We have already taken notice of almoft all the works the befiegers may meet with beyond the covert way; there remains, therefore, only to fee the manner of conducting the attacks of the other outworks moft commonly ufed in fortified towns.

§ 18. *Attack of a Horn-work.*

A HORN-work is nothing more than the front of a fortification, which projects into the field, and is joined to the place by two long fides. It is placed oppofite to the curtains, and fometimes alfo to the baftions. The befiegers fhould endeavour, as much as poffible, to avoid attacking the fide covered by thefe works, becaufe they are very difficult to take, and of courfe will greatly lengthen out the fiege. But fuppofing there is an abfolute neceffity for attacking the place on the fide covered by a horn-work oppofite the baftion, and that this horn work has an half-moon oppofite to its curtain: The trenches and parallels are to be made in the ufual manner; the fame method is to be ufed in regard to the ricochet batteries, which will alfo enfilade the branches of the horn-work. The taking of the covert-way of the half-moon, and of the half baftions of the horn-work, is carried on in the fame manner as the attack of the half-moon, and the two baftions of the body of the place. There remains, therefore, only to fhow how the lodgments are to be made in this work. We will fuppofe that there are two retrenchments withinfide, as in Plate DXXXV. fig. 5.

When the lodgments towards the point of the half baftions are finifhed, fome guns are to be planted there, in order to batter the face of the oppofite baftion; and they are to be placed over-againft the lodgments of the flanked angles of the half baftions. Thefe lodgments are to be extended on both fides towards the curtain, along which faps are carried on; as alfo towards the orillon of the half baftions, if they are made with orillons: this will form a kind of fmall parallel, the fire of which will help to cover the lodgments in front, in cafe the enemy fhould make any fallies to deftroy them. In large fortifications, fuch as horn and crown works, the lodgments ought to be carried on with the greateft circumfpection, in order to be able to fupport them againft every attack of the enemy.

As all thefe lodgments are commanded by the baftion, it will be requifite to dig the faps fufficiently deep, fo as to be fecure againft their fire; and likewife to make traverfes near enough to each other for the fame effect.

If the baftion can be battered in breach from the rampart of the half baftions of the horn-work, the befiegers will for this purpofe make ufe of batteries erected on thefe half-baftions; and for the fame end they will alfo plant a battery of fix or eight guns towards the middle of the curtain.—Should it be impoffible to fink fufficiently into thefe, fo as to batter the lower part of the revetement of the baftion, ftill they might be ufefully employed in playing againft the enemy's defences, and driving them out of their retrenchments. When the lodgments are well fecured withinfide, it will be extremely difficult for the enemy to continue in the retrenchments, without running the rifk of being made prifoners of war; becaufe the communication between them and the place will become too difficult. They might indeed, by means of a bridge level with the water, retire into the collateral half-moons: but at the fame time that the befiegers endeavour to make themfelves mafters of the horn-work, they will alfo ftrive to get poffeffion of thefe half-moons; the taking of which muft inevitably follow that of this work.

As foon as the enemy are entirely driven out of the horn-work, the befiegers muft poffefs themfelves of it by carrying on lodgments which fhall occupy its whole extent; and if there be any occafion to erect batteries within, in order to batter the baftion in breach, they are to be erected along its counterfcarp, as may be feen in z (*ibid*).

Sometimes it fhall happen, that the ground of the infide of the horn-work will not permit lodgments to be extended there, as they are ranged in this figure, becaufe it may be too wet and marfhy, or elfe of too narrow a circumference. In that cafe there is no carrying on the lodgments but along the parapet of the front of this work, and along its branches, if the breadth of the platform of the rampart of thefe branches will permit. It muft be made to defile by frequent zig-zags or turnings; but if it be too narrow, the only way for the befiegers is to fink very deep, in order to defile from the fire of the place, and to cover themfelves by traverfes made very near one another.

Explanation of Plate DXXXV. fig. 5.

a, Cavaliers of the trenches. *b*, Batteries of ftone mortars. *c*, Batteries to breach the half-moon before the horn-work. *d*, Batteries againft the defence of this half-moon. *e*, Paffages over the ditch before this half-moon. *f*, Lodgements in it. *g*, Batteries againft the flanks of the horn-work. *h*, Batteries to breach the half baftions of the horn-work. *i*, Batteries againft its curtain. *l*, Lodgments in the half baftions and in the horn-work. *m*, Paffages over the ditch before the retrenchments in the horn-work. *n*, Lodgments in thefe retrenchments. *o*, Batteries againft the defences of the collateral half-moons. *p*, Batteries to breach thefe half-moons. *q*, Paffages over the ditch before thefe works. *r*, Lodgments in the fame. *s*, Batteries to breach the reduits of the half-moons. *t*, Paffages over the ditch

Of Sieges. ditch before the reduits. *v*, Lodgments in the reduits. *x*, Bridge of fascines, or a road to carry the cannon to the horn-work. *y*, Batteries against the defences of the bastion A. *z*, Batteries to breach this bastion. B, Passages over its ditch. C, Lodgments in the bastion A. D, Lodgments on the border of the ditch before the retrenchment of the bastion A. E, Passages over the ditch before this retrenchment.

Plate DXXXVII. represents the plan of the lodgments made in the horn and crown work of Philipsburg in 1734.

A great deal more might be said in regard to all these articles; but for the particulars, we refer the reader to the Memoirs of M. de Vauban, which display the whole extent of genius of that great man, and show how capable he was of finding out expedients for surmounting all obstacles arising either from soil, situation, or different manners of fortifying.

§ 19. *To prevent succours from being thrown into a town besieged.*

Not to interrupt the thread of the usual operations of a siege, we have supposed that the general had taken every necessary measure to guard against all the attempts of the enemy, and to secure success by the great superiority of his forces. Sometimes, however, it may happen, that an enemy who was looked upon as too weak to relieve the place, shall prepare to attack the army of the besiegers, either in consequence of drawing out most of the troops from the neighbouring garrisons, which are least exposed, or of having been reinforced from some other part. In such case, there are two ways to follow. The first is, to wait for the enemy in the lines, and to hinder them from breaking through: the second, to leave part of the army in the lines, in order to carry on the siege, and to oppose any sallies of the garrison; with the other to go and meet the enemy, and fight them out of the lines.

Both these ways are supported by the opinion of different generals; but the latter seems to have the most general approbation.

The inconvenience of waiting for the enemy in the lines, is the uncertainty on which side he intends to direct the attack; for which reason the besiegers are obliged to be equally strong in all their posts; and when the line is very extensive, the troops are at too great a distance from one another, to make any considerable resistance on the side where the enemy forms his attack. Most lines of circumvallation, that were ever attacked, have been forced; so that both reason and experience seem to establish it as a maxim, that it is preferable to go and meet the enemy, and not to let him come within reach of the lines.

Without pretending, however, to determine so important a matter, it seems, that when a line is not very extensive, it may be defended to an advantage. And, first, it is beyond all doubt, that if the troops behind the line know how to avail themselves of the several circumstances in their favour, their situation is in many respects preferable to that of the assailants. The latter are exposed to the fire of the line for a very considerable time before they can come up to the border of the ditch. This ditch must be filled up: and all the while they are exposed to the same fire, which must kill a great many of their men, and throw their troops into some confusion. And when they break into the line, they can make but a very narrow front; for which reason, they may be charged both in front and flank by the troops within; who, if they do their duty, must drive them into the ditch. For, suppose the first line of the defendant's infantry next the ditch should be obliged to give way, the horse that are behind them may and ought to fall upon the enemy's foot that have pierced through the line; and as the latter cannot force their way but in some confusion, the former may easily drive them out again. We may therefore conclude, that if the troops are sensible of the many advantages of a good line, and are determined to defend it; if the several parts are likewise well supported, and all the necessary precautions have been taken to prevent being surprised; it will be extremely difficult for the enemy to force it.

Thus, at the siege of Philipsburg, in 1734, prince Eugene reconnoitred the lines of circumvallation, and found them so well disposed, that he never once attacked them. They formed a kind of irregular semicircle round the place, of which the Rhine might be considered as the diameter. They were defended by a kind of fore ditch, and by wells betwen this fore-ditch and the lines, as may be seen in Plate DXXIX. If the prince had attempted to pass over this ditch and these wells, he would have lost a great number of men by the fire of the lines. The wells were so near to one another, that there was no possibility of passing between them: they must have been filled up, as well as the fore-ditch, with fascines; which would have been too tedious and dangerous an enterprise.

In such a situation, therefore, the besiegers may wait quietly in their lines; but if they should be of so great an extent, as not to admit of being equally guarded, then it seems to be the safest way to draw out the troops, and meet the enemy, as marshal Tallard did at Landau, in 1703. After he had defeated the army which was marching to the relief of the place, he returned and finished the siege. The duke of Vendome acted just in the same manner at the siege of Barcelona, in 1697. Having had intelligence that the marquis of Valesco, viceroy of Catalonia, was preparing to attack him, he went out to meet that general, gained a complete victory, and returned afterwards before the place, which was obliged to capitulate.

At the same time, we must allow that the safest way to conduct a siege, is to have a good army of observation advantageously posted so as to cover the siege, and be near enough to receive succours from the troops employed before the town, should the enemy come to a resolution of giving battle.

If the enemy do not think proper to attack the besieging army, they may probably try to throw in some small succours of troops and ammunition into the town. The way to prevent them is to make the circumvallation very exact, and not to leave an opening in it, under any pretext whatsoever.

The enemy may likewise attempt the raising of the siege, by making themselves masters of the spot, or place, from whence the besiegers draw their provisions and ammunition. But before a general lay siege to a town, he should take all the necessary precautions for securing his magazines, covering his convoys, and guarding the several posts through which the enemy might march to attack him.

Another expedient the enemy may think of for raising the siege, is to attack some place of importance, which the besiegers have an interest in preserving; in order to engage them to march to its assistance, and to abandon the siege they have in hand. But this expedient ought to have been foreseen, and every precaution taken to prevent it. However, should the enemy find means to engage in an enterprise of importance, and which requires an immediate relief, if a general thinks there is not time sufficient to take the place he has laid siege to, and at the same time to oppose the enemy's designs, in that case he may raise the siege; but for so doing, there should be very cogent reasons. When king William laid siege to Namur, in 1695, marshal Villeroy, in order


PLAN
of the Attacks of
LANDAU
in 1713.
Scale of Fathoms
A
B
C
Third
Parallel
Parallel
Second
Parallel
First

Fig. 2.

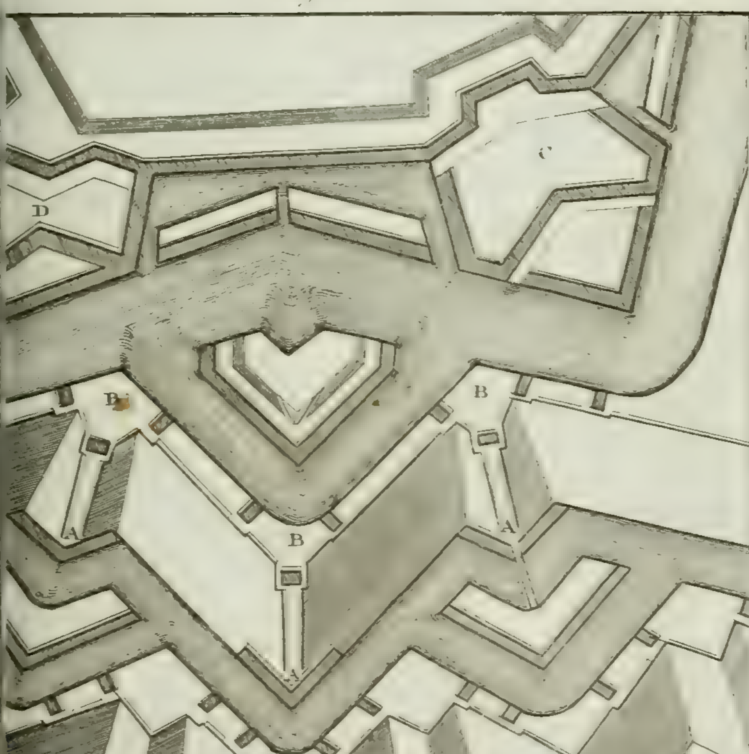
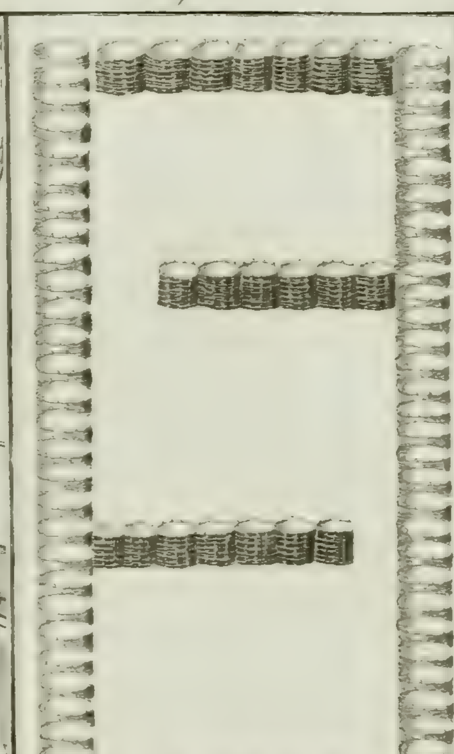

C
D
B
B
A
B
A
A

Fig. 3.



der to divert him from his purpose, ſat down before Bruſ- ls, thinking he ſhould oblige that prince to march to its lief, and abandon his enterpriſe againſt Namur; but king Villiam choſe rather to ſuffer that city to be bombarded, ian to relinquiſh a very important conqueſt, in which he as in a manner ſure of ſucceeding.

Sect. II. *Of Defence.*

1. *Of the Troops and Ammunition with which a fortified Town ought to be provided.*

As the goodneſs of the works, when a place is well provided with troops, ammunition, and proviſions, is what enbles it to hold out againſt the attack of an enemy; ſo the rant of any one of theſe three articles will not permit all he advantage to be reaped that was propoſed in fortifying town. Men are properly the ſoul of a defence; and withut them the beſt fortifications in the world are not able to nake any great reſiſtance againſt the enemy.

Therefore we muſt firſt of all lay down as a maxim, that governor cannot make a good defence, unleſs he hath the umber of troops neceſſary for defending the ſeveral poſts, nd obliging the enemy to pay dear for them. Immenſe ums are expended in fortifying a place, in order to ſtop a trong army with a ſmall force: but what reſiſtance can the lace make without exerting a briſk fire; and what will hoſe heaps of walls avail, if they are not defended? The garriſon of a town beſieged ought to have a reaſonable tock of proviſions, in order to ſupport themſelves under he fatigue of military duty; they ought alſo to have owder, arms, and generally every thing that is requiſite o annoy the enemy, and to ſtop the progreſs of their operations.

It is not very eaſy to ſettle the number of troops neceſſary to defend a town; the nature of the ground on which the place is ſituated, and the number of outworks, ought to determine the ſtrength of the garriſon. M. Vauban in his Memoirs reckons, that in a place regularly fortified with good baſtions, half-moons, and covert-ways, we ſhould allow 500 or 600 men to each baſtion: That if the town has hornworks, 600 men may be likewiſe aſſigned to each of theſe; and in proportion for the other outworks, according to the relation which their defence may require to that of the horn-work; and the horſe ſhould be the tenth part of the number of the infantry.

This being premiſed, ſuppoſe a place has ſix baſtions, there muſt be a garriſon of ſix times ſix hundred foot, which makes 3600, and the tenth part of that number in horſe, which makes 360. Hence a ſufficient garriſon for ſuch a place will be 3960 men.

In order to compute, as near as poſſible, the quantity of ammunition and proviſions that may be required for ſuch a garriſon, we muſt calculate how many days they will be able to maintain a ſiege. The following are M. Vauban's remarks on this ſubject.

	Days.
For the inveſting the place and the tracing the lines	4
For the opening of the trenches to the attack of the covert-way	9
For the attack and taking of the covert-way, and making lodgments in it	4
For the deſcent and paſſage over the ditch before the half moon	3
For fixing the miners, or for the batteries till the making of a reaſonable breach	4
Carry over	24
Brought over	24
For taking and ſecuring the interior part of the half-moon	3
For the paſſage over the great ditch before the two baſtions, ſuppoſed to be begun before the taking of the half-moon	4
For fixing the miners, or erecting batteries on the covert-way, to lay the place open and make a reaſonable breach	4
For the defence and ſupport of the breach after the place is laid open	2
For the miſtakes which the enemy may happen to commit, and their neglect in their works	4
Total of the defence	41

In this defence it is plain we ſuppoſe a town to be fortified only with half-moons and a covert-way; but if the half-moon had a reduit with a revetement and rampart, it might hold out four days longer. If there were retrenchments in the baſtions, they might retard the taking of the place five or ſix days. If the ditch was ſtrengthened with tenailles and caponiers, the paſſage over it might be protracted two or three days. If there was a good hornwork, or ſome other like fortification properly ſtrengthened with a half-moon, a covert-way, and retrenchments within the work, the taking of it would coſt about 12 or 14 days. If this work had tenailles, the paſſage over its ditch would be later by two or three days. If there was a fore-ditch and a ſecond coverty-way, the progreſs of the attacks would ſtill be leſs rapid, and we might reckon 10 or 12 days for the taking of this ſecond covert-way and the paſſage over its ditch. If there were redoubts near the place, they would ſtill protract the taking of it for ſome days.

From this eſtimate, though not very exact, an idea may be formed of the duration of a ſiege: a point abſolutely neceſſary for ſecuring, at leaſt, a ſufficient quantity of ammunition during the time; we ſay at leaſt, becauſe it is always prudent, if poſſible, to have a greater quantity of ammunition than is ſuppoſed to be wanted. When once the number of the garriſon, together with the duration of the ſiege, is fixed, it is then very eaſy to calculate the quantity of powder and ammunition with which the place is to be provided.

It is judged, that to be well provided with cannon, eight pieces ſhould be allowed to each baſtion. Therefore in a place of ſix baſtions there ought to be 48 pieces.

As a town is never attacked on all ſides, and there are ſeldom above two or three attacks at the moſt, the cannon belonging to thoſe baſtions that are not attacked, ſerve to ſtrengthen the baſtions attacked, and they are placed alſo in the outworks of the fronts attacked.

Among the cannon for the defence of the town there ſhould be ſome of 24, of 16, of 12, of 8, and of 4 pounders, and even of 2 and 1. The latter are of very great ſervice, becauſe of their being ſo convenient to remove with eaſe, and with few men, from one place to another; for this diſturbs the enemy, who find it difficult to deſtroy theſe ſmall pieces. The largeſt ſerve to fire againſt their batteries and their works. The ſmall ones are carried to the outworks, and to the covert way, from whence they are fired *en barbette*. It is cuſtomary to make uſe of ſea carriages for theſe ſmall pieces

Beſides cannon, the town ought to be provided with a great number of wall guns, carabines, muſkets, &c. We are to ſuppoſe that moſt of the ordinary arms will be broke in the ſervice; and therefore care muſt be taken to provide new ones when wanted.

The number of mortars neceſſary may be eſtimated at

Of Sieges.

two to every bastion. They must be of different bores, of 12 and 8 inches diameter. There ought also to be several stone mortars.

The garrison of a place of six bastions, consisting, as we have already observed, of 3600 foot, are to be employed or distributed in the following manner.

We should, first of all, reckon about 600 soldiers wounded and sick, in the first 12 or 15 days of the siege, and for the service of the batteries, the removing of ammunition, &c. And then there will remain 3000 for the defence of the place.

These are to be divided into three equal bodies; one for the guard, the other for the biovac under arms, ready to march on the first notice where wanted, and the third to rest.

The horse are also divided into three bodies like the foot; that for the guard is chiefly placed on the right and left of the attack; that for the biovac is generally quartered by brigades, in different parts of the town, where they may be of service, either to keep the inhabitants in awe, or to be ready to act in sallies. In regard to the third corps, who are to rest, their horses must be saddled in the day; and the horse or dragoons must be ready to mount instantly, should there be any occasion for their service.

The guard of infantry and the biovac ought to be under arms, at the several posts assigned them in the works of the place; and for the corps at rest, they must be ready to support the troops on guard, in case these should have need of their assistance.

The guard of foot of 1000 men may be subdivided nearly into three equal bodies; two of which to defend the posts attacked, and the third the other posts not attacked. And in regard to the two first, they may be subdivided also into three equal bodies; two of which are to fire the first two hours of the night, the other is to relieve one of them at the end of that time, the next is relieved two hours after; and so on alternately, that there may be always two thirds of this guard in action, and the other third at rest.

There is no occasion for so brisk a firing by day as by night; because the besieged are more capable of seeing what the enemy are about, and of opposing their attempts; but in the night nothing but a strong cannonading can guard against their enterprises. By day the troops fire from between baskets, sand-bags, or gabions, placed on the upper part of the parapet, to the end that being under cover they may take better aim at the enemy.

As the most perfect fortifications cannot hold out long without the necessary ammunitions, too much care cannot be taken in regard to this article.

"The ancients, says Mr Folard, were accustomed to lay in a great store of provisions, when a place was threatened with a siege; a store sufficient not only for three or four months, but for three or four years at least. This they were induced to do for two reasons; the fear of being blockaded; and the inviolable law of defending themselves to the last extremity. The moderns take less precaution in respect to provisions, as well as to every thing else; they think it sufficient to lay in a stock for three or four months in towns of the greatest strength and importance; which is very wrong. I grant, indeed (continues Mr Folard), that the law of holding out to the very last extremity is looked upon as chimerical at present, and entirely left to the ancients: but it should be considered, that an enemy well acquainted with the state of things will measure the strength of the place by the quantity of provisions contained therein; and making a calculation of the loss of men in the attack, together with the expence of a long siege, they will choose, if they are wise (and certainly they will gain by it in the end), to take it rather by blockade than by a siege in form: at least they will be sure of becoming masters of it in three or four months through want of provisions; whereas a siege may last that time, if the garrison are obstinate. Such a town as Lisle in Flanders, and as Bergues, both of which are out of the line of communication of our frontier, cannot be too well stocked with provisions. A wise and experienced minister will victual them at least for eighteen months, because they may be blockaded. It is much the same in regard to Strasburg and to Landau. The latter was never victualled for more than three or four months: how imprudent, therefore, must it be to lay siege to it, when it may be taken by a blockade almost as soon as by a siege, which is attended moreover with an infinite loss of brave men, and a monstrous expence?"

These reflections of M. Folard are very solid; but circumstances will not always permit a place to be so well provided as one could wish.

When a governor finds that the enemy threatens to lay siege to a town under his care, and that the place is in want of the chief things necessary for a vigorous defence, he is to exert all his abilities, in order to remedy this inconvenience as much as possible. The greatest want of all is that of provisions; he must therefore endeavour to get a supply, both from the country and from the people of the town; which is to be distributed among the garrison with the greatest economy. The useless mouths should be all sent out, and an inquiry ought to be made after those who are suspected of having hoarded any corn; and upon paying them for it, or upon giving them security of payment, they should be obliged to deliver it up for the subsistence of the garrison.

Hitherto we have made no mention of the inhabitants; yet they may be rendered serviceable in contributing to ease the garrison. The governor should make use of such workmen who exercise handicraft trades for every thing relating to their respective branches; and those who are not artificers, should watch the fire that may be kindled by the shells and red-hot bullets; they ought likewise to transport the materials to the places assigned them; and even to work at the different retrenchments which the governor should think fit to order in the town, provided however that they be not too much exposed to the fire of the besiegers. An article of the greatest importance, in regard to the inhabitants, is to oblige them to lay in a stock of provisions for six months, and those that are able should be obliged to make still a greater provision, which will be a resource to the garrison when their own stock is exhausted.

§ 2. Necessary Preparations for maintaining a Siege.

When a town is threatened with a siege, the governor ought not only to take care to have a plentiful stock of ammunition and provisions, but moreover he should use all the precautions requisite for retarding the enemy's approaches, and rendering them more difficult and dangerous.

He ought therefore to leave nothing in the neighbourhood that may serve to cover the enemy; he should clear the adjacent country of all houses that are within reach of cannon-shot, and fill up, if possible, the caverns or hollow ways that may be concealed, or build some redoubts and other works under the protection of the place, by which they may be enfiladed. He ought to cut down all the trees; in a word, he should prevent the enemy's having any cover within reach of the cannon of the place; he should see that the fortifications be all in a good condition, and that the covert-way be well palisaded; in fine, he should cause arrows to be built on the saliant angles of the glacis.

glacis. Retrenchments may also be made in the re-entering places of arms of the covert way, by raising a parapet within them, and parallel to their faces, with a small ditch before it. Nor should the galleries for the mines be forgotten: on the contrary, they ought to be begun betimes, and carried out into the country as far as the ground will permit: and chambers should be made under all the angles of the glacis. If there are any houses within the rampart which may obstruct the defence, the governor ought to see them demolished; and nothing should be left, either within or without, which can any way be of service to the besiegers. If there are new raised troops, care should be taken to discipline them well.

The governor should also see that the hospitals be in a good condition, that the sick and wounded be taken care of, nor think it beneath his character to visit them himself, and to let the soldiers see how greatly he has their preservation at heart. This is the surest way to gain their confidence and affection, and to engage them to do their utmost towards defending the place.

As it is now the custom to throw a great number of shells into a town besieged, it is necessary to have vaulted places under ground bomb-proof, where part of the garrison not on duty may rest in safety. They are not so much wanted in large cities, where there are always different quarters secure from the enemy's shells: but a small town is in every part exposed to the bombs; so that some places under ground are absolutely necessary for the garrison to take their rest, and to prevent the troops from being continually incommoded. These subterraneous caverns are generally made in the gorges of the bastions, and sometimes under the rampart behind the curtains.

Where there are none of those subterraneous places, it will be necessary, as soon as the town is invested, to erect defences to shelter the men from the bombs; these are made of strong pieces of timber, laid sloping against the parts the least exposed, and they may be covered with thick planks laid in the same manner. The large houses should also be shored, that is, all the floors, from top to bottom, should be supported with strong upright timbers, and the upper floor covered with large beams laid across one another, and these again with earth, fascines, dung, &c. When they are thus fitted up, they may serve either for the accommodation of the troops or for hospitals, &c. But what deserves a more special care, is the powder-magazines. They ought to be bomb-proof; but as there are very few that can resist the shock of a great number of shells, they should therefore be covered with seven or eight feet thick of earth, and a layer of fascines, dung, and strong planks laid over them, so as to form a kind of roof. But if it should happen, either from their situation or height, that this cannot be done, then a range of large trees, well fastened together, must be laid over them, so as to diminish the shock of the shells. The windows of the powder-magazines should have no prospect towards the besiegers; and to prevent all accidents, nobody should be permitted to go in or out of the doors, but when the fire of the enemy is slackened.

When there are no powder-magazines in a town, it is very difficult to preserve the powder during a siege; all that can be done, is to distribute it in different places, as in cellars and caves made under the ramparts, or in gardens, &c. and to cover these places well with thick planks, earth, fascines, &c.

The mischief done by shells consists not only in demolishing the buildings on which they fall, but likewise in setting fire to most places they fall upon; and when they are followed by red hot balls, it is very difficult to hinder the town from being burnt. In order to remedy this evil, timely precautions should be taken, and the inhabitants employed in extinguishing the fire.

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First of all, a great number of casks, filled with water, should be placed in the streets; and the soldiers and inhabitants ought to be divided into companies, to prevent the spreading of the flames. It will be proper to divide these into small bodies, and to allot different quarters to each of them, for extinguishing any fire that may happen to particular houses. By these means each corps, or company, will become answerable, in some measure, for the houses intrusted to their care, and use their utmost endeavours to preserve them. The pavements must also be taken up, and dung laid in the streets, to prevent further mischief from the bursting of the shells.

§ 5. *Of the Defence from the investing to the Attack of the Covert-way.*

When the place is invested, and the besiegers begin to work upon the line of circumvallation, the governor ought not at first to fire upon the enemy's troops with the largest cannon, but with his small pieces only. For as the enemy ought to pitch their camp as near as possible to the place, provided they are out of reach of cannon-shot, they will think themselves at a sufficient distance when out of the reach of those small pieces: but as soon as they are encamped, the garrison are to give them a full volley with their great guns, which will oblige them to decamp once more, and make them lose time.

While the besiegers are constructing the lines, their engineers spare no pains to get an exact knowledge of the adjacent ground, and to reconnoitre the fortifications, that they may form the plan of attack, which they will be sure to make on the weakest side. To prevent this, M. Goulan proposes the following scheme.

As soon as the town is invested, the governor should send 200 or 300 men every night to that side which he knows to be the weakest, with orders to lie upon their faces, in the form of a semicircle, of which the palisades of the covert-way may be considered as the diameter. These men should be divided into small parties, of three or four men each, at the distance of 20 or 30 paces from one another, so as to occupy a large tract of ground. All these different parties ought to agree upon a signal, to give notice when any body passes by them, and they should remain there in silence till day, without stirring, unless somebody happens to pass by; in which case, the first that sees them should rise, and give the signal to the rest, who are to do the same; then all drawing close together, and advancing to the palisades, they will take those who passed, as it were, in a net, without any [illegible] their enemy, who cannot be numerous enough to rescue them from the hands of 200 or 300 men, protected by the fire of the covert-way. If the men who come to reconnoitre the place, instead of passing through the intervals, should fall in with some of these parties, and endeavour to get off, they must be fired upon: thus the enemy can be [illegible] hindered from [illegible], and thereby [illegible] a knowledge of the ground, or the side most proper to be attacked.

From the time the place is invested, the besieged should send every night small parties of eight or ten men, commanded by a serjeant, with orders to lie upon their faces all round the border of the glacis, and to listen attentively to every thing that passes. Whatever care the besiegers may take to open the trenches in silence, still it will be very difficult for this operation to be made, without such a motion as must be heard or perceived from the neighbourhood of the glacis. These small parties may even advance a little farther,

Of Sieges. further, obferving filence, and taking care not to be furprifed by the parties which the enemy alfo may fend out on that fide, to watch whether there are any troops of the garrifon ready to fall upon the workmen.

When the fide on which the enemy open their trenches is known, the great pieces of ordnance are mounted on the rampart of the town *en barbette*, and the fmall ones on the covert-way, from whence they are to fire brifkly upon the trenches. And to point more exactly, fire-balls are thrown from the mortars, which will give light enough to difcover the workmen. Juft at this time, the befieged fhould make the greateft fire againft the enemy, becaufe it is then they are moft uncovered, and confequently moft expofed. As the befieged cannot have their batteries ready till the fecond or third day after the opening of the trenches, during that time the guns may continue to fire *en barbette;* but it will hardly be poffible to fire in that manner when the enemy's batteries are once erected. Mortars fhould likewife be ufed for throwing fhells on the workmen and thofe employed on the batteries; in fhort, the beft ufe fhould be made of the artillery, before the enemy are in a condition to filence it.

It is cuftomary to make two or three attacks in order to divide the attention of the garrifon; and of thefe, generally fpeaking, there is only one real: they muft therefore endeavour to find out this real attack, and to ufe the utmoft diligence in making good retrenchments, as well in the outworks, which the enemy muft take before they can come to the body of the place, as in the gorge of the baftion of the front attacked. But to render thefe retrenchments ftrong and firm, they fhould have been begun and even finifhed before the opening of the trenches. A governor, who has a proper knowledge of fortification, ought to judge on which fide a town is moft acceffible, and to prefume that here the enemy will commence their attack; confequently he ought to think of every method of defence, the beft adapted to retard the approaches, and difpute every inch of ground.

The befieged fhould fo difpofe their artillery at the beginning of a fiege, as to enfilade the branches, and to direct their fire againft the head of the trenches or the faps. This muft be their principal effort; for it is by continually firing upon them that they may reafonably hope to retard the works.

When the enemy have erected their batteries, it is very difficult for the befieged to maintain theirs, efpecially if they are placed on the produced faces of the pieces attacked. For as the cannon are continually firing *à ricochet* againft thefe faces, and it being difficult to guard againft this firing, it will be very dangerous for the foldiers to remain there: all that can be done is to make fome traverfes, in order to diminifh their effect; which is difficult indeed to compafs, becaufe the fhot falling upon the traverfes will bound between them. It is advifable not to perfift in firing always from the fame place againft the enemy's batteries. By ceafing to fire from that part where the befiegers know there was a battery, they may be induced to think they have deftroyed it, which will prevent their continuing to fire againft it, and be a means of preferving the battery for future fervice. But in order to give them trouble, fmaller guns may be placed in the outworks, on the faces of the baftions, from whence the trenches and batteries of the befiegers can be difcovered; and they muft often change place to perplex the enemy, who will find it very difficult to difmount thofe moving pieces. The befieged however muft endeavour to repair the parapets deftroyed by the enemy, and to take proper meafures for firing again from thence, as foon as the befiegers have fhifted their guns.

It is alfo advifable that the batteries of the befieged fhould not fire in falvos, or all at a time: for it is well known, that the befiegers place foldiers in the trenches to obferve, through fmall loop-holes made with fand-bags in the parapet of the trench, when the batteries of the town are fired, and to give notice to thofe who are at work in the trenches, which way the guns are pointed, that they may put themfelves under cover. If the befieged have only fix pieces on a battery, and they fire them all at a time, the enemy have fome moments of fecurity to look over the parapet and to examine the ground where they intend to work and to conduct the trenches: but when the garrifon vary their manner of firing, they give more uneafinefs to thofe who are at work in the trenches, who will not be fo ready to look over the parapet; which, though it be neceffary, in order to view the fituation of the ground towards which the works are to be directed, is ever dangerous, but efpecially when the trenches are brought within mufket-fhot of the place.

§ 4. *Of Sallies.*

A GARRISON that keeps within a place, without making fallies, is, as the chevalier de Ville fays, like thofe who are not concerned when their neighbour's houfe is on fire, and will not ftir to extinguifh it till it has reached their own. And indeed, as the befiegers continually carry on their approaches towards the town, it is of the utmoft importance to endeavour, in time, to ftop their progrefs; to which end, the making of fallies is extremely conducive, efpecially when they are well conducted, otherwife they would rather accelerate than retard the taking of the place.

How great foever the advantage of fallies may be, they are proper only when a garrifon is numerous. A fmall garrifon, although well ftocked with all the kinds of neceffary ammunitions for making a defence, and for holding out, ought to be very careful how they venture to make a fally. But a numerous garrifon, not fo well provided, ought to fatigue the enemy as much as poffible by frequent fallies. The fame meafure ought to be followed when a town is but ill fortified; the garrifon fhould not fhut themfelves up fo as to be obliged to furrender, as it were, without making much refiftance. It is beft in thofe cafes to harafs the enemy continually, to keep them at a diftance as long as poffible, and to ufe every ftratagem and endeavour that may retard their approaching the glacis, and the taking of the covert-way. Thus it was that the marquis of Uxelles, afterwards marfhal of France, behaved at the fiege of Mentz in 1689. He defended that large and ill fortified town upwards of two months, with the help of a very brave garrifon; but was obliged to capitulate for want of powder and ammunition, though he was ftill mafter of the covert-way, and even in fome meafure of the glacis.

When the befiegers are at a diftance from the place, fallies are very dangerous, becaufe the enemy may cut them off from the town with their horfe; but when they have made their fecond parallel, and advanced the branches of the trenches towards the third parallel at the foot of the glacis, then is the time for the garrifon to fally. They may even venture, though with great caution, when the befiegers are at work upon the fecond parallel, and before it is entirely finifhed; but the moft favourable opportunity of fallying, is when the befiegers are come to the third parallel, and want to make a lodgment on the glacis. Then there is no danger of being cut off; and the enemy may be furprifed the more eafily, as the garrifon have it in their power to fall upon them all at once, and to throw them into confufion, without giving them time to recover themfelves.

Sallies may be either great or fmall; the former ought to

to be with 500 or 600 men at leaſt, or proportioned to the guard in the trenches; the latter are only with 10, 15, or 20 men.

The intent of great ſallies ſhould be to deſtroy a conſiderable part of the works of the beſiegers, in order to oblige them to begin again; to nail up their guns; to retake ſome poſt which had been abandoned; and laſtly, to obſtruct the enemy's works as much as poſſible, and thereby retard the taking of the place.

In regard to ſmall ſallies, they ſerve for no other end than to interrupt the workmen at the head of the trenches, ſo as to frighten them, and oblige them to run away. As it requires ſome time to bring them back, and to make them return to their work, this will occaſion delay, and retard the approaches.

The beſt time for great ſallies, is two hours before daylight, the troops being then fatigued and ſleepy; therefore more eaſily ſurpriſed, and leſs capable of making a vigorous reſiſtance. And when it has rained very hard in the night, ſo that the guard in the trenches may be unable to make uſe of their fire arms, this is alſo a favourable circumſtance: in ſhort, no opportunity ſhould be neglected to ſurpriſe the enemy; for ſallies ſeldom prove advantageous any other way. The following is the order which M. Vauban propoſes to be obſerved.

There ſhould be a detachment of 90 men drawn up, 30 in front, and three deep; to which muſt be added a fourth rank of 30 grenadiers. The three firſt ranks of this detachment ſhould be armed with cuiraſſes; each ſoldier ſhould have a ſword and piſtol at his belt, and a partizan, or long iron fork with a hook, in his hand. This detachment is to be followed by another of 180 men, 30 in front, and ſix deep; the firſt rank of theſe is to be armed as the former, with cuiraſſes and long weapons, the reſt as uſual. The firſt rank in this detachment is to make up the rear in the retreat. After this ſecond detachment 200 workmen are to follow with proper tools to deſtroy the enemy's works, and ſeveral of theſe with combuſtibles to burn what they cannot otherwiſe deſtroy. Some of them are to be provided with long nails of ſteel, and of different magnitude, to ſpike the cannon; there muſt be ſome of a very large ſize, becauſe the touch-holes happen frequently to be ſo very wide, that common nails will not fill them up exactly.

Beſides the two detachments and workmen above mentioned, another body of 300 or 400 men ſhould be ordered to ſupport them, and to follow them ſlowly as far as the head of the trenches; where, if they find that thoſe who went before them have no need of aſſiſtance, they ſhould halt to be ready to act if occaſion requires it. If the guard of the trenches ſhould make a vigorous attack upon the ſally, this detachment will ſupport them, and jointly encounter the beſiegers. If the latter are repulſed, which muſt be the caſe if the ſally is not foreſeen and expected, the workmen muſt ſet about demoliſhing the works, and filling up the trenches as faſt as poſſible. Theſe troops ſhould alſo endeavour to penetrate as far as the batteries, in order to nail up the cannon, and to maintain themſelves in the trenches long enough for the workmen to deſtroy great part of them. When they have done what they propoſed, they retreat to the covert-way in good order; and if the enemy ſhould be ſo imprudent as to purſue them as far as the glacis, they muſt be received with a briſk fire as well from the cannon of the ramparts as from the troops in the covert-way.

In ſallies, and generally in all actions performed by night, the ſoldiers ſhould put ſomething in their hats, as a white paper or handkerchief, to know one another in the dark. The troops deſigned for this purpoſe are drawn up in the place of arms within the town, or in the ditch if it be dry, or elſe in the covert-way. When they are to march out by different gates, ſome ſignal [illegible] be agreed upon, that they may all move at the ſame time. If there are more attacks than one againſt the town, as [illegible], then ſeveral ſallies may be made at the ſame time [illegible] attacks. It might be proper to make a great [illegible] one ſide, in order to draw all the attention of the enemy that way; and while they are [illegible] in the [illegible], [illegible] on the other ſide; for then they [illegible] leſs reſiſtance, and will be [illegible] the beſieger. However, as a ſally which [illegible] the ſucceſs that might be expected, ought not to diſcourage the garriſon from repeating the attempt; [illegible] crowned with ſucceſs ought not to [illegible] dent, or inſpire them with too great a [illegible] enemy. The miſtakes the latter may have committed, will rouſe their attention, and put them upon their guard. We ought ever to ſuppoſe, that they will [illegible] do, were we in their place, and that they will take proper meaſures to remove every obſtacle that may oppoſe them.

Hitherto we have taken no notice of [illegible] in ſallies; and yet on ſome occaſions [illegible], which is when the beſiegers [illegible] a [illegible] place. In this caſe, two detachments of horſe are ordered to the right and left to ſupport the ſallies, and to hinder the enemy's horſe from falling upon them. Theſe detachments ſerve alſo to protect their retreat, and to prevent their being cut off; but when the beſiegers have finiſhed their third parallel, the ſallies are then made with foot only, and ſhould, as we have above obſerved, be often repeated, provided the garriſon is numerous enough to diſpute every inch of ground with the enemy.

As ſoon as the troops are returned from the ſally, fireballs ſhould be thrown into the trenches, to diſcover the workmen who are employed in repairing the miſchief that has been done, and are at that time in ſome meaſure uncovered. The fire of the place well ſerved at this juncture, muſt kill a great many of the enemy. So far relates to great ſallies.

The ſmall ſallies, which are intended merely to diſturb the beſiegers without being able to do them much hurt, are conducted in the manner following. The governor orders out parties of 10, 15, or 20 ſtout men only, as hath been already obſerved, who are to advance ſoftly to the head of the trenches, and to jump into them quickly, making a great noiſe, and throwing grenades; after which they are to retire with all expedition: the alarm which they will occaſion is ſufficient to make the workmen take to their heels, who deſire nothing better than to have a ſpecious pretence, as M. Goulon obſerves, to run away upon the leaſt alarm; and it is impoſſible to prevent it, or to bring them back the ſame night; ſo that the beſiegers muſt loſe all this time. If, ſays the ſame author, the beſiegers become accuſtomed to theſe little ſallies, ſo as to grow ſecure and take no notice of them, the beſieged obſerving this muſt make one in good earneſt, which coming unexpected, will eaſily overturn the workmen and the troops that cover them: after which they may retire without fighting, leſt they ſhould draw the whole guard of the trenches upon their backs.

§ 5. *Of the Defence of the Glacis and the Covert-way.*

Besides the ſallies which retard the [illegible] of the beſiegers on the glacis, mines may [illegible] of approaching. We have already taken notice of [illegible] in the ſection of *Attack*; we have only to obſerve [illegible], that the beſieged muſt make the beſt uſe of them poſſible, in order to blow up the enemy as often as the [illegible] will [illegible]:

Of Sieges. permit; this is the sureſt way to keep the beſiegers in awe, and to oblige them to advance with the greateſt circumſpection.

Beſides the galleries and mines which ought to be under the glacis, the beſieged may alſo lay oppoſite to its angles large planks, ſtuck full of very long nails, with the points upwards, to incommode the enemy in paſſing over the glacis. Theſe planks ought to be ſtrongly fixed, to prevent their being eaſily taken away. The burying of caiſſons in the glacis is alſo productive of a good effect; but they ought never to be placed nearer than ſix or eight feet to the inſide of the covert-way, leſt they ſhould do any damage to the troops that defend this poſt.

When the enemy endeavour to make a lodgment on the glacis, the garriſon muſt repeat their ſallies with greater vigour; which may be done without any inconvenience, becauſe of the facility of retreating. When the troops are returned from the ſally, fire is ſet to the chambers and caiſſons, which will greatly diſconcert the beſiegers. If the chambers are well diſpoſed, they muſt hurt their lodgments prodigiouſly; and as ſoon as they are ſprung, the beſieged may fall upon the enemy, this being a favourable opportunity for ſurpriſing them in diſorder, and conſequently of deſtroying part of their works. This manner of proceeding ſhould be often repeated, in order to fatigue the beſiegers, and to retard the taking of the covert-way.

When the enemy are ready to ſtorm it, the garriſon muſt prepare to give them a warm reception. The difficulty of making a lodgment in the covert-way may be increaſed by a double row of paliſades: the ſecond ſhould be lower than the firſt, to the end that the enemy may not perceive them. Theſe two rows ought to be at the diſtance of four or five feet from one another, to prevent the beſiegers from jumping over them into the covert-way. Between them may be made a ſmall ditch; into which moſt of the enemy's grenades will fall, and cauſe leſs miſchief to the troops. Care muſt be taken to make ſtrong retrenchments in the places of arms, either by raiſing a parapet withinſide, and parallel to their faces, with a ſmall ditch at the foot of it, or by ſimple rows of paliſades, which will hinder the enemy from forcing their way ſo eaſily as they would otherwiſe be capable of doing. In each place of arms there ſhould be one or two barrels of powder, with balls and ſmall arms neceſſary for the defence of the covert-way.

All the batteries muſt be got ready to fire with the utmoſt briſkneſs upon the enemy, when they are at work upon their lodgment. Every part of the place that looks into the covert-way ought to be lined with troops, who are to fire upon the beſiegers; but there ought to be no troops in the parts oppoſite to the places of arms, that the troops poſted there may not be hurt by the fire from the body of the place.

The garriſon ſhould endeavour to be informed by deſerters at what time the enemy intend to make their attack; the motions of the latter may be alſo obſerved by perſons poſted on ſteeples; and as ſoon as the troops are perceived to make an extraordinary motion, and the trenches to be filled more than uſual, this is a ſign that they are going to attack. The vicinity of the enemy's works may alſo enable the beſieged to judge of their forwardneſs; and all this together direct them to take ſuch meaſures as are proper for giving a warm reception to the beſiegers.

As ſoon as the garriſon perceive that the enemy are marching out of their trenches, they ſhould keep firing upon them continually with great and ſmall arms from all the works facing the attack. This will deſtroy a great many of their men before they can reach the paliſades: the two rows of which in the covert-way will prevent their jumping into it directly. They will be under a neceſſity of breaking them ſucceſſively with hatchets; and while this is doing, a general diſcharge is to be made from the batteries of the town, which will do great execution. When, after a vigorous reſiſtance, the garriſon find themſelves hard preſſed by the enemy, they may abandon the covert-way, and retire into the places of arms; and while the beſiegers are working upon their lodgment, they will be expoſed to the fire of the place, which takes them in front; and to that of the places of arms, by which they are taken in flank; ſo that their loſs muſt increaſe conſiderably. If they have mines ready, as we ſuppoſe they have, they muſt ſpring them, after having ſuffered the enemy to work for ſome time upon their lodgments; and after having kept firing againſt them continually with great and ſmall arms, then immediately they ſhould make a ſtrong ſally from the places of arms, and taking advantage of the diſorder into which the beſiegers muſt inevitably be thrown, they will oblige them to abandon the covert-way.

If there is no poſſibility of hindering the enemy from making lodgments on the creſt of the covert-way, or, which is the ſame thing, on the ridge of the glacis, the beſieged muſt endeavour to retard them, and to diſpute as long as poſſible their taking poſſeſſion of the places of arms. On this occaſion fougaſſes are employed with ſucceſs, and ſhould be repeated ſeveral times if the ground will permit. When the beſiegers have once completed their lodgment, and ſupported it in a proper manner, they want nothing further than a little time to extend themſelves, and to become maſters of the covert-way. The obſtinacy of the beſieged can only retard, but not abſolutely hinder, the taking of this outwork.

Let us ſuppoſe that the enemy reſolve to approach the covert-way by ſap, and that they have raiſed cavaliers in the trenches to plunge into this outwork, the beſieged muſt ſtrive to retard this operation by every ſtratagem imaginable; for when the cavaliers are once conſtructed, it will be very dangerous to abide any longer in the covert way. They muſt ſtop the beſiegers at every ſtep with mines; they muſt haraſs them with a conſtant diſcharge of fire-arms, and diſpute every inch of ground, defending themſelves behind every traverſe, and in the places of arms, as well as they can, without running too great a riſk of having their retreat cut off.

§ 6. *Of the Defence of the Paſſage over the Ditch before the Half-moon.*

The enemy having made themſelves maſters of the covert-way, and perfected all their lodgments, will erect their batteries for making a breach, and prepare for the deſcent into the ditch. All this while the beſieged muſt keep firing both with their great and ſmall arms, in order to incommode the enemy in the conſtruction of their batteries. If the ditch is dry, the ſoldiers may mount with ladders along the counterſcarp, and from thence throw grenades into the enemy's works; and when they cover themſelves in the covert way with ſand-bags, gabions, &c. againſt the fire of the place, theſe very ſoldiers ſhould, with great ſap-hooks, pull down part of them, and afterwards jump nimbly into the ditch, leaving the enemy expoſed to the fire of the town while they are putting their materials again into order. Mines may be likewiſe uſed here with great advantage; they furniſh various means to haraſs the enemy, to obſtruct their works, and to make them loſe time and men.

The batteries of the beſiegers being deſtroyed by mines made under them, muſt oblige them to loſe a great deal of time in repairing them, and in endeavouring to make themſelves maſters of the mines, otherwiſe they can never be ſecure.

ces. secure. When the besieged have blown up the batteries that were to open the breach, they must make good use of the time which the enemy will spend in repairing them, and strive to perfect the retrenchments, which should have been set about at the commencement of the siege, in the gorge of the half-moon, and in those of the bastions of the front attacked.

The mines for blowing up the batteries of the covert-way may be disposed in such a manner as to tumble the guns into the ditch, as may be seen in the course of mathematics by M. Belidor, who performed it with success at the academy of La Fere.

It is certainly a great advantage thus to be able to become masters of the cannon of the besiegers, and to oblige them to erect new batteries, which must take them up a considerable time. A doubt here may arise, whether if these batteries are opposite to that part where the enemy intend to pass the ditch, this would not be helping to fill it up, should the besieged blow up the guns: but this inconvenience is of no great consequence, especially as it may easily be remedied, by clearing away the rubbish of the mine which tumbles into the ditch along with the battery.

As the besiegers work at the descent into the ditch at the same time that they are preparing their batteries, the besieged must think of retarding both these operations also at the same time. If the descent into the ditch is made under ground, miners should be employed to interrupt the work; and if the ditch is dry, small detachments, as M. Goulon observes, of five or six men, may be placed near the counterscarp, to watch the moment that the enemy break through it, and immediately to fire into the gallery: this discharge will either kill or frighten the miners; and at least will retard the works. Those who have fired, should retire on each side the opening to load their arms again, which may be repeated several times. Fire-balls and grenades may be likewise thrown into this opening, which will oblige the sappers to retreat.

If the ditch is filled with water, the same operations may likewise be performed with small boats made on purpose; and to cover these boats a kind of parapet should also be raised by means of strong boards, with holes to fire through upon the soldiers, who upon opening the gallery will throw fascines into the ditch. At the siege of Lisle, marshal Boufflers contrived some boats of this kind to retard the passage over the ditch, before the grand lunettes or tenaillons in the front attacked, and that before the half-moon.

When the enemy make their opening into the dry ditch, they must be opposed with a strong fire, as well from the face of the bastion which flanks the ditch before the half-moon, as from the place of arms or traverse, which ought to be constructed the whole breadth of the ditch, in order to strengthen the defence. By night small sallies should be made from this place of arms, with a view to interrupt the passage over the ditch, and to retard, as much as possible, the fixing of the miner.

There are two ways of passing the dry ditch, and of bringing the miner to the foot of the revetement which he is to enter. The first consists in making a gallery six feet wide, with a double row of barrels. These must be filled with sand-bags, and so must the spaces between them, in order to render the passage of the gallery more safe; and that there may be a shelter from fire-works, strong planks are laid over it, and these again are covered with raw hides, or with earth and dung. This gallery is continued within three or four feet of the revetement; and in this space a good epaulement is raised with sand-bags to cover the miner on the side exposed to the place. In regard to the other side, it is of no use to stop it up; nay, it serves for an opening to fill the ditch with the earth dug out of the galleries, which the miners are making in the rampart of the work attacked. It is easy to oppose the progress of this gallery with a continued fire, and with several other works constructed within the ditch.

Of a [illegible]

The other way, which, as we have already [illegible] [illegible] of the [illegible] [illegible] breach by sap, with [illegible] the place, may be [illegible] from the fire works [illegible] this sap may be retarded [illegible] [illegible] away the earth [illegible] and [illegible] out with [illegible] fat [illegible].

If the ditch is filled with [illegible] rupt the enemy's bridge [illegible] great and small guns, as well [illegible] they are in a condition [illegible] epaulement. If the water [illegible] open sluices in order to [illegible] to carry away the [illegible]. [illegible] set fire to it with [illegible]. They may likewise [illegible] and draw away the [illegible] throw anchors upon it; and [illegible] those parts which flank the ditch, they may draw these anchors with cords fastened to them, and tumble part of the epaulement into the ditch. In short, every expedient must be tried that may possibly retard the enemy's approaches: for when once they have [illegible] they will soon be masters of the [illegible] bridge [illegible], whatever [illegible] to defend the breach; because, as the besiegers can always pour in fresh men to supply the [illegible] attack, they must at length surmount all opposition.

§ 7. Of the Defence of the Half-moon.

While the enemy are effecting the passage over the ditch, besides the difficulties that are raised to retard the work, all proper precautions should be used to defend the breach, and prevent the taking of the half-moon. For this purpose guns are placed in all the works from which the breach may be seen; and they should be placed on carriages or on pieces of wood, as the [illegible] find most [illegible], of least hinderance to the defence, and productive of the best effect.

If the half-moon has no redoubt, as here we suppose it has none, the retrenchments, which ought to have been made there, must be put into good condition; a row of palisades must be placed before it, in order to stop the first fury of the enemy after they have made themselves masters of the breach; in a word, the besieged must prepare to dispute every inch of ground, and to retire from the half-moon into the town, when they find themselves hard pressed and no longer able to maintain that post.

When the enemy present themselves at the foot of the breach, a great number of grenades, and sacks filled with powder, are thrown among them, with a view to [illegible] them into disorder. Glass or earthen bottles filled with powder, and burning matches twisted round them, are capable of doing them a deal of mischief. A great quantity of loose powder may be scattered about the breach when the enemy are ready to mount to the assault; and when they are mounted, lighted matches or burning coals may be thrown among the powder to set it on fire; which will [illegible] a number of those who are in the breach. It will be proper also to throw into the breach a quantity of harrows, thick full of large nails with the points upwards; and to prevent the

2

Of Sieges. the enemy from removing them, they muſt be faſtened with chains, or with great cords. It is adviſable to be provided with crows-feet, and to ſpread them about; as alſo with chevaux-de-friſe, and with heriſſons, that ſhall extend the whole width of the breach (ſee HERISSON). Shells alſo faſtened to the ends of chains, in order to confine them to that part where they may do moſt damage to the enemy, are an excellent contrivance. Their fuſees are made ſhorter than uſual, to the end that they may produce their effect more readily. Faſcines ſmeared over with tar, and, in ſhort, every ſtratagem ought to be tried to hinder the enemy from lodging themſelves in the breach.

When the beſiegers have ſurmounted all theſe obſtacles, and at laſt have got poſſeſſion of the breach, the mines are ſprung in order to blow them up, and chevaux-de-friſe are placed along the whole breadth of the breach. The troops poſt themſelves behind, and continue to make a vigorous fire upon the beſiegers while they are uſing their utmoſt endeavours to penetrate into the half-moon; and when they begin to force their way, the firſt rank of men that defend it, being armed with partiſans or halberts, and ſupported by the other troops, ought to fall upon the enmy, and cut them in pieces. But if the beſiegers at length by dint of numbers ſhould drive the garriſon from the breach, the latter ought to retire into the retrenchment, and from thence make a very briſk firing; and when they find that this is alſo upon the point of being forced, then they are to withdraw their cannon, and whatever ammunition they may have, into the place; and laſt of all, if they have any mines under that ſpot, they muſt ſpring them as they retire, in order to do all the miſchief and to create all the confuſion they can to the beſiegers.

Sometimes it ſhall happen that the enemy, after having made themſelves maſters of the half-moon, omit to leave a ſufficient number of troops to guard the lodgment, upon a preſumption that the beſieged will not attempt to retake it. Whenever they ſhow a confidence of this kind, a ſtrong body of the garriſon ſhould return in the night and ſtorm this work, either by the gorge, or by ſome other part. There are great odds, but ſuch a vigorous and ſudden ſurpriſe will be productive of a very good effect; at leaſt there is no great riſk in trying, if the ſtrength of the garriſon will permit; and ſhould they ſucceed, the taking of the town will be retarded ſeveral days.

Here we have ſuppoſed that the enemy are reſolved to ſtorm the half-moon; but if they ſhould attempt to get poſſeſſion of it by means of ſaps, in that caſe the workmen muſt be continually haraſſed by blowing up mines, and kept as long as poſſible from the breach by means of fire-works of all kinds. When they begin to make a lodgment in the breach, then the beſieged ſhould fall upon them briſkly, and deſtroy the lodgment; in ſhort, every artifice imaginable ſhould be uſed to retard their progreſs.

This laſt method is leſs bloody than the other; but on the other hand, it may be very tedious, when the beſieged ſpare no pains to diſturb the enemy's ſappers and miners.

One thing that greatly deſerves attention, and may render it very difficult for the beſiegers to mount to the aſſault, or to lodge themſelves in the breach by means of ſaps, is to clear away the rubbiſh in the breach. In a dry ditch this may be eaſily done; but in a wet one, the thing is more difficult: on the other hand, in the latter caſe the breach is more eaſy to defend than in the former; becauſe as the enemy cannot come to the foot of it but by the bridge of faſcines, which is made in the ditch, and is ſeldom above 10 or 12 feet wide, they cannot of courſe preſent themſelves with ſo large a front before the breach as in a dry ditch; conſequently the garriſon muſt find it much eaſier to repel them.

§ 8. *Of the Defence of the Paſſage over the Ditch before the Baſtion.*

AT the ſame time that the enemy are carrying on the attacks of the half-moon, they work at the paſſage over the ditch before the baſtion. What has been ſaid in regard to the defence of the ditch before the half-moon, may be applied on this occaſion; we have only to add, that when this ditch is dry, the caponier will be of great uſe to fire upon the enemy in their paſſage over the ditch, and to ſally from thence in order to deſtroy their works. If the ditch be wet, it muſt be defended in the ſame manner as that before the half moon: here only we ſhall add, that if there is a tenaille oppoſite to the curtain of the front attacked, the fire from thence will greatly annoy thoſe who are employed in filling up the ditch. Beſides, the boats by which we obſerved that the enemy might be incommoded in the paſſage over the ditch, the beſieged may likewiſe have recourſe to a kind of floats, made with double joiſts, at the end of which are faſtened empty barrels, to prevent their ſinking too deep in the water; and theſe floats ſhould be loaded with ſhells, barrels of gunpowder, faſcines, pitch and tar; and in ſhort, with all ſorts of combuſtibles proper for ſetting fire to the bridge, and to the enemy's epaulement: theſe are brought forward and faſtened to the epaulement, and afterwards they are ſet on fire with a match, or with tow laid amidſt the combuſtibles.

When there are dikes or ſluices, by means of which the ditch may be filled with water at any time, every art muſt be tried to defend it while it is dry; and when all the defences are exhauſted, then the water is let in, and the enemy will be obliged to begin their work again.

§ 9. *Of the Defence of the Baſtions in the Front attacked.*

HERE the reader muſt recollect what has been ſaid in regard to the defence of the breach in the half-moon. The defence of the baſtions is more eaſy, becauſe it is not ſo difficult to retreat from thence, by means of the retrenchment; and this retrenchment ſhould be larger and more ſpacious than that of the half-moon, and more difficult to force.

Beſides all the precautions we have been mentioning, as mines under the breaches, within the baſtions, &c. the beſieged ſhould alſo mount ſeveral pieces of cannon on the breach, charged with cartridge-ſhot, and pointed downwards, ſo as to be able to ſweep the whole ſurface of the ground on which the enemy muſt form in order to march to the aſſault. Care muſt alſo be taken, leſt the enemy, diſcouraged with the difficulty of ſtorming the breach, attempt to ſcale the baſtion, as hath been practiſed ſeveral times, and particularly by the duke de Noailles, marſhal of France, at the ſiege of Gironne, in 1712. The way to guard againſt this attempt, is to place along the parapet of the works that may be inſulted, large pieces of timber, which are to be tumbled upon the ladders as ſoon as the enemy offer to mount. They ſhould alſo have loaded ſhells all along the rampart, faſtened to chains, and to let down towards the middle of the ladders, where they will burſt and kill thoſe who are mounted. They ſhould likewiſe be provided with combuſtibles of different kinds, to throw upon the beſiegers, and to keep them off from the foot of the revetement. When the garriſon are well prepared againſt this attempt, it will be very difficult for the enemy to ſucceed.

The entrance of the baſtion may likewiſe be defended, by

by making a ditch in the upper part of the breach, and filling it with all sorts of combustible matter. This will form an impenetrable barrier against the enemy, at least for some days; which time is to be employed in strengthening the retrenchments, and throwing up others, one behind another, if the ground will permit, and it be resolved to defend the place to the last extremity. Though it is usual for the enemy to force their way into the town by the bastion, and therefore the principal retrenchments for defending the entrance of the place should be raised in this part; yet it is proper not to neglect the curtain. The enemy may be apprised of these retrenchments, and as it is not the practice to make any behind the curtain, they may take it into their heads to batter it in breach, and to construct a bridge in the ditch before it, in order to penetrate into the town. Thus did prince Eugene act at Lisle; as the back part of the curtain was open, the place was obliged to capitulate. The breaches may likewise be defended by repairing them with large trees laid across one another, the branches pointed towards the enemy. Cannon will make no great impression on this kind of wall; which was the principal defence of the ancients when a breach was made.

When the besiegers have triumphed over all these obstacles, so as to be masters of the breach, and to extend their lodgments on the bastion; then it is no longer possible to defer capitulating, unless there are several retrenchments one behind the other. In that case, indeed, the besieged, if they think proper, may defend themselves to the very last; but this desperate defence is very rare, because every wise governor chooses to preserve the garrison, and to save the town from being plundered, which would be the case, according to the laws of war, if it was taken by storm.

§ 10. *Of Precautions to be used against the surprising of Towns, Scalades, sudden Attacks, &c.*

The right way to prevent surprises, is to think that the enemy have a design upon the town, and to use all the precautions possible in order to frustrate their designs. With this view a governor should put the fortifications into a good state of defence, should see that the several posts, whether accessible or inaccessible, be well guarded, that parties be sent to range in all the principal avenues of the place; in a word, he should most exactly observe whatever is prescribed in the military ordinances concerning the guard of towns, the opening and shutting of gates, &c. We shall make no mention of any of these particulars, because a very short stay in a garrison is sufficient for learning every thing that may relate to the daily and customary duty, as well for the safety of the town, as for the preserving peace and good order among the inhabitants, and for preventing any strangers or suspected persons from entering the place, &c.

We shall only observe, that when a fortress is situated upon a river, care should be taken to have boats in the night, filled with soldiers, both above and below the town, to hinder any body from getting in that way undiscovered. If the ditches are filled with water, in frosty weather the ice should be broke every day; in short, nothing should be neglected that tends to secure the place against any enterprise either from within or without.

But chiefly on fair or market days this vigilance should be exerted; the guards ought to be doubled at all the gates, and the garrison should be disposed in such a manner as to be ready to fly to their arms upon the first beat of drum: care should be also taken to make the cavalry mount on horseback, ready to act in all events. By [illegible] cautions, it will be very difficult for the [illegible] the town; nay, the consequence [illegible] exact discipline observed by the [illegible] such their design; for no [illegible] neglect of military duty, and too [illegible] the governor.

With regard to precautions against scalades, they consist in having small parties [illegible] of the place, in order to be better informed of the enemy's motions, and to keep a patrol all [illegible] the ditch unperceived. A cuvett (F) may be [illegible] within the ditch, and palisades planted within some distance of the wall, to hinder the enemy [illegible] ladders to it; the flanks of the bastions should be furnished with cannon, charged with cartridge-shot, with balls of a quarter of a pound weight, or with pieces of old iron, to fire upon those who should attempt to scale the place [illegible]; in the corps de gardes, within reach of the rampart, a provision should be made of halberts, with all other offensive weapons fit for repelling the enemy when they appear on the top of the ladder, and for driving them into the ditch; the ramparts should be stocked with a great quantity of cylindrical timber, to roll down upon the ladders, and those that are upon them; and if the garrison are not [illegible]rous as to be able to cover the whole ramparts, they should fix chevaux-de frize, or something else, to the upper part of the parapet, which will hinder the enemy from getting over, in order to jump upon the rampart. There ought also to be a stock of shells and grenades all loaden upon the walls, in order to roll them down into the ditch upon the enemy. There should likewise be fire-works ready to throw upon them, as fascines done over with pitch and tar, powder-barrels, fire-pots, &c.; a great number of fire-balls should be also flung into the ditch in order to give light, and that the cannon of the place may do good execution upon those who are got into it; the ditch should likewise be filled with crows feet, or little holes dug and covered with hurdles and earth, so that the enemy shall not perceive them, but tumble into them: in the middle of these little ditches there should be a palisade, or some long iron-spikes, ranged in such a manner as to run those through that shall fall upon them. Neither are the gates to be neglected; the enemy will not fail to try to fix a petard to them, while the troops are endeavouring to make themselves masters of the rampart. Soldiers must be placed in a convenient situation for firing on the person that fixes the petard: in all events the gates must be strengthened withinside, and large trees must be got ready to debar the enemy from entering the town, should they be able to break open the gate.

At the first alarm of an attack, all the troops ought to run to the place assigned them, in order to be led from thence to the ramparts. With regard to the cavalry, they ought also to mount on horseback, [illegible] into several small bodies, which are to [illegible] the rampart, ready at all events to charge the enemy, should they find means to penetrate by some way or other into the town.

If the enemy make several attacks at the same time, it will not be proper to quit those parts where they do not show themselves; this perhaps is a feint only to draw the troops from the side which they really intend to attack; therefore the garrison should be equally on their guard on all sides, and leave no [illegible] enemy have forced their way into the town: then indeed the bu-

(F) A cuvett is a small ditch dug in the middle of the large one.

Of Sieges. finefs is to charge them vigoroufly, in order to oblige them to retire.

Upon the whole, it is eafy to withftand a fcalade when there is no furprife; and therefore it rarely happens that a governor, who takes the neceffary precautions againft any fuch accidents, will lofe a town by this kind of attack.

A fcalade may be attempted in the day as well as by night; the latter indeed is more favourable to the affailants, yet they will not fucceed a whit the better, if they find that the garrifon are prepared to receive them, agreeable to what we have already mentioned.

There remains only to mention a word or two in regard to accelerated fieges; which is, that a governor will not be expofed to this fort of fiege, if he takes the proper precautions to be informed of the fteps and approaches of the befiegers.

If the enemy pretend to carry on a fiege in form, and at the fame time accelerate their approaches on one fide of the place, the garrifon muft fall vigoroufly upon them, and fpare no pains to drive them out of what works they have feized upon. One may fufpect their defign, if it appears that they do not make their attack on the fide of the town where naturally they ought to make it, that they want to become mafters of the place with greater eafe; and then the befieged fhould double their guard on that fide. In general, there fhould be a conftant attention to all the fronts of the place, and they fhould be all equally guarded, till it appears clearly by the enemy's works on which fide they form their attack, and which way they direct their works; neither are the other fides to be even then neglected, left the enemy fhould lay hold of this opportunity to attack them. It is always to be fuppofed that they are informed of every thing that paffes within the town, either by their fpies, or by deferters; for which reafon the poft that feems leaft acceffible ought not to be neglected.

§ 11. *Of Capitulations.*

The capitulation being the laft tranfaction, both in the attack and defence of a town, this feems to be the moft natural place for fpeaking of it, as it feems to be the moft proper fubject for terminating this article.

When the governor, who defends a town, finds himfelf reduced to the laft extremity, or is ordered by his court to furrender, with a view of obtaining better conditions of the enemy, both for the town and garrifon, he orders the chamade to be beat. For this purpofe one or more drummers are directed to beat their drums on the rampart, on the fide next to the attack, to give notice to the befiegers that the governor has fomething to propofe to them; one or more white colours are likewife hung out for the fame purpofe, and one of them remains either on the rampart or on the breach during the time of negociation. The fame is practifed in demanding a fufpenfion of arms, after a very violent attack, to bury the dead, carry off the wounded, &c.

As foon as the chamade is beat, the firing ceafes on both fides, and the governor fends fome officers of diftinction to the general who commands the fiege, with the conditions on which it is propofed to furrender. As a fecurity, or as hoftages for thofe officers, the befiegers fend at the fame time the fame number into the town: if the governor's propofals are not agreeable to the commander of the befieging army, he rejects them, and mentions what terms he is willing to grant. Generally fpeaking, he threatens the governor to allow him no conditions at all if he does not determine to furrender quickly; for inftance, when the paffage over the ditch of the place is finifhed, or batteries are erected oppofite the flanks, &c. If the befieged find the conditions too hard, the hoftages are reftored, and the drums are beat again upon the rampart, to make every body withdraw before hoftilities are renewed, which is done very foon after. It is to be obferved, that during the negotiation they ought to be quiet on both fides, and by no means fhould go on with the operations of the fiege. The governor ought during this time to be upon his guard, for fear of being furprifed by ftratagem; which might expofe him to the difcretion of the befieger.

Suppofe that the terms of capitulation are agreed upon, two or three of the principal officers of the garrifon are fent as hoftages to the enemy; and the general of the befieging army fends back the fame number, and of equal degree, as a fecurity for fulfilling the capitulation.

The conditions infifted upon by the befieged muft vary according to the different circumftances and fituations in which they find themfelves. But when the capitulation is entirely fettled, an officer of artillery from the befiegers enters the town, to take an inventory of all the artillery and ammunition remaining in the place, in conjunction with an officer of artillery from the garrifon. A commiffory of ftores enters likewife to take an account of the provifions.

When a governor finds that he muft furrender, and that there are confiderable magazines of ammunition and provifions, he fhould deftroy moft of them before he offers to furrender, to the end that there may remain no more in the place than what is neceffary for a capitulation, and that the enemy may reap no advantage from thence. If he fhould not, before he enters into a capitulation, burn or deftroy thofe magazines, the enemy might infift on their being preferved; but they can think nothing of it when thofe precautions are taken beforehand.

As foon as the befieged have delivered up a gate of the town to the enemy, the firft regiment of the army enters, and mounts guard.

When the day is come that the garrifon are to leave the place, the befieging army is drawn up in two files of battalions and fquadrons, and the garrifon are to pafs between them. The hour for their marching out being arrived, the general and the principal officers put themfelves at the head of the troops, to fee the garrifon defile before them.

The governor puts himfelf at the head, followed by the principal officers; and he makes the garrifon march in the beft order poffible. The oldeft regiments move commonly in the van and the rear, and the others in the centre with their baggage. When there is any cavalry, it is divided in the fame manner into three corps, for the van, the centre, and the rear. Small detachments of horfe and foot are made to march along with the baggage, and to take care of its not being rifled.

The artillery granted by the capitulation marches after the firft battalion. When the garrifon arrive at the place agreed upon, they deliver up the hoftages of the befiegers to the efcort; and when the latter have rejoined the army, they fend back the hoftages which the befieged left for the fecurity of the efcort, with the waggons, and other things granted by the befieging army for efcorting the garrifon.

When the garrifon are made prifoners of war, they are likewife efcorted to the town agreed upon by the terms of the capitulation.

Every thing fettled in the capitulation ought to be facred and inviolable, and fhould be underftood in its genuine and moft natural fenfe: yet as this is not always practifed, the governor fhould take the utmoft precaution to have no word inferted that fhall be in the leaft equivocal, or liable to different interpretations. There are a great many examples which prove the neceffity of this precaution.

When the garrison of a town capitulate in order to retire to the citadel, there are some particular conditions to be observed; such as follow.

That the citadel shall not be attacked on the side next the town; that the sick and wounded, who cannot be removed, shall stay in their present lodgings; and when they are recovered, they shall be provided with carriages and transports to retire in safety to the place agreed on in the capitulation. None should be suffered to enter the citadel, but those who may be of use in defending it; the rest, who are called *useless mouths*, by no means ought to be admitted. Mention should be made in the capitulation, that those people shall be conducted to some neighbouring place in the dominions of their sovereign, which should be named. A certain time ought also to be allowed for the whole garrison to enter the citadel; and it should be expressly mentioned, that during this time the besiegers shall construct no works that are necessary for the reduction of the citadel.

A maritime town requires also some particular conditions, in regard to the ships that may be in the harbour. It should be stipulated, that they shall quit the harbour the same day as the garrison marches out of the town, or when the weather permits to sail to the port agreed upon. They should preserve their artillery, rigging, ammunition and provisions, &c. If they should be obliged by want of provisions to put into any harbour of the besiegers in the way, it ought to be mentioned in the capitulation, that they shall be received there, and supplied with necessaries for continuing their voyage; they ought also to be provided with passports, and, in a word, to have every kind of security, that they shall not be insulted by the enemy's ships, but suffered without the least obstacle to steer to the port agreed upon.

Man of War Bird. See Pelicanus.

War-Cry was formerly customary in the armies of most nations, when just upon the point of engaging. Sometimes they were only tumultuous shouts, or horrid yells, uttered with an intent to strike terror into their adversaries; such as is now used by the Indians in America, called the *war-whoop*.

WARBLES, in farriery. See there § xxxii.

WARBURTON (William), who has been justly styled *vir magnus, acer, memorabilis*, was descended from an ancient and considerable family in Cheshire. His grandfather distinguished himself in the civil wars of the last century; and being of the royal party, probably injured his fortune by his attachment to his king and the constitution of his country. He married a lady of the county of Nottingham, by whom he had three sons; the second of whom, George, being bred to the law, practised as an attorney at Newark in that county.

William, the subject of this memoir, and the second son of Mr George Warburton, was born at Newark, December 24. 1698. He was first put to school there under a Mr Twells, but had the chief part of his education at Okeham in Rutlandshire, where he continued till the beginning of the year 1714, when, his cousin being made head master of the school at Newark, he returned to his native place, and was for a very short time under the care of that learned and respectable relation. In the month of April of the same year, he was put out clerk to Mr Kirke, an eminent attorney of Great Markham in Nottinghamshire; and continued with that gentleman till the spring of the year 1719. He then returned to his family at Newark; but whether he practised there or elsewhere as an attorney, is not known to his accomplished biographer, the bishop of Worcester.

He had always expressed a strong inclination to take orders; and the love of letters, which tended to retard, rather than forward, his progress in the profession chosen for him by his friends, growing every day stronger in him, it was deemed expedient to give way to that inclination. In the studies necessary to fit him for the church, he was directed by his cousin the schoolmaster of Newark; to whom, long afterwards, when he stood high in the very front of literature, he gratefully acknowledged his obligations. At length, on the 22d of December 1723, he was ordained deacon by archbishop Davis of York, and priest on the first of March 1727, by bishop Gibson of London.

Though he never liked the profession of an attorney, he had certainly acquired a very considerable knowledge of the laws of England; for in a dispute which arose in 1726, about the judicial power of the court of chancery, he combated with success the opinions of no less a man than the lord chancellor Hardwicke, then attorney-general.

In 1728 he was presented by Sir Robert Sutton to the rectory of Brand-Broughton, in the diocese of Lincoln, where he spent the greater part of his life, and composed all the great works which will carry his fame down to posterity. In the same year he was put upon the king's list of Masters of Arts, erected on his majesty's visit to the university of Cambridge. He had already published some juvenile performances, which displayed genius and reading, and attracted considerable notice; but it was not till the year 1736 that he may be said to have emerged from the obscurity of a private life into the notice of the world.—The first publication which rendered him afterwards famous now appeared, under the title of "The Alliance between Church and State; or, the Necessity and Equity of an Established Religion and a Test Law; demonstrated from the Essence and End of Civil Society, upon the fundamental Principles of the Law of Nature and Nations." In this treatise, says Bishop Horsley †, the author "hath shown the general good policy of an establishment, and the necessity of a Test for its security, upon principles which republicans themselves cannot easily deny. His work is one of the finest specimens that are to be found perhaps in any language, of scientific reasoning applied to a political subject."

† *Review of the Case of the Protestant Dissenters.*

At the close of the Alliance was announced the scheme of the Divine Legation of Moses, in which he had then made a considerable progress. The first volume of this work was published in January 1737-8, under the title of "The Divine Legation of Moses demonstrated on the Principles of a religious Deist, from the Omission of the Doctrine of a future State of Rewards and Punishments in the Jewish Dispensation, in six books, by William Warburton, M. A. author of the Alliance between Church and State;" and met with a reception which neither the subject, nor the manner in which it was treated, seemed to authorise. It was, as the author afterwards observed, fallen upon in so outrageous and brutal a manner as had been scarce pardonable, had it been "The Divine Legation of Mahomet." It produced several answers, and so much abuse from the authors of "The Weekly Miscellany," that in less than two months he was constrained to defend himself, in "A Vindication of the Author of the Divine Le-

Warburton.

gation of Moses, from the Aspersions of the Country Clergyman's Letter in the Weekly Miscellany of February 24. 1737-8, 8vo."

Mr Warburton's extraordinary merit had now attracted the notice of the heir apparent to the crown, in whose immediate service we find him in June 1738, when he published "Faith working by Charity to Christian Edification, a Sermon, preached at the last episcopal Visitation for Confirmation in the Diocese of Lincoln; with a Preface, shewing the Reasons of its Publication; and a Postscript, occasioned by some Letters lately published in the Weekly Miscellany, by William Warburton, M. A. Chaplain to his Royal Highness the Prince of Wales."

In March 17[illegible], the world was in danger of being deprived of this extraordinary genius by an intermitting fever, which with some difficulty was relieved by a plentiful use of the bark.

The "Essay on Man" had been now published some years; and it is universally supposed, that the author had, in the composition of it, adopted the philosophy of the Lord Bolingbroke, whom, on this occasion, he had followed as his guide, without understanding the tendency of his principles. In 1738, M. de Crousaz wrote some remarks on it, accusing the author of Spinozism and Naturalism; which falling into Mr Warburton's hands, he published a defence of the first epistle, and soon after of the remaining three, in seven letters; of which six were printed in 1739, and the seventh in June 1740, under the title of "A Vindication of Mr Pope's Essay on Man, by the author of the Divine Legation." The opinion which Mr Pope conceived of these defences, as well as of their author, will be best seen in his letters. In consequence, a firm friendship was established between them, which continued with undiminished fervour until the death of Mr Pope; who, during the remainder of his life, paid a deference and respect to his friend's judgment and abilities, which will be considered by many as almost bordering on servility.

Towards the end of the year 1739, Mr Warburton published a new and improved edition of the first volume of the Divine Legation; and in May 1741, appeared the second part, which completed the argument, though not the entire plan of that work. "A work, says Bishop Hurd ‡, in all views of the most transcendant merit, whether we consider the invention or the execution. A plain simple argument, yet perfectly new, proving the divinity of the Mosaic law, and laying a sure foundation for the support of Christianity, is there drawn out to a great length by a chain of reasoning so elegantly connected, that the reader is carried along it with ease and pleasure; while the matter presented to him is so striking for its own importance, so embellished by a lively fancy, and illustrated from all quarters by exquisite learning and the most ingenious disquisition, that in the whole compass of modern or ancient theology, there is nothing equal or similar to this extraordinary performance."

‡ *Life of Warburton prefixed to his Works.*

This is the panegyric of a man reflecting with tenderness on the memory of his friend and benefactor; but it approaches much nearer to the truth than the censures of those cabalistic critics, who, fastening upon some weak part of the Divine Legation, or perhaps never having looked into it, have ridiculously contended that the author was far from being eminent as a scholar (A), and that his work is inimical to the cause of Christianity! Putting partiality aside, there is in the Divine Legation of Moses abundant evidence of the malignant folly of this charge, as no man can read and understand that work without being convinced that its author was a Christian, not only sincere but zealous; that he was, what Gibbon calls him *, "a man of vigorous faculties, of a mind fervid and vehement, supplied by unlimited and incessant industry, with a wonderful extent and variety of knowledge, which had neither depressed his imagination nor clouded his perspicuity; and that to every work, and this work in particular, he brought a memory full fraught, with a fancy fertile of original combinations, exerting at once the powers of the scholar, the reasoner, and the wit." But we think it must be acknowledged, that his learning was too multifarious to be always exact, and his inquiries too eagerly pushed to be always cautious. We have no hesitation, however, to say, that to the divine this great work, with all its imperfections, is, in our opinion, one of the most valuable that is to be found in any language.

In the summer 1741, Mr Pope and Mr Warburton, in a country ramble, took Oxford in their way. The university was naturally pleased at the arrival of two such strangers, and seemed desirous of inrolling their names among their graduates. The degree of D. D. was intended for the divine, and that of L. L. D. for the poet: but intrigue and envy defeated this scheme; and the university lost the honour of decorating at the same time the two greatest geniuses of the age, by the fault of one or two of its members. Pope retired with some indignation to Twickenham, where he consoled himself and his friend with this sarcastic reflection—"We shall take our degree together in fame, whatever we do at the university."

The friendship of this eminent poet was of service to Mr Warburton in more respects than that of increasing his fame. He introduced and warmly recommended him to most of his friends, and among others to Mr Murray, afterwards earl of Mansfield, and Ralph Allen, Esq; of Prior-park. In consequence of this introduction, we find Mr Warburton at Bath 1742; where he printed a sermon which had been preached at the Abbey church on the 24th of October, for the benefit of Mr Allen's favourite charity, the General Hospital or Infirmary. In this year also he printed a Dissertation on the origin of books of chivalry, at the end of Jarvis's Preface to a translation of Don Quixote, which Mr Pope tells him, he had not got over two paragraphs of, before he cried out, *Aut Erasmus, aut Diabolus*.

In 1742, Mr Warburton published "A Critical and Philosophical Commentary on Mr Pope's Essay on Man. In which is contained a Vindication of the said Essay from the Misrepresentation of M. de Resnal, the French Translator, and of M. de Crousaz, Professor of Philosophy and Mathematics in the Academy of Lausanne, the Commentator." It was at this period, when Mr Warburton had the entire confidence of Mr Pope, that he advised him to complete the Dunciad, by changing the hero, and adding to it a fourth book. This was accordingly executed in 1742, and published early in 1743, with notes by our author; who, in consequence of it, received his share of the abuse which Mr Cibber liberally bestowed on both Mr Pope and his annotator. In the latter end of the same year he published complete editions of "The Essay on Man," and "The Essay on Criticism;" and from the specimen which he there exhibited of his abilities, it may be presumed Mr Pope

(A) We have heard this affirmed by narrow-minded clergymen, who were destitute themselves of every spark of science, and had no other claim to literature than what arose from a slight acquaintance with Hebrew critics of a very peculiar cast; to whom, it must be owned, that no great respect was indeed ever paid by the author of the Divine Legation of Moses.

Pope determined to commit the publication of those works which he should leave to Mr Warburton's care. At Mr Pope's desire, he, about this time, [illegible] the "Essay on [illegible]," as it [illegible] in the last edition of that translation.

The publication of "The Dunciad" [illegible] which our author rendered Mr Pope in [illegible] after a lingering and tedious illness, the event of which had been long foreseen, this great poet died [illegible] May 1744; and by his will, dated the [illegible] of the preceding December, bequeathed to Mr Warburton one half of his library, and the property of all such of his works already printed as he had not otherwise disposed of or alienated, and all the profits which should arise from any edition to be printed after his death: but at the same time directed that they should be published without any future alterations.

"In 1744, Mr Warburton turned his attention to the several attacks which had been made on the "Divine Legation," and defended himself in a manner which, if it did not prove him to be possessed of much humility or diffidence, at least demonstrated, that he knew how to wield the weapons of controversy with the hand of a master. His first defence now appeared, under the title of "Remarks on several occasional Reflections, in Answer to the Reverend Dr Middleton, Dr Pococke, the [illegible] of the Charter-House, Dr Richard Grey, and others; serving to explain and justify divers Passages in the Divine Legation, objected to by those learned Writers. To which is added, A General Review of the Argument of the Divine Legation, as far as it is yet advanced; wherein is considered the Relation the several Parts bear to each other and the whole. Together with an Appendix, in Answer to a late Pamphlet intitled, An Examination of Mr W——'s second Proposition." This was followed next year by "Remarks on several occasional Reflections, in Answer to the Reverend Doctors Stebbing and Sykes; serving to explain and justify the Two Dissertations in the Divine Legation, concerning the Command to Abraham to offer up his Son, and the Nature of the Jewish Theocracy, objected to by these learned Writers. Part II. and last." Both these answers are couched in those high terms of confident superiority, which marked almost every performance that fell from his pen during the remainder of his life.

On the 5th of September 1745, the friendship between him and Mr Allen was more closely cemented by his marriage with Miss Tucker, who survived him, and is now, if alive, Mrs Stafford Smith of Prior-park. At that important crisis our author preached and published three seasonable sermons: 1. "A faithful Portrait of Popery, by which it is seen to be the Reverse of Christianity, as it is the Destruction of Morality, Piety, and Civil Liberty. Preached at St James's, Westminster, October 1745." 2. "A Sermon occasioned by the present unnatural Rebellion, &c. Preached in Mr Allen's Chapel at Prior-park, near Bath, November 1745." 3. "The Nature of National Offences truly stated.—Preached on the General Fast-day, December 18. 1745-6." On account of the last of these sermons, he was again involved in a controversy with his former antagonist Dr Stebbing, which occasioned "An Apologetical Dedication to the Reverend Dr Henry Stebbing, in Answer to his Censure and Misrepresentations of the Sermon preached on the General Fast, &c."

Notwithstanding his great connections, his acknowledged abilities, and his established reputation, a reputation founded on the durable basis of learning, and upheld by the decent and attentive performance of every duty incident to his station; yet we do not find that he received any addition to the preferment given him in 1728 [illegible] Sutton [illegible] the [illegible] to the [illegible] until April 1746, when he was [illegible] by the [illegible] of Lincoln's Inn to be their preacher. In [illegible] he published "A Sermon preached on the Thanksgiving appointed to be observed the 9th of October, for the [illegible] of the late unnatural Rebellion." [illegible] his edition of Shakespeare, with the Preface [illegible]; and in the same year he published, 1. "A Letter [illegible] to a Member of Parliament concerning [illegible]." 2. "Preface to Mrs Cockburn's Remarks upon the Principles and Reasonings of Dr Rutherforth's Essay on the Nature and Obligations of Virtue," &c. 3. "Preface to a [illegible] Inquiry into the [illegible] and [illegible] of the [illegible], wherein the Nature of a [illegible], and the [illegible] of [illegible] by [illegible]." [illegible] edition. [illegible] between Church and State, [illegible]."

"In 1749, a very [illegible] moral character of [illegible] be the least [illegible] the name of [illegible] Lord Bolingbroke, or his [illegible] reflecting [illegible] on Mr Pope's [illegible] was [illegible] that [illegible] had been [illegible] (as it was [illegible]) should be printed. [illegible] his [illegible] to the public, [illegible] more copies, which were found, after his death, in the printer's warehouse. This [illegible] was aggravated beyond measure; and, notwithstanding the [illegible] which Lord Bolingbroke had received of Pope's devotion to him, envenomed with the utmost malignity. Mr Warburton thought it became him to vindicate his deceased friend; and he did it so effectually, as not only to silence the accuser, but to cover him with confusion ‡."

‡ Hurd's Life of [illegible]

About this time the publication of Dr Middleton's Inquiry concerning the miraculous Powers of the Christian Church, gave rise to a controversy, which was managed with great warmth and asperity on both sides, and not much to the credit of either party. On this occasion Mr Warburton published an excellent performance, written with a degree of candour and temper, which, it is to be lamented, he did not always exercise. The title of it was "Julian; or a Discourse concerning the Earthquake and fiery Eruption which defeated that Emperor's attempt to rebuild the Temple at Jerusalem, 1750." A second edition of this discourse, "with Additions," appeared in 1751, in which year he gave the public his edition of Mr Pope's Works, with Notes, in nine volumes 8vo; and in the same year printed "An Answer to a Letter to Dr Middleton, inserted in a Pamphlet intitled, The Argument of the Divine Legation fairly stated," &c.; and "An Account of the Prophecies of Arise Evans, the Welsh Prophet in the last Century," annexed to the first volume of Dr Jortin's Remarks on Ecclesiastical History, which afterwards subjected him to much trouble.

In 1752, Mr Warburton published the first volume of a course of sermons, preached at Lincoln's Inn, intitled, "The Principles of Natural and Revealed Religion, occasionally opened and explained;" and this was two years afterwards followed by a second. After the public had been some time promised, it may, from the alarm which was taken, be almost said threatened with, the appearance of Lord Bolingbroke's Works, they were about this time printed

Warbur-ton

printed. The known abilities and infidelity of this nobleman had created apprehensions in the minds of many people, of the pernicious effects of his doctrines; and nothing but the appearance of his whole force could have convinced his friends, how little there was to be dreaded from arguments against religion so weakly supported. Many anfwers were foon publifhed, but none with more acutenefs, folidity, and fprightlinefs, than "A View of Lord Bolingbroke's Philofophy, in two Letters to a Friend, 1754;" the third and fourth letters were publifhed in 1755, with another edition of the two former; and in the fame year a fmaller edition of the whole; which, though it came into the world without a name, was univerfally afcribed to Mr Warburton, and afterwards publicly owned by him. To fome copies of this is prefixed an excellent complimentary epiftle from the Prefident Montefquieu, dated May 26. 1754.

At this advanced period of his life, that preferment which his abilities might have claimed, and which had hitherto been withheld, feemed to be approaching towards him. In September 1754, he was appointed one of his Majefty's chaplains in ordinary, and in the next year was prefented to a prebend in the cathedral of Durham, on the death of Dr Mangey. About this time the degree of Doctor of Divinity was conferred on him by Dr Herring, then archbifhop of Canterbury. A new impreffion of The Divine Legation being now called for, he printed a fourth edition of the firft part of it, corrected and enlarged, divided into two volumes, with a dedication to the earl of Hardwicke. The fame year appeared "A Sermon preached before his Grace Charles Duke of Marlborough, Prefident, and the Governors of the Hofpital for the Small-pox and for Inoculation, at the Parifh-church of St Andrew, Holborn, April the 2[illegible]th, 1755." And in 1756, "Natural and Civil Events the Inftruments of God's Moral Government; a Sermon, preached on the laft public Faft-day, at Lincoln's Inn Chapel."

In 1757, Dr Warburton meeting with Mr Hume's tract, entitled, The Natural Hiftory of Religion, filled the margin of the book, as well as fome interleaved flips of paper, with many fevere and fhrewd remarks on the infidelity and naturalifm of the author. Thefe he put into the hands of his friend Dr Hurd, who, making a few alterations of the ftyle, added a fhort introduction and conclufion, and publifhed them in a pamphlet, entitled, "Remarks on Mr David Hume's Natural Hiftory of Religion, by a Gentleman of Cambridge, in a Letter to the Reverend Dr Warburton." This lively attack upon Mr Hume gave him fo much offence, that he thought proper to vent his fpleen on the fuppofed author, in the pofthumous difcourfe which he called his *Life*; and thus to do greater honour to Dr Hurd than to any other of his numerous antagonifts.

Towards the end of the year 1757, Dr Warburton was promoted to the deanery of Briftol; and in the beginning of the year 1760, he was, through Mr Allen's intereft with Mr Pitt, afterwards earl of Chatham, advanced to the bifhopric of Gloucefter. That great minifter is known to have declared, "that nothing of a private nature, fince he had been in office, had given him fo much pleafure as bringing our author on the bench." There was, however, another minifter, who dreaded his promotion, and thought that he faw a fecond Atterbury in the new bifhop of Gloucefter; but Warburton, fays bifhop Hurd, had neither talents nor inclination for parliamentary intrigue or parliamentary eloquence: he had other inftruments of fame in his hands, and was infinitely above the vanity of being caught

"With the fine notion of a bufy man ‡."

‡ *Dryden.*

He was confecrated on the 20th of January 1760, and on the 30th of the fame month preached before the houfe of lords. In the next year he printed "A Rational Account of the Nature and End of the Sacrament of the Lord's Supper." In 176[illegible], he publifhed "The Doctrine of Grace; or the Office and Operations of the Holy Spirit vindicated from the Infults of Infidelity and the Abufes of Fanaticifm," 2 vols 12mo; and in the fucceeding year drew upon himfelf much illiberal abufe from fome writers of the popular party, on occafion of his complaint in the houfe of lords, on the 15th of November 1763, againft Mr Wilkes, for putting his name to certain notes on the infamous "Effay on Woman."

In 1765 he publifhed a new edition of the fecond part of the Divine Legation, in three volumes; and as it had now received his laft hand, he prefented it to his great friend Lord Mansfield, in a dedication which deferves to be read by every perfon who efteems the well being of fociety as a concern of any importance. It was the appendix to this edition which produced the well-known controverfy between him and Dr Lowth, which we have noticed elfewhere (fee LOWTH), as doing no great honour, by the mode in which it was conducted, to either party. In the next year he gave a new and much improved edition of the Alliance between the Church and State. This was followed, in 1767, by a third volume of fermons, to which is added, his firft Triennial Charge to the Clergy of the Diocefe of Gloucefter; which may be fafely pronounced one of the moft valuable difcourfes of the kind that is to be found in our own or any other language. With this publication he clofed his literary courfe; except that he made an effort towards publifhing, and actually printed, the ninth and laft book of the Divine Legation. This book, with one or two occafional fermons, and fome valuable directions for the ftudy of *theology*, have been given to the world in the fplendid edition of his works in feven volumes 4to, by his friend and biographer the prefent bifhop of Worcefter. That prelate confeffes, that the ninth book of the Divine Legation difplays little of that vigour of mind and fertility of invention which appear fo confpicuous in the former volumes; but he adds, perhaps truly, that under all the difadvantages with which it appears, it is the nobleft effort which has hitherto been made to give a *rationale* of Chriftianity.

While the bifhop of Gloucefter was thus exerting his laft ftrength in the caufe of religion, he projected a method by which he hoped to render it effectual fervice after his death. He transferred L. 500 to Lord Mansfield, Sir Eardley Wilmot, and Mr Charles Yorke, upon truft, to found a lecture, in the form of a courfe of fermons, to prove the truth of revealed religion in general, and of the Chriftian in particular, from the completion of the prophecies in the Old and New Teftament, which relate to the Chriftian church, efpecially to the apoftacy of Papal Rome. To this foundation we owe the admirable Introductory Lectures of Hurd, and the well-adapted Continuation of Halifax and Bagot.

It is a melancholy reflection, that a life fpent in the conftant purfuit of knowledge, frequently terminates in the lofs of thofe powers, the cultivation and improvement of which are attended to with too ftrict and unabated a degree of ardour. This was in fome degree the misfortune of Dr Warburton. Like Swift, and the great duke of Marlborough, he gradually funk into a fituation in which it was a fatigue to him to enter into general converfation. There were, however, a few old and valuable friends, in whofe company, even to the laft, his mental faculties were exerted in their wonted force; and at fuch times he would appear cheerful for feveral hours, and on the departure of his friends retreat as it were within himfelf. This melancholy habit

habit was aggravated by the loss of his only son, a very promising young gentleman, who died of a consumption but a short time before the Bishop, who himself resigned to fate in the 81st year of his age. A neat marble monument has been erected to him in the cathedral of Gloucester, with this inscription—

To the Memory of
WILLIAM WARBURTON, D. D.
For more than 19 Years Bishop of this See;
A Prelate
Of the most sublime Genius, and exquisite Learning.
Both which Talents
He employed, through a long Life,
In the Support
Of what he firmly believed,
THE CHRISTIAN RELIGION;
And
Of what he esteemed the best Establishment of it,
THE CHURCH OF ENGLAND.
He was born at Newark upon Trent,
Dec. 24. 1698.
Was consecrated Bishop of Gloucester,
Jan. 20. 1760.
Died at his Palace, in this City,
June 7. 1779.
And was buried near this Place.

WARD (Dr Seth), an English prelate chiefly famous for his knowledge in mathematics and astronomy, was born at Buntingford in Hertfordshire, about the year 1617. He was admitted of Sidney college Cambridge, where he applied with great vigour to his studies, particularly to the mathematics, and was chosen fellow of his college. He was involved not a little in the consequences of the civil war, but soon after the Restoration obtained the bishopric of Exeter; in 1667, he was translated to Salisbury; and in 1671 was made chancellor of the order of the garter; he was the first Protestant bishop that enjoyed that honour, and he procured it to be annexed to the see of Salisbury. Bishop Ward was one of those unhappy persons who have the misfortune to survive their senses, which happened in consequence of a fever ill cured; he lived to the Revolution, without knowing any thing of the matter, and died in 1690. He was the author of several Latin works in mathematics and astronomy, which were thought excellent in their day; but their use has been superseded by later discoveries and the Newtonian philosophy.

WARD (Dr John), was the son of a dissenting minister, and born at London in 1679. He for some years kept a school in Tenter-alley, Moorfields; but rendered himself so eminent in the study of antiquity, that in 1720 he was chosen professor of rhetoric in Gresham college: in 1723, during the presidency of Sir Isaac Newton, he was elected a fellow of the Royal Society; and in 1752 one of the vice-presidents, in which office he was continued to his death. He was elected one of the trustees of the British Museum in 1753, and died at Gresham college in 1758. The work for which he is best known, is his Lives of the Professors of Gresham College; which is a considerable addition to the history of learning in our country. His Lectures on Oratory were published after his death, in two volumes 8vo.

WARD, is variously used in our old books: a ward in London is a district or division of the city, committed to the special charge of one of the aldermen; and in London there are 26 wards, according to the number of the mayor and aldermen, of which every one has his ward for his proper guard and jurisdiction. A forest is divided into wards; and a prison is called a *ward*. Lastly, the heir of the king's tenant, that held *in capite*, was termed a *ward* during his nonage; but this wardship is taken away by the statute 12 Car. II. c. 24. Ward. Wardship.

WARD-Holding, in Scots law. See LAW, N° clxv. 1. and clxvi. 3.

WARD Hook, or *Wadd-hook*, in gunnery, a rod or staff, with an iron end turned serpentwise, or like a screw, to draw the wadding out of a gun when it is to be unloaded.

WARDEN, or GUARDIAN, one who has the charge or keeping of any person, or thing, by office. Such is the warden of the Fleet, the keeper of the Fleet prison, who has the charge of the prisoners there, especially such as are committed from the court of chancery for contempt.

WARDHUYS, a port of Norwegian Lapland, 120 miles south east of the North Cape. E. Long. 31. 12. N. Lat. 72. 23.

WARDMOTE, in London, is a court so called, which is kept in every ward of the city; answering to the *curiata comitia* of Rome.

WARDROBE, a closet or little room adjoining to a bed-chamber, serving to dispose and keep a person's apparel in; or for a servant to lodge in, to be at hand to wait, &c.

Wardrobe, in a prince's court, is an apartment wherein his robes, wearing apparel, and other necessaries, are preserved under the care and direction of proper officers.

In Britain, the *Master or Keeper of the Great Wardrobe* was an officer of great antiquity and dignity. High privileges and immunities were conferred on him by king Henry VI. which were confirmed by his successors; and king James I. not only enlarged them, but ordained that this office should be a corporation or body politic for ever.

It was the duty of this office to provide robes for the coronations, marriages, and funerals of the royal family; to furnish the court with hangings, cloths of state, carpets, beds, and other necessaries; to furnish houses for ambassadors at their first arrival, cloths of state, and other furniture, for the lord lieutenant of Ireland, and all his majesty's ambassadors abroad; to provide all robes for foreign knights of the garter, robes for the knights of the garter at home; robes and all other furniture for the officers of the garter; coats for kings, heralds, and pursuivants at arms; robes for the lords of the treasury, and chancellor of the exchequer, &c. livery for the lord chamberlain, grooms of his majesty's privy chamber, officers of his majesty's robes; for the two chief justices, for all the barons of the exchequer, and several officers of these courts; all liveries for his majesty's servants, as yeoman of the guard, and warders of the Tower, trumpeters, kettle-drummers, drummers, and fifes; the messengers, and all belonging to the stables, as coachmen, footmen, littermen, postilions, and grooms, &c. all the king's coaches, chariots, harnesses, saddles, bits, bridles, &c. the king's water-men, game-keepers, &c. also furniture for the royal yachts, and all rich embroidered tilts, and other furniture for the barges. Beatson's Political Index, vol. ii.

Besides the master or keeper of the wardrobe, who had a salary of L. 2000, there was his deputy, who had L. 150, and comptroller and a patent clerk, each of whom has a salary of L. 300. Besides many other inferior officers and servants, who were all sworn servants to the king.

There was likewise a removing wardrobe, who had its own set of officers, and standing wardrobe-keepers at St James's, Windsor Castle, Hampton Court, Kensington, and Somerset House; but the whole of the wardrobe establishment was abolished by act of Parliament in 1782, and the duty of it in future to be done by the lord chamberlain.

WARDSHIP, in chivalry, one of the incidents of te-

nure

Wardship. nure by knight service. See *Feodal System*, *Knight Service*, and Tenure.

Upon the death of a tenant, if the heir was under the age of 21, being a male, or 14, being a female, the lord was intitled to the wardship of the heir, and was called the *guardian in chivalry*. This wardship consisted in having the custody of the body and lands of such heir, without any account of the profits, till the age of 21 in males, and 16 in females. For the law supposed the heir-male unable to perform knight service till 21; but as for the female, she was supposed capable at 14 to marry, and then her husband might perform the service. The lord therefore had no wardship, if at the death of the ancestor the heir-male was of the full age of 21, or the heir-female of 14: yet if she was then under 14, and the lord once had her in ward, he might keep her so till 16, by virtue of the statute of Westminster, 1. 3 Edw. I. c. 22. the two additional years being given by the legislature for no other reason but merely to benefit the lord.

This wardship, so far as it related to land, though it was not nor could be part of the law of feuds, so long as they were arbitrary, temporary, or for life only; yet when they became hereditary, and did consequently often descend upon infants, who by reason of their age could neither perform nor stipulate for the services of the feud, does not seem upon feodal principles to have been unreasonable. For the wardship of the land, or custody of the feud, was retained by the lord, that he might out of the profits thereof provide a fit person to supply the infant's services till he should be of age to perform them himself. And if we consider a feud in its original import, as a stipend, fee, or reward for actual service, it could not be thought hard that the lord should withhold the stipend so long as the service was suspended. Though undoubtedly to our English ancestors, where such stipendary donation was a mere supposition or figment, it carried abundance of hardship; and accordingly it was relieved by the charter of Henry I. which took this custody from the lord, and ordained that the custody, both of the land and the children, should belong to the widow or next of kin. But this nobe immunity did not continue many years.

The wardship of the body was a consequence of the wardship of the land; for he who enjoyed the infant's estate was the properest person to educate and maintain him in his infancy: and also in a political view, the lord was most concerned to give his tenant a suitable education, in order to qualify him the better to perform those services which in his maturity he was bound to render.

When the male heir arrived to the age of 21, or the heir-female to that of 16, they might sue out their livery or *ousterlemain*; that is, the delivery of their lands out of their guardian's hands. For this they were obliged to pay a fine, namely, half-a-year's profits of the land; though this seems expresly contrary to *magna charta*. However, in consideration of their lands having been so long in ward, they were excused all reliefs, and the king's tenants also all primer seisins. In order to ascertain the profits that arose to the crown by these fruits of tenure, and to grant the heir his livery, the itinerant justices, or justices in eyre, had it formerly in charge to make inquisition concerning them by a jury of the county, commonly called an *inquisitio post mortem*; which was instituted to inquire (at the death of any man of fortune) the value of his estate, the tenure by which it was holden, and who, and of what age, his heir was; thereby to ascertain the relief and value of the primer seisin, or the wardship and livery accruing to the king thereupon. A manner of proceeding that came in process of time to be greatly abused, and at length an intolerable grievance; it being one of the principal accusations against Empson and Dudley, the wicked engines of Henry VII. that by colour of false inquisitions they compelled many persons to sue out livery from the crown, who by no means were tenants thereunto. And afterwards a court of wards and liveries was erected, for conducting the same inquiries in a more solemn and legal manner.

When the heir thus came of full age, provided he held a knight's fee, he was to receive the order of knighthood, and was compellable to take it upon him, or else pay a fine to the king. For in those heroical times no person was qualified for deeds of arms and chivalry who had not received this order, which was conferred with much preparation and solemnity. We may plainly discover the footsteps of a similar custom in what Tacitus relates of the Germans, who, in order to qualify their young men to bear arms, presented them in a full assembly with a shield and lance; which ceremony is supposed to have been the original of the feodal knighthood. This prerogative, of compelling the vassals to be knighted, or to pay a fine, was expresly recognised in parliament by the statute *de militibus*, 1 Edw. II.; was exerted as an expedient for raising money by many of our best princes, particularly by Edw. VI. and Q. Elizabeth; but this was the occasion of heavy murmurs when exerted by Charles I.: among whose many misfortunes it was, that neither himself nor his people seemed able to distinguish between the arbitrary stretch and the legal exertion of prerogative. However, among the other concessions made by that unhappy prince before the fatal recourse to arms, he agreed to divest himself of this undoubted flower of the crown; and it was accordingly abolished by statute 16 Car. I. c. 20.

WARE, a town of Hertfordshire, with a market on Tuesdays, and a fair on the last Tuesday in April, and Tuesday before St Matthew's day (Sep. 21.) for horses and other cattle. It is a large, well frequented, and well inhabited thoroughfare town, seated on the river Lea, 21 miles north of London. It carries on a great trade in malt and corn, which they are continually sending in large quantities to London. E. Long. 0. 3. N. Lat. 51. 50.

WARN, in law, is to summon a person to appear in a court of justice.

WARNING *of Tenants*, in Scots law. See Law, N° clxvii. 16.

WARP, in the manufactures, a name for the threads, whether of silk, wool, linen, hemp, &c. that are extended lengthwise on the weaver's loom; and across which the workman, by means of his shuttle, passes the threads of the woof, to form a cloth, ribband, fustian, or the like.

Warp, a small rope employed occasionally to remove a ship from one place to another, in a port, road, or river. And hence,

To Warp, is to change the situation of a ship, by pulling her from one part of a harbour, &c. to some other, by means of warps, which are attached to buoys; to anchors sunk in the bottom; or to certain stations upon the shore, as posts, rings, trees, &c. The ship is accordingly drawn forwards to those stations, either by pulling on the warps by hand, or by the application of some purchase, as a tackle, windlass, or capstern, upon her deck.

When this operation is performed by the ship's lesser anchors, these machines, together with their warps, are carried out in the boats alternately towards the place where the ship is endeavouring to arrive: so that when she is drawn up close to one anchor, the other is carried out to a competent distance before her, and being sunk, serves to fix the other warp, by which she is farther advanced.

Warping is generally used when the sails are unbent, or when

when they cannot be successfully employed, which may either arise from the unfavourable state of the wind, the opposition of the tide, or the narrow limits of the channel.

WARRANDICE, in Scots law. See LAW, N° clxiv. 11.

WARRANT, is a power and charge to a constable or other officer to apprehend a person accused of any crime. It may be issued in extraordinary cases by the privy council, or secretaries of state; but most commonly it is issued by justices of the peace. This they may do in any cases where they have a jurisdiction over the offence, in order to compel the person accused to appear before them; for it would be absurd to give them power to examine an offender, unless they had also power to compel him to attend and submit to such examination. And this extends to all treasons, felonies, and breaches of the peace; and also to all such offences as they have power to punish by statute. Before the granting of the warrant, it is fitting to examine upon oath the party requiring it, as well to ascertain that there is a felony or other crime actually committed, without which no warrant should be granted; as also to prove the cause and probability of suspecting the party against whom the warrant is prayed.

This warrant ought to be under the hand and seal of the justice; should set forth the time and place of making, and the cause for which it is made; and should be directed to the constable, or other peace officer, or it may be to any private person by name. A general warrant to apprehend all persons suspected, without naming or particularly describing any person in special, is illegal and void for its uncertainty; for it is the duty of the magistrate, and ought not to be left to the officer, to judge of the ground of suspicion. Also a warrant to apprehend all persons guilty of such a crime, is no legal warrant; for the point upon which its authority rests, is a fact to be decided on a subsequent trial; namely, whether the person apprehended thereupon be guilty or not guilty. When a warrant is received by the officer, he is bound to execute it, so far as the jurisdiction of the magistrate and himself extends. A warrant from any of the justices of the court of king's bench extends over all the kingdom, and is tested or dated *England:* but a warrant of a justice of the peace in one county, must be backed, that is, signed, by a justice of another county, before it can be executed there. And a warrant for apprehending an English or a Scotch offender, may be indorsed in the opposite kingdom, and the offender carried back to that part of the united kingdom in which the offence was committed.

WARRANTY, WARRANTIA, in law, a promise, or covenant, by deed, made by the bargainer for himself and his heirs, to warrant and secure the bargainee and his heirs, against all men, for enjoying the thing agreed on or granted between them.

WARREN (Sir Peter), an admiral, distinguished by his virtue, learning, and undaunted courage, was descended from an ancient family in Ireland, and received a suitable education to qualify him for a command in the royal navy, in which he served for several years with great reputation; but the transaction which placed his great abilites in their full light, was the taking of Louisbourg in the year 1745, when he was appointed commodore of the British squadron sent on that service. He joined the fleet of transports from Boston in Canso-bay on the 25th of April, having under his command the Superb of 60, and the Launceston and Eltham of 40 guns; he was afterwards joined by several other men of war sent from England, and took possession of Louisbourg on the 17th of June. The French, exasperated at this loss, were constantly on the watch to retake it; and in 1747 fitted out a large fleet for that purpose, and at the same time another squadron to promote their success in the East Indies. These squadrons sailed at the same time; but the views of the French were rendered abortive by the gallant admiral Anson and Sir Peter Warren, who had been created rear-admiral, who with a large fleet of ships fell in with the French, defeated the whole fleet, and took the greatest part of the men of war. This was the last service Sir Peter rendered to his country as a commander in the British fleet; for a peace being concluded in the succeeding year, the fleet was laid up in the several harbours. Warren, Warsaw.

He was now chosen one of the representatives in parliament for Westminster; and in the midst of his popularity he paid a visit to Ireland, his native country, where he died of an inflammatory fever in 1752, sincerely lamented by all ranks of people; and an elegant monument of white marble was erected to his memory in Westminster abbey.

WARREN, is a franchise or place privileged by prescription or grant from the king, for the keeping of beasts and fowls of the warren; which are hares and coneys, partridges, pheasants, and some add quails, woodcocks, and water fowl, &c. These being *feræ naturæ*, every one had a natural right to kill as he could: but upon the introduction of the forest laws at the Norman conquest, these animals being looked upon as royal game, and the sole property of our savage monarchs, this franchise of free warren was invented to protect them, by giving the grantee a sole and exclusive power of killing such game, so far as his warren extended, on condition of his preventing other persons. A man therefore that has the franchise of warren, is in reality no more than a royal game-keeper: but no man, not even a lord of a manor, could by common law justify sporting on another's soil, or even on his own, unless he had the liberty of free warren. This franchise is almost fallen into disuse and since the new statutes for preserving the game; the name being now chiefly preserved in grounds that are set apart for breeding hares and rabbits. There are many instances of keen sportsmen in ancient times, who have sold their estates, and reserved the free-warren, or right of killing game, to themselves: by which means it comes to pass that a man and his heirs have sometimes free-warren over another's ground.

A warren may lie open; and there is no necessity of inclosing it as there is of a park. If any person offend in a free-warren, he is punishable by the common law, and by statute 21 Edw. III. And if any one enter wrongfully into any warren, and chase, take, or kill, any coneys without the consent of the owner, he shall forfeit treble damages, and suffer three months imprisonment, &c. by 22 and 23 Car. II. c. 25. When coneys are on the soil of the party, he hath a property in them by reason of the possession, and action lies for killing them; but if they run out of the warren and eat up a neighbour's corn, the owner of the land may kill them, and no action will lie.

WARSAW, a large city of Poland, the capital of that country, and of the province of Masovia. It is built partly in a plain, and partly on a gentle ascent rising from the banks of the Vistula, which is abont as broad as the Thames at Westminster, but very shallow in summer. This city and its suburbs occupy a vast extent of ground, and are supposed to contain 70,000 inhabitants, among whom are a great number of foreigners. The whole has a melancholy appearance, exhibiting the strong contrast of wealth and poverty, luxury and distress, which pervades every part of this unhappy country. The streets are spacious, but ill paved; the churches and public buildings are large and magnificent: the palaces of the nobility are numerous and splendid;

Wart ‖ Washington.

did; but the greateſt part of the houſes, particularly in the ſuburbs, are mean and ill conſtructed wooden hovels.—Warſaw is 160 miles ſouth-eaſt by ſouth of Dantzic, 130 north-north-eaſt of Cracow, and 300 north-eaſt by north of Vienna. E. Long. 21. 6. N. Lat. 50. 14.

WART. See SURGERY-*Index*.

WARWICK, the capital of Warwickſhire in England, and from which this county derives its name. It is very ancient, and ſuppoſed by Cambden to be the place called by the Romans *Præſidium*, where the Dalmatian horſe were poſted. It ſtands on a rock of free-ſtone, of which all the public edifices in the town are built. At the Norman invaſion it was a conſiderable place; and had many burgeſſes, of whom 12 were obliged by their tenure to accompany the king in his wars. It is ſupplied with water brought in pipes from ſprings half a mile from the town, beſides what it derives from the wells within it made in the rock: and it is eaſily kept clean, by being ſituated upon a declivity. Four ſtreets, from the four cardinal points of the compaſs, meet in the centre of the town. The principal public buildings are St Mary's, a very ſtately edifice, an hoſpital, a town-houſe of free-ſtone, three charity ſchools, and a noble bridge over the Avon. It has had ſeveral charters; but is governed at preſent by a mayor, 12 brethren, 24 burgeſſes, &c. It is a very handſome populous town, and gives title of earl to the family of the Grevilles. W. Long. 1. 36. N. Lat. 52. 20.

WASH, among diſtillers, the fermentable liquor uſed by the malt diſtillers. See BREWERY.

WASHING, in painting, is when a deſign, drawn with a pen or crayon, has ſome one colour laid over it with a pencil, as Indian ink, biſtre, or the like, to make it appear the more natural, by adding the ſhadow of prominences, apertures, &c. and by imitating the particular matters whereof the thing is ſuppoſed to conſiſt.

Thus they waſh with a pale red, to imitate brick and tile; with a pale Indian blue, to imitate water and ſlate; with green, for trees and meadows; with ſaffron or French berries, for gold or braſs; and with ſeveral colours for marbles.

WASHING of Ores, the purifying an ore of any metal, by means of water, from earths and ſtones, which would otherwiſe render it difficult of fuſion.

WASHINGTON, a city of North America, now building for the metropolis of the United States. It is ſeated at the junction of the rivers Potomac and the Eaſtern Branch, extending about four miles up each, including a tract of territory ſcarcely to be exceeded, in point of convenience, ſalubrity, and beauty, by any in the world. This territory, which is called *Columbia*, lies partly in the ſtate of Virginia, and partly in that of Maryland, and was ceded by theſe two ſtates to the United States of America, and by them eſtabliſhed to be the ſeat of government after the year 1800. It is divided into ſquares or grand diviſions, by ſtreets running due north, and ſouth, and eaſt, and weſt, which form the ground-work of the plan. However, from the Capitol, the preſident's houſe, and ſome of the important areas in the city, run diagonal ſtreets, from one material object to another, which not only produce a variety of charming proſpects, but remove the inſipid ſameneſs which renders ſome other great cities unpleaſing. The great leading ſtreets are all 160 feet wide, including a pavement of 10 feet, and a gravel walk of 30 feet planted with trees on each ſide, which will leave 80 feet of paved ſtreet for carriages. The reſt of the ſtreets are in general 110 feet wide, with a few only 90 feet, except North, South, and Eaſt Capitol Streets, which are 160 feet. The diagonal ſtreets are named after the reſpective ſtates compoſing the Union, while thoſe running north and ſouth are, from the Capitol eaſtward, named *Eaſt Firſt Street*, *Eaſt Second Street*, &c. and thoſe weſt of it are in the ſame manner called *Weſt Firſt Street*, *Weſt Second Street*, &c. Thoſe running eaſt and weſt are from the Capitol northward named *North A Street*, *North B Street*, &c. and thoſe ſouth of it are called *South A Street*, *South B Street*, &c. The ſquares or diviſions of the city amount to 1150. The rectangular ſquares generally contain from three to ſix acres, and are divided into lots of from 40 to 80 feet in front, and their depth from about 110 to 300 feet, according to the ſize of the ſquare. The irregular diviſions produced by the diagonal ſtreets are ſome of them ſmall, but generally in valuable ſituations. Their acute points are all to be cut off at 40 feet, ſo that no houſe in the city will have an acute corner. All the houſes muſt be of brick or ſtone. The area for the Capitol (or houſe for the legiſlative bodies) is ſituated upon the moſt beautiful eminence in the city, about a mile from the Eaſtern Branch, and not much more from the Potomac, commanding a full view of every part of the city, as well as a conſiderable extent of the country around. The preſident's houſe will ſtand upon a riſing ground, not far from the banks of the Potomac, poſſeſſing a delightful water proſpect, with a commanding view of the Capitol, and ſome other material parts of the city.

The city being ſituated upon the great poſt road, exactly equidiſtant from the northern and ſouthern extremities of the Union, and nearly ſo from the Atlantic Ocean to the river Ohio, upon the beſt navigation, and in the midſt of the richeſt commercial territory in America, commanding the moſt extenſive internal reſources, is by far the moſt eligible ſituation for the reſidence of congreſs; and it is now preſſing forward, by the public-ſpirited enterpriſe, not only of the people of the United States, but alſo of foreigners.

WASP, in zoology. See VESPA.

WATCH, in the art of war, a number of men poſted at any paſſage, or a company of the guards who go on the patrole.

WATCH, in the navy, the ſpace of time wherein one diviſion of a ſhip's crew remains upon deck, to perform the neceſſary ſervices, whilſt the reſt are relieved from duty, either when the veſſel is under ſail or at anchor.

The length of the ſea-watch is not equal in the ſhipping of different nations. It is always kept four hours by our Britiſh ſeamen, if we except the dog-watch, between four and eight in the evening, that contains two reliefs, each of which are only two hours on deck. The intent of this is to change the period of the night-watch every 24 hours; ſo that the party watching from 8 till 12 in one night, ſhall watch from midnight till four in the morning on the ſucceeding one. In France the duration of the watch is extremely different, being in ſome places ſix hours, and in others ſeven or eight; and in Turky and Barbary it is uſually five or ſix hours.

A ſhip's company is uſually claſſed into two parties; one of which is called the *ſtarboard* and the other the *larboard* watch. It is, however, occaſionally ſeparated into three diviſions, as in a road or in particular voyages.

In a ſhip of war the watch is generally commanded by a lieutenant, and in merchant-ſhips by one of the mates; ſo that if there are four mates in the latter, there are two in each watch; the firſt and third being in the larboard, and the ſecond and fourth in the ſtarboard watch: but in the navy, the officers who command the watch uſually divide themſelves into three parties, in order to lighten their duty.

WATCH, is alſo uſed for a ſmall portable movement, or machine, for the meaſuring of time; having its motion regulated by a ſpiral ſpring.

Watches,

Watches, strictly taken, are all such movements as show the parts of time; as clocks are such as publish it, by striking on a bell, &c. But commonly the name *watch* is appropriated to such as are carried in the pocket; and *clock* to the large movements, whether they strike the hour or not. See Clock.

The invention of spring or pocket-watches belongs to the present age. It is true, we find mention made of a watch presented to Charles V. in the history of that prince: but this, in all probability, was no more than a kind of clock to be set on a table, some resemblance whereof we have still remaining in the ancient pieces made before the year 1670. There was also a story of a watch having been discovered in Scotland belonging to king Robert Bruce; but this we believe has turned out altogether apocryphal. The glory of this very useful invention lies between Dr Hooke and M. Huyghens; but to which of them it properly belongs, has been greatly disputed; the English ascribing it to the former, and the French, Dutch, &c. to the latter. Mr Derham, in his Artificial Clockmaker, says roundly, that Dr Hooke was the inventor; and adds, that he contrived various ways of regulation. One way was with a loadstone: Another with a tender straight spring, one end whereof played backwards and forwards with the balance; so that the balance was to the spring as the bob to a pendulum, and the spring as the rod thereof: A third method was with two balances, of which there were divers sorts; some having a spiral spring to the balance for a regulator, and others without. But the way that prevailed, and which continues in mode, was with one balance, and one spring running round the upper part of the verge thereof: Though this has a disadvantage, which those with two springs, &c. were free from; in that a sudden jerk, or confused shake, will alter its vibrations, and put it in an unusual hurry.

The time of these inventions was about the year 1658; as appears, among other evidences, from an inscription on one of the [illegible] balance watches presented to king Charles II [illegible] *Hooke inven.* 1658. T. Tompion *fecit*, 1675. The invention presently got into reputation, both at home and abroad; and two of them were sent for by the dauphin of France. Soon after this, M. Huygens's watch with a spiral spring got abroad, and made a great noise in England, as if the longitude could be found by it. It is certain, however, that his invention was later than the year 1673, when his book *de Horol. Oscillat.* was published; wherein he has not one word of this, though he has several other contrivances in the same way.

One of these the lord Brouncker sent for out of France, where M. Huygens had got a patent for them. This watch agreed with Dr Hooke's in the application of the spring to the balance; only M. Huygens's had a longer spiral spring, and the pulses and beats were much slower. The balance, instead of turning quite round, as Dr Hooke's, turns several rounds every vibration.

Mr Derham suggests, that he has reason to doubt M. Huygens's fancy first was set to work by some intelligence he might have of Dr Hooke's invention from Mr Oldenburg, or some other of his correspondents in England; and this, notwithstanding Mr Oldenburg's attempt to vindicate himself in the Philosophical Transactions, appears to be the truth (A). Huygens invented divers other kinds of watches, some of them without any string or chain at all; which he called, particularly, *pendulum watches*.

Striking Watches are such as, besides the proper watch-part for measuring of time, have a clock part for striking the hours, &c.

Repeating Watches, are such as by pulling a string, &c. repeat the hour, quarter, or minute, at any time of the day

or

(A) To expect perfection in a work of this extent would be unreasonable, and we trust to the candour of our readers for their acceptance of our best endeavours: we hold ourselves much obliged to them for their communications of every remark which may enable us to render the Encyclopædia Britannica more worthy of that most encouraging reception which it has met with from the Public. To the regular series of articles, the present Editor [illegible] that a Supplement was to be annexed, which should include not only those additions which have been made to the [illegible] of the sciences during the progress of the work, but likewise such articles as he or his predecessor [illegible] their unremitting occupation or their ignorance, suffered to escape their notice. In that Supplement he would have corrected all such errors or mistakes in the work as might have been discovered by himself or pointed out to him by his correspondents. But he is no Proprietor, and cannot announce the publication of a Supplement but as an event of great [illegible]. He is therefore much obliged to his highly respected friend and correspondent who has put it in his power at present to do [illegible] the memory of Dr Robert Hooke; one of the greatest ornaments of the Royal Society of London [illegible] its infant state and juvenile vigour, and one of the most extensive and inventive geniuses that the world [illegible].

In the article Hautefeuille, we ascribe to that author the invention of the regulating or balance spring of a watch, by which its motion is made as truly equable as by a pendulum. This is verified by the watches of Harrison, Arnold and others, which do not deviate from equable motion above one second in several days. That the importance of this is acknowledged by the intelligent Public, is evident from the serious and repeated deliberations of the British [illegible], and the high rewards which it has given to the makers of such watches; and we trust that this will appear to [illegible] readers as are not so much interested in mechanical performances a sufficient excuse for our anxiety to give the [illegible] of the invention to its right owner. We had collected from our searches that Mr Huyghens had discovered, [illegible] of pendulous motions, what kind of motion would be produced by any kind of varying force, and that a [illegible] in the proportion of its distance from the place of rest would produce isochronous vibrations, whatever might be their extent; and had made experiments on the force of springs, and found them to vary according to this very [illegible]. In consequence of this, he saw that a balance-watch might be made to answer the same end with his cycloidal pendulum [illegible], which he had been for several years trying to fit for the discovery of the longitude of a ship at sea, under the [illegible] of the States of Holland and the court of France, having obtained a patent monopoly from the States and [illegible] Louis XIV. When, after repeated disappointments, he introduced his proposed watches, with sanguine hopes of their performance, but before any trial, and applied for such an extension of his patent as should [illegible] a balance regulated by a spring, he was opposed by the watch-markers. They had willingly acquiesced in his [illegible] to the pendulum-clock, which was entirely his own domain: but they could not help considering this [illegible] an encroachment on a common which they had possessed from time immemorial. The opposition was [illegible]

Holland

Watch. or night.—This repetition was the invention of Mr Barlow, and firft put in practic by him in larger movements or clocks about the year 1676. The contrivance immediately fet the other artifts to work, who foon contrived divers ways of effecting the fame. But its application to pocket-watches was not known before king James the Second's reign; when the ingenious inventor above-mentioned, having directed Mr Thompfon to make a repeating watch, was foliciting a patent for the fame. The talk of a patent engaged Mr Quare to refume the thoughts of a like contrivance, which he had had in view fome years before: he now effected it; and being preffed to endeavour to prevent Mr Barlow's patent, a watch of each kind was produced before the king and council; upon trial of which, the preference was given to Mr Quare's. The difference between them was, that Barlow's was made to repeat by pufhing in two pieces on each fide the watch-box; one of which repeated the hour, and the other the quarter: whereas Quare's was made to repeat by a pin that ftuck out near the pendant, which being thruft in (as now it is done by thrufting in the pendant itfelf), repeated both the hour and quarter with the fame thruft.

Of the Mechanifm of a WATCH, properly fo called. Watches, as well as clocks, are compofed of wheels and pinions, and a regulator to direct the quicknefs or flownefs of the wheels, and of a fpring which communicates motion to the

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Holland and in France, and naturally came to the knowledge of Mr Hautefeuille. This perfon was confcious of a double right to oppofe this encroachment, having alfo, though perhaps empirically, and without principle, difcovered that a fpring, applied to the balance of a watch, produced a furprifing equability of vibration; and hoped by its means to produce a perfect ifochronifm. By Mr Hautefeuille's oppofition the effect of the French patent was ftopped for want of regiftration. The Dutch patent was however expeded, and trials were made. But their refult was unfavourable; many things were wanting befides the true adjuftment of the regulating power of the balance-fpring. Scientific mechanics was then in its infancy, Galileo was dead, Newton was but beginning his glorious career; Huyghens therefore had few affiftants.

The Royal Society of London was juft founded, and Charles II. or his brother the duke of York, faw, *like a prince*, how conducive their labours would be to public profperity, and particularly to the improvement of navigation. The king therefore enjoined them to turn much of their attention to this object: he eftablifhed the Royal Obfervatory at Greenwich *for this exprefs purpofe;* and the parliament held out encouragement for the difcovery of the longitude. It was natural therefore for Mr Huyghens to look to this quarter for encouragement; and if any one will take the pains to compare the dates of Mr Huyghens's mathematical labours, after his differtation on the pendulum, and his correfpondence with the Britifh literati, till he was elected member of the Royal Society, his *private* correfpondence afterward with Mr Oldenburgh, a German, their fecretary, and his public correfpondence with him as fecretary of the Society, he will obferve the operation of fomething more than fcientific zeal.

This correfpondence, however, did not anfwer Mr Huyghens's hopes; for it informed him that the ground had been preoccupied by Mr Hooke, who had long before difcovered, that a fpring properly applied to a watch-balance would produce ifochronous vibrations, and had alfo long ago applied for a Royal patent for the monopoly. The hiftory of this application is curious, as a mere matter of anecdote; and it is inftructive, while it is humiliating to human vanity, fhowing us, that even in the greateft characters, genius and talents, and noble and undoubted virtues, may exift along with fome of our lefs honourable propenfities, and cannot altogether hinder their operation. There never was a time in which it was more proper that every one of us fhould have a monitor, who fhould fometimes call out aloud to us, "Remember that thou art a man," than the perfent, when fanatic vanity, under the falfe and abufed name of *philofophy*, is waging war with every thing that is good or true, and threatens to plunge the cultivated portions of the human race into their former barbarifm, with the horrid addition of the habits of favage atrocity; while the voice of religion, which would call us together as the children of one parent, is ftifled amidft the yells of brother fiends. We hope for indulgence, then, while we endeavour, in a few words, to make the hiftory of this invention as clear as can be expected in a fubject which does not fo fenfibly intereft the public in general, and after fuch a long interval of time.

Mr Hooke, from his infancy, had a ftrong predilection for mechanics; he had alfo a ftrong propenfity to fyftem-making; and, from his firft years of ferious occupations, entertained a notion, that every thing might be formed into a fyftem, and that nothing could be profecuted with any well-founded profpect of improvement unlefs it was fo treated. His amazingly comprehenfive genius grafped at every thing which came under his obfervation; and he immediately began to form a fyftem about it.—His writings are full of fcraps of fuch fyftematic views; many of them, it muft be acknowledged, hafty, inaccurate, and futile, but ftill fyftematical. He called them algebras, and confidered them as having a fort of inventive power, or rather as means of difcovering things unknown by a procefs fomewhat fimilar to that art. He valued himfelf highly on account of this view of fcience, which he thought peculiar to himfelf; and he frequently fpeaks of others, even of the moft eminent, as childifhly contenting themfelves with partial views of the corners of things. He was likewife very apt to confider other inventors as encroachers on his fyftems, which he held as a kind of property, being ferioufly determined to profecute them all in their turn, and never recollecting that any new object immediately called him off, and engaged him for a while in the moft eager purfuit. His algebras had already given him many fignal helps; and he had no doubt of their carrying him through in every inveftigation. Stimulated by this overfond expectation, when a difcovery was mentioned to him he was too apt to think and to fay, that he had long ago invented the fame thing; when the truth probably was, that the courfe of his fyftematic thoughts on the fubjects with which it was connected had really fuggefted it to him, with fuch vivacity, or with fuch notions of its importance, as to make him fet it down in his regifter in its own fyftematic place (for this was his conftant practice, worthy of fuch a genius, and of immenfe fervice to all inquifitive men). But it was put out of his mind by fome new object of purfuit. We, at this time, can hardly conceive the ardour with which every thing was treated in thofe youthful days of fcientific novelty.

His favourite algebra, of which he frequently fpeaks as an invaluable treafure, and the fource of all his reputation, was his Mechanical Algebra or Method of Mechanic Invention. He fays, that no queftion in mechanics could be propofed to him, but he could quickly tell whether it were poffible to folve it, and could get into the proper track for the folution. Unfortunately

the whole machine. But the regulator and spring of a watch are vastly inferior to the weight and pendulum of a clock, neither of which can be employed in watches. In place of a pendulum, therefore, we are obliged to use a balance (fig. 1.) to regulate the motion of a watch; and a spring (fig. 2.) which serves in place of a weight, to give motion to the wheels and balance.

The wheels of a watch, like those of a clock, are placed in a frame formed of two plates and four pillars. Fig. 3. represents the inside of a watch, after the plate (fig. 4.) is taken off. A is the barrel which contains the spring (fig. 2.); the chain is rolled about the barrel, with one end of it fixed to the barrel A (fig. 5.), and the other to the fusee B.

Watch.

When a watch is wound up, the chain which was upon the barrel winds about the fusee, and by this means the spring is stretched; for the interior end of the spring is fixed by a hook to the immoveable axis, about which the barrel revolves; the exterior end of the spring is fixed to the inside of the barrel, which turns upon an axis. It is therefore easy to perceive how the spring extends itself, and how its elasticity forces the barrel to turn round, and consequently obliges the chain which is upon the fusee to unfold and turn the fusee; the motion of the fusee is communicated to the wheel C (fig. 5.); then, by means of the teeth, to the pinion *c*, which carries the wheel D; then to the pinion *d*, which carries the wheel E; then to the pinion *e*, which

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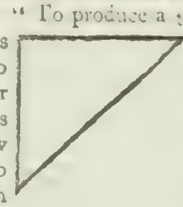
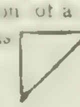
Unfortunately this perished in the burning of Gresham College, where Mr Hooke had apartments from the Royal Society; and he does not seem to have replaced it. It was perhaps, like the rest, nothing more than scraps. The Correspondent who favours us with these observations saw, in 1763, many papers of Mr Hooke's writings in the Society's archives, which had evidently been rescued from the flames, and had been in the possession of Mr Waller; part of which he published, and would have given more had he lived. Many of the leaves were scraps, perhaps single lines; many had dates; many of them were such as would be fragments of this mechanical algebra. Mr Hooke positively says, that it was by this system that he discovered the regulating power of a spring. And this brings us to the subject in hand, to which we hope the foregoing observations will not be thought too long a preface.

In 1655 he was admitted into the INVISIBLE SOCIETY at Oxford, and was particularly patronised by Dr Ward, afterwards bishop of Salisbury, who instructed him in astronomy, and strongly recommended to his mechanical genius the discovery of some method of maintaining the vibrations of a pendulum, as of immense service to the astronomer. This Hooke accomplished immediately, and thought of using pendulum clocks for discovering the longitude at sea; and *his method* of mechanic inventions *quickly* led him, he says, to the discovery of the regulating power of springs as equivalent (nay, he says, superior) to that of gravity. This is remarkable; for it appears that he had at that time mathematics enough to inform him, that nothing would produce isochronous vibrations but an accelerative force proportional to the space *to be passed through*, a truth neither obvious nor easily come at; and that the accelerative action of gravity on a common pendulum was not exactly in this proportion: but he did not then know the mechanical properties of the cycloid, a discovery reserved to do honour to Mr Huyghens. Our Correspondent farther informs us, that he recollects seeing, among the scraps of Mr Hooke's writing, words nearly to the following purpose: "To produce a translation of a moveable thus ———— or thus ——— in the same time, requires a pressing power thus  or thus ." This will evidently appear to be a hasty expression of a force as the distance to be run through. He had found by experiments, made probably with other views, that the force of a spring was proportional to its deviation from its quiescent shape, and this whatever was its shape. Of this truth he now saw the value, and marked it in his register, and gave it to his friends, agreeably to the custom of the times, in the form of a cipher *ce, iii, no, sss, tt, uu*; which was afterwards explained "*Ut tensio, sic vis.*"

Mr Boyle was then his chief patron, and to him he communicated his scheme of measuring time accurately by a balance-watch regulated by a spring; and showed him watches so constructed, which performed with surprising accuracy. Immediately after the Restoration, Mr Boyle acquainted Lord Brouncker and Sir Robert Moray, the most eminent gentlemen of the age for mathematical learning, and for natural knowledge in general, with Mr Hooke's discovery and schemes; and those gentlemen encouraged him to apply for a patent, and even drew up a form for an act of parliament, to give him a profit on his invention by a duty on shipping. This draught was shown to the king, and he granted a warrant for a patent to Mr Hooke for 14 years; which warrant was in the possession of Mr Waller.

It appears that these gentlemen were so sensible of the merits of the invention, and so confident of its success, that they associated themselves with Dr Hooke in the prosecution of it. But in what respect they were to contribute, besides their influence in procuring the patent and the act of parliament, does not appear. There remained, however, in Mr Waller's possession several scrolls and drafts of a mutual agreement between them to this effect: In one of them it was agreed, that if the profits should exceed L. 6000, Mr Hooke should have ⅓ths of the overplus; if it should be only L. 4000, he should have ⅔ds, &c. they having the rest; and that Dr Hooke should be declared the author and inventor. It is [illegible] that they were to advance the money necessary for carrying on the trade of watchmaking.—Many alterations were made in the terms of agreement; and it appears, that before any thing definitive was done, Hooke was disgusted, because they insisted, that if they or any other person should fall on any way of improving on these principles, they should enjoy the benefit of it during the currency of the patent. This he flatly refused; saying, that it was [illegible]. It is probable that his manner of refusal, which never was gracious or polite, might offend persons of their rank, and contribute to put an end to the whole affair; for it never went farther, and Hooke became much more retentive and close than formerly.

But while things were on a friendly footing, there occurred sufficient proofs of Dr Hooke's being the author of the invention, and that even Mr Huyghens could hardly fail of knowing something of it when he was [illegible], ten or eleven years before he published his claim, and even before he had analysed the motion of [illegible]. In page 247. of the Society's Register, in 1669, mention is made of Hooke's watches for the pocket, where the motion is regulated by springs. Now Hooke, in his first watches, employed two opposite springs, straight, and acting on the [illegible]

[illegible]

Watch. which carries the wheel F; then to the pinion f, upon which is the balance-wheel G, whose pivot runs in the pieces A called the *potance*, and B called a *follower*, which are fixed on the plate fig. 4. This plate, of which only a part is represented, is applied to that of fig. 3. in such a manner that the pivots of the wheels enter into holes made in the plate fig. 3. Thus the impressed force of the spring is communicated to the wheels: and the pinion f being then connected to the wheel F, obliges it to turn (fig. 5.) This wheel acts upon the palettes of the verge 1, 2, (fig. 1.), the axis of which carries the balance HH, (fig. 1.) The pivot I, in the end of the verge, enters into the hole c in the potance A (fig. 4.) In this figure the palettes are represented; but the balance is on the other side of the plate, as may be seen in fig. 6. The pivot 3 of the balance enters into a hole of the cock BC (fig. 7.), a perspective view of which is represented in fig. 8. Thus the balance turns between the cock and the potance c (fig. 4.), as in a kind of cage. The action of the balance-wheel upon the palettes 1, 2 (fig. 1.), is the same with what we have described with regard to the same wheel in the clock; *i. e.* in a watch, the balance-wheel obliges the balance to vibrate backwards and forwards like a pendulum. At each vibration of the balance a palette allows a tooth of the balance-wheel to escape; so that the quickness of the motion of the wheels is entirely determined by the quickness of the vibrations of the balance; and these vibrations of the balance and motion of the wheels are produced by the action of the spring.

But the quickness or slowness of the vibrations of the balance depend not solely upon the action of the great spring, but chiefly upon the action of the spring a, b, c, called *the spiral spring* (fig. 9.), situated under the balance H, and represented in perspective (fig. 6.) The exterior end of the spiral is fixed to the pin a, (fig. 9.) This pin is applied near the plate in a, (fig. 6.); the interior end of the spiral is fixed by a peg to the centre of the balance. Hence if the balance is turned upon itself, the plates remaining immoveable, the spring will extend itself, and make the balance perform one revolution. Now, after the spiral is thus extended, if the balance be left to itself, the elasticity of the spiral will bring back the balance, and in this manner the alternate vibrations of the balance are produced.

In fig. 5. all the wheels above described are represented in such a manner, that you may easily perceive at first sight how the motion is communicated from the barrel to the balance.

In fig. 10. are represented the wheels under the dial-plate by which the hands are moved. The pinion a is adjusted to the force of the prolonged pivot of the wheel D (fig. 5.), and is called a *cannon pinion*. This wheel revolves in an hour. The end of the axis of the pinion a, upon which the minute-hand is fixed, is square; the pinion (fig. 10.) is indented into the wheel b, which is carried by the pinion a. Fig. 11. is a wheel fixed upon a barrel, into the cavity of which the pinion a enters, and upon which it turns freely. This wheel revolves in 12 hours, and carries along with it the hour-hand. For a full account of the principles upon which watches and all time-keepers are constructed, we must refer our readers to a short treatise, entitled *Thoughts on the Means of improving Watches*, by Thomas Mudge.

Watch-glasses, in a ship, are glasses employed to measure the period of the watch, or to divide it into any number of equal parts, as hours, half-hours, &c. so that the several stations therein may be regularly kept and relieved, as at the helm, pump, look-out, &c.

WATCHING, in medicine, is when the patient cannot sleep. In fevers it is a dangerous symptom, and if long continued ends in a delirium.

WATER, a well known fluid, diffused through the atmosphere, and over the surface of the globe, and abounding in a certain proportion in animals, vegetables, and minerals.

1 Uses of water. The uses of water are so universally known, that it would be superfluous to enumerate them in this article. It is essential to animal and vegetable life; it makes easy the intercourse between the most distant regions of the world; and it is one of the most useful powers in the mechanic arts. It is often found combined with various substances, and is then frequently beneficial in curing or alleviating diseases.

Those properties of water which fit it for answering mechanical purposes are explained in other articles of this Work (see HYDROSTATICS, PNEUMATICS, n° 3. RESISTANCE, and RIVERS); but it still remains for us to give an account of the late celebrated discovery of the composition of water, and the various substances which are often found chemically united with it.

2 Not transmutable into earth. The ancient philosophers considered water as one of the four elements. During the age of the alchymists, when it was believed that different substances could be converted into gold, it was also an opinion, adopted by many, that water could be changed into earth. Even so late as the time of Mr Boyle

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lance by a silk fibre rolled round the cylindric axis of the balance. Mr Hooke, long after this, complained to the Society of Mr Oldenburgh's communicating this and other things to Huyghens, with whom he had an intimate correspondence. In 1665 Sir Robert Moray wrote a letter to Mr Oldenburgh, presuming, from his intimacy with Mr Huyghens, that he would know how soon his watches would be ready, and desired him to ask Mr Huyghens, "Whether he did not apply a spring to *the axis* of the balance?" and if he should say any thing to that purpose, then to tell him WHAT *Hooke had done in that way*, and that he intended more. *N. B.* Before this time the treaty had been dropped, and there appeared to Sir Robert no farther need of concealment.

From these and other facts that might be produced, we think it most evident that Mr Hooke invented the regulating spring of a watch, by which it is made perfectly adequate to the purpose of finding the longitude at sea; that he invented it eight or ten years before Mr Huyghens thought of such a thing, and fifteen years before he published it in the *Journal des Sçavans* in 1674.

Our readers cannot fail of making some remarks on this anecdote, which will perhaps extenuate a little Mr Hooke's morose behaviour, and explain, and perhaps excuse, his disposition to boast of his own inventions and arrogate those of others. If any of the expressions in the article allotted to his name should have made too unfavourable an impression, this note may help to soften it. We do not think that it can be inferred from those facts that either Hautefeuille or Huyghens *purloined* Hooke's invention. The one might fall upon it in the course of his many experiments; and the other, from his mathematical discoveries of the requisites for isochronous vibrations, might be induced to *try* whether springs afforded such a force. But there can remain no doubt but that Hooke made the discovery LIKE A PHILOSOPHER. If to this Work any Supplement shall be given by the present Editor, he will endeavour still farther to wipe away the obloquy which has been cast upon the memory of Dr Hooke for his arrogance in claiming the merit of inventions *supposed* to be the property of others.

Boyle this sentiment was not laid aside. He relates, that a friend of his, by distilling a quantity of water an hundred times, found at length that he had got six-tenths of the first quantity in earth: whence he concludes, that the whole water, by further prosecuting the operation, might be converted into earth. Others have made experiments to the same purpose, and seemingly with the same success; but the deception is now found out. Water has the power of corroding the hardest bodies, even glass itself, by long digestion, especially when assisted by heat; and hence those who have made the experiments just mentioned have been themselves deceived, by supposing the earth which really came from the containing vessel to come from the water.

Margraaf made several experiments to determine whether water be transmutable into earth, and found that after every distillation a sediment was left. Lavoisier repeated Margraaf's experiments, and gave the explanation which we alluded to, that the sediment consisted of portions of the glass separated by the water. Dr Black, in the valuable course of lectures which he has for many years delivered, with so much honour to himself, and so much to the advancement of the science of chemistry, goes still farther: he ingeniously supposes, that the alkali, which is an essential ingredient in the composition of glass, unites with the water, and makes the glass swell, and thus occasions small portions of it to be detached.

Historical Account of the Discovery of the Composition of Water.

THAT water is not a simple but a compound substance, consisting of a mixture of vital and inflammable air, is one of the most astonishing and important discoveries which has been made since the origin of chemistry, or indeed since the origin of science. The history of this curious and interesting discovery we shall trace back with as much precision and impartiality as possible to the first hints which were thrown out upon the subject, and endeavour at the same time to assign to all who have contributed to the discovery the merit to which they are respectively intitled.

The first thing that led chemists to make experiments concerning the composition of water, was a letter which Mr John Warltire, lecturer in natural philosophy, wrote to Dr Priestley, dated Birmingham 18th April 1781, and published in the Appendix to the 5th volume of Dr Priestley's *Experiments and Observations*. This gentleman had long entertained an opinion that the question "whether heat be a heavy body," might be determined by burning inflammable air mixed with atmospherical air. For some time he was deterred from trying the experiment, from an apprehension that the consequences of passing the electrical spark through so combustible a mixture might be attended with danger; but at length, being encouraged by Dr Priestley, he prepared an apparatus for the purpose. He got a copper ball weighing 14 oz. and sufficient to contain three wine pints, with a screw stopper adapted to it, so that no air could escape. When he filled this ball with inflammable and common air, and made the electric spark to pass thro' it, a loss of weight was observed, upon an average, about two grains. When the same experiment was made in close glass vessels, the inside of the glass, though clear and dry before the operation, became immediately wet with dew, and was lined with a sooty substance. When Mr Warltire saw the moisture, he said to Dr Priestley, that it confirmed an opinion which he had long entertained, that common air deposits its moisture when it is phlogisticated. After this experiment had been repeated by Dr Priestley and Mr Warltire in company, they next fired a mixture of vital and inflammable air; but the only effects which they observed were, that the light was much more intense, and the heat much greater.

During the same year, and after the publication of the [illegible] volume of Dr Priestley's works, referred to above, Mr Cavendish repeated the experiments of Mr Warltire; but [illegible] though the vessel which he used held [illegible] grains of water, and though the experiment was repeated several times with common and inflammable air, he could never perceive any loss of weight of more than [illegible] of a grain, and commonly none at all. In all these experiments Mr Cavendish did not perceive the least sooty matter, but the inside of the glass globe became dewy, as Mr Warltire had observed. The inflammable air was procured from zinc.

That he might examine the nature of the dew, he burned 500,000 grain measures of inflammable air with two and a half times that quantity of common air, and the burned air was made to pass through a glass cylinder eight feet long, and three quarters of an inch diameter, in order to deposit the dew. These two kinds of air were mixed and set on fire by a lighted candle. In a short time 135 grains of water were condensed in the cylinder, which had no taste nor smell, and which left no sensible sediment when evaporated to dryness; neither did it yield any pungent smell during the evaporation: in short, it seemed pure water. From this experiment Mr Cavendish concluded, that when inflammable and common air are exploded in a proper proportion, almost all the inflammable air, and near one-fifth of the common air, lose their elasticity, and are condensed into dew; which, when examined, is found to be pure water.

He wished next to examine the effect produced by firing a mixture of vital and inflammable air. He took a glass globe holding 8800 grain measures, furnished with a brass cock, and an apparatus for firing air by electricity. The globe was exhausted of its air by an air-pump, and then a mixture of 19,500 grain measures of dephlogisticated air, and 37,000 of inflammable air, was conveyed successively from a glass jar, inverted in water, into the globe, and there fired by electricity. At the end of the experiment, when the whole air was consumed, a condensed liquor was found in the globe, weighing about 30 grains, which was sensibly acid to the taste; and, by saturation with fixed alkali, and evaporation, yielded near two grains of nitre. The product of nitre must have been occasioned by a mixture of azotic gas, which had combined with part of the oxygene, or dephlogisticated air; which are now well known to be the component parts of the nitric acid. These experiments, Mr Cavendish informs us, were made in 1781.

Mr Cavendish having mentioned these experiments to Dr Priestley, that gentleman made a course of experiments in order to investigate the same subject; an account of which is published in the Philosophical Transactions for [illegible], and also in the last volume of his Experiments. Having formerly [illegible] observed several remarkable changes in fluid substances, in consequence of long exposure to heat in glass vessels hermetically sealed, Dr Priestley formed a design of exposing all kinds of solid substances to [illegible]. As many substances consist of parts [illegible] before attaining any considerable degree of heat in the usual pressure of the atmosphere, he imagined that if the same substances were [illegible] under a greater pressure, they might [illegible] and undergo remarkable changes. [illegible] ideas to Mr Watt, the [illegible] of the steam-engine, Mr Watt mentioned a [illegible] that it might be possible to convert water or steam into permanent air.

For

Water.

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Account of Mr Watt's theory.
Phil. Tranſ. 1784, p. 332.

For many years before this period, Mr Watt tells us he had entertained an opinion, that air was a modification of water, which was originally founded on the facts, that in moſt caſes wherein air was actually made (which ſhould be diſtinguiſhed from thoſe wherein it is only extricated from ſubſtances containing it in their pores, or otherwiſe united to them in the ſtate of air), the ſubſtances were ſuch as were known to contain water as one of their conſtituent parts; yet no water was obtained in the proceſſes, except what was known only to be looſely connected with them, ſuch as the water of the cryſtalliſation of ſalts. This opinion aroſe from a diſcovery, that the latent heat contained in ſteam diminiſhed in proportion as the ſenſible heat of the water from which it was produced increaſed. In other words, the denſer the ſteam was, the leſs latent heat it contained.

Having been informed by Dr Prieſtley of the reſult of the experiment of firing a mixture of dephlogiſticated and inflammable air, Mr Watt was enabled to form the very theory which has been ſince demonſtrated to be true. "Let us conſider (ſays he) what obviouſly happens in the caſe of the deflagration of the inflammable and dephlogiſticated air. Theſe two kinds of air unite with violence, they become red hot, and upon cooling totally diſappear. When the veſſel is cooled, a quantity of water is found in it equal to the weight of the air employed. The water is then the only remaining product of the proceſs; and water, light, and heat, are all the products, unleſs there be ſome other matter ſet free which eſcapes our ſenſes. Are we not then authoriſed to conclude, that water is compoſed of dephlogiſticated air and phlogiſton deprived of part of their latent or elementary heat; that dephlogiſticated or pure air is compoſed of water deprived of its phlogiſton and united to elementary heat and light; and that the latter are contained in it in a latent ſtate, ſo as not to be ſenſible to the thermometer or to the eye; and if light be only a modification of heat, or a circumſtance attending it, or a component part of the inflammable air, then pure or dephlogiſticated air is compoſed of water deprived of its phlogiſton and united to elementary heat?"

Phil. Tranſ. for 1784, & *Idées ſur la Meteor.* par J. A. De Luc, tom. ii. p. 213.

We have ſaid that the theory of Mr Watt is now demonſtrated to be true. To this aſſertion an objection may be raiſed from the language in which he ſtates his theory; for he explains it by uſing the word *phlogiſton*, a word which is now exploded from philoſophy as the name of an imaginary ſubſtance. But it is ſufficient to reply, that Mr Watt uſes the word phlogiſton as ſynonymous with inflammable air. It may be proper alſo to add, that the paſſage quoted above was contained in a letter from Mr Watt to Dr Prieſtley, dated the 26th of April 1783.

Moſt of the experiments hitherto made favoured the concluſion which Mr Watt had drawn; but ſo many difficulties occurred to Mr Cavendiſh and Dr Prieſtley, that they ſeemed to heſitate about the theory. Dr Prieſtley in particular, after conſideration, declared againſt it; while Mr Cavendiſh only waited till the difficulties ſhould be removed. In the mean time experiments were made in a different quarter, which gave the moſt inconteſtable proofs of the truth of the theory.

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Which is eſtabliſhed by experiments at Paris.
Idées ſur la Meteor. par De Luc, tom ii. part iii. chap. iv.

M. de Luc had gone to Paris in January 1783. During his reſidence there, he received a letter from Dr Prieſtley, announcing the reſult of his experiments concerning the converſion of water into air. M. de Luc immediately communicated the contents of this letter to ſeveral members of the Academy of Sciences. But the difficulties which had occurred to Dr Prieſtley prevented them from acquieſcing in Mr Watt's theory. In the month of June following, Dr Blagden, who was well acquainted with all the experiments both of Mr Cavendiſh and of Dr Prieſtley, and of the opinions of Mr Watt, made a journey to Paris, in which he had an opportunity of converſing on this ſubject with the ſame gentlemen of the Academy to whom M. de Luc had formerly imparted the experiments of Dr Prieſtley. Notwithſtanding the additional facts which he was enabled to lay before them, he found them averſe from admitting the theory. They ſuppoſed that the water collected after the combuſtion of the two kinds of air had been diſſolved in them before. As the queſtion depended upon the proof of a fact, they reſolved however to make the proper experiments for examining it. The celebrated Lavoiſier took this experiment upon himſelf. It was made on the 24th of June in the preſence of Dr Blagden and many gentlemen of the academy; and the ſucceſs was as complete as the moſt ſanguine imagination could have conceived. It was repeated by Meſſrs Monge and Meunier, and the ſame reſult was found. The compoſition of water was now therefore put beyond doubt, and is now almoſt univerſally received as an unqueſtionable fact.

A[t]ten[pt to] eſtim[ate] the m[erit] of tho[ſe] concer[ned] in thi[s diſ]cover[y].

As we wiſh upon all occaſions to aſcribe to all eminent men the honour which they deſerve, we ſhould willingly eſtimate the comparative merit of thoſe philoſophers who were moſt active in this diſcovery; but though we feel ourſelves diſpoſed to be altogether impartial, it is attended with ſo many difficulties, that we will not preſume to affirm that our opinions are formed with perfect accuracy. With reſpect to Mr Watt, we think it appears that he was the firſt perſon who formed the true theory. He had for many years before thought it probable, that if the latent heat of ſteam could be wholly converted into ſenſible heat by a great increaſe of heat, the ſteam might ſuffer ſome remarkable change, ſuch as into permanent air. And no ſooner had he heard of the deflagration of oxygenous and hydrogenous gas by Dr Prieſtley, than he formed this theory.

Merit [of] Mr W[att].
Phil. [*Tranſ.*] *for* 17[84, p.] 335.

Of M[r Ca]vendi[ſh].

Mr Cavendiſh had the merit of making a proper uſe of Dr Prieſtley's account of Mr Warltire's experiment, from which Dr Prieſtley had been able to draw no concluſions, but had conſidered it merely as a curious fact. Without knowing any thing of Mr Watt's ideas, as far as appears to us, he made a number of ingenious experiments, which led him to conclude, that it was highly probable that water was a compoſition of air. The air which he employed ſeems not to have been pure; ſo that beſides the water he procured a quantity of nitrous acid. He however acted like an able and candid philoſopher; he went as far as his experiments would permit him, and he went no farther. In one point he continued to differ from Mr Watt after his theory was made public. Mr Watt ſuppoſed that water conſiſted of dephlogiſticated air (oxygenous gas) and phlogiſton (hydrogenous gas according to him), deprived of part of their latent heat; whereas Mr Cavendiſh thought there was no ſuch thing as elementary heat. We muſt further add, that it was Mr Cavendiſh who taught Dr Prieſtley to turn to a proper account the experiment of Mr Warltire; and therefore, that it was in fact from Mr Cavendiſh's experiments ultimately that Mr Watt was enabled to eſtabliſh his theory.

Of Dr Prieſt[ley].

The merit of Dr Prieſtley lies wholly in his being the inſtrument of promoting this diſcovery. He firſt publiſhed the experiment of Mr Warltire; and when Mr Cavendiſh had informed him of the ſucceſs he had met with in repeating that experiment, he began alſo to ſtudy the ſame ſubject. His diſcoveries were more uſeful to Mr Watt than to the author himſelf; for Mr Watt formed the theory which he had formerly been meditating; but Dr Prieſtley never came to a ſteady concluſion on the ſubject. We have read over carefully all his papers concerning the converſion of

water

Fig. 1.

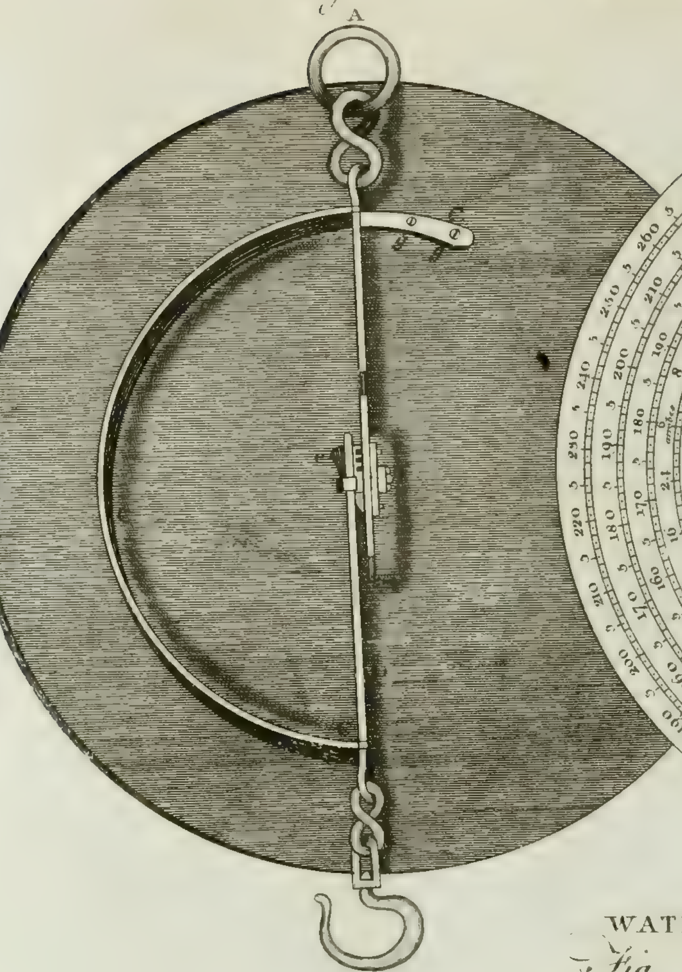
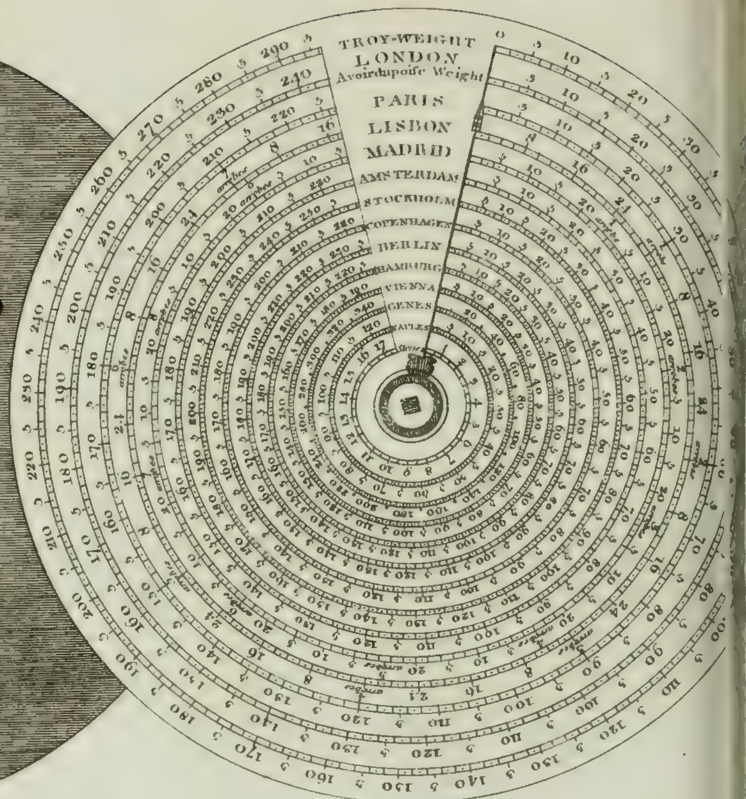


Fig. 2.



WATER.

Fig. 1.

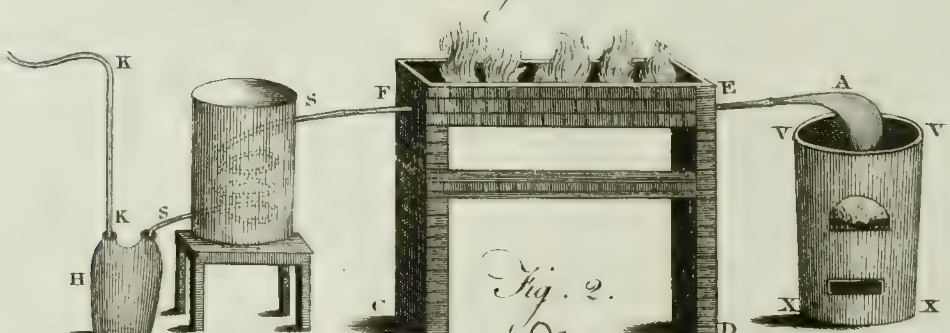
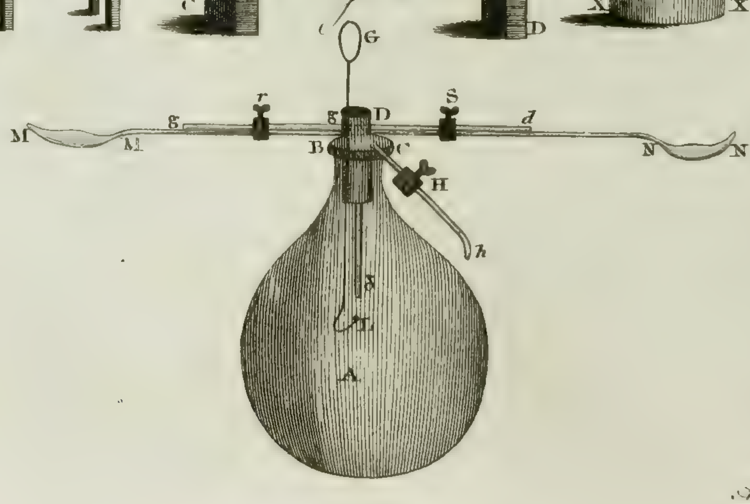


Fig. 2.



A. Bell Prin. Wal. Sculptor.

water into air, but cannot help saying, that we went along with the bewildered author weary and fatigued. His experiments are very often made at random, almost always founded on false principles, and seldom lead to any thing but to doubt and perplexity. M. Lavoisier sent him a copy of his ingenious paper on the composition of water; he repeated some of the experiments of that illustrious chemist, but he only involved himself in numberless difficulties. We are now no longer surprised at the singularity of Dr Priestley's opinions in religion; either at his incredulity in some things, or at his licentious sentiments in others. He that can doubt of the conclusive evidence which M. Lavoisier has given of the composition of water, must either have received less understanding than the bulk of mankind, or his mind must be warped with inextricable prejudices. With peculiar pleasure we mention Dr Black on this occasion. That gentleman, no less conspicuous for his candour and modesty than for his ingenuity, had, along with all other chemists of the time, believed the doctrine of phlogiston, and taught it in his public lectures; but, upon examining the Lavoisierian system, he was convinced of its truth, and had the honesty to confess it, though he was thus obliged to acknowledge to his students, that he had for many years been teaching errors. This acknowledgment does much honour to Dr Black, and proves that he is well entitled to the high character which he has so long held.

The merit of M. Lavoisier was great upon the present occasion. From England indeed he received the theory and the first experiments on the composition of water; but he was the first person who demonstrated the theory, and put it beyond doubt. His knowledge of the distinction between carbone and hydrogene, as well as the perfect accuracy with which his experiments were made, enabled him to prove, with as much certainty as physical science generally admits, that water is composed of vital and inflammable air. We will now give some account of the proofs of this fact; and, as we have never seen them stated with more clearness and precision than by M. Lavoisier himself in his Elements of Chemistry, we shall take our account of them from him.

Proofs of the Composition of Water.

Exper. 1. Take a glass tube from 8 to 12 lines diameter, and place it across the furnace EFCD, with a gentle inclination from E to F (A). The higher extremity of the tube is then luted to the glass retort A, containing a known quantity of distilled water. To the lower extremity F is luted the worm SS, the lower end of which is fixed in the neck of the bottle H, which bottle has the bent tube KK fixed to a second opening. This bent tube is intended to carry off any elastic fluids which may escape into the bottle H. A fire is then lighted in the furnace EFCD, sufficient to keep the tube EF red hot, but not to melt it. The water in the retort A is kept boiling by a fire in the furnace VVXX. The water is gradually changed into steam by the heat of the two furnaces. It passes through the glass tube EF into the worm SS, where it is condensed, and then drops into the bottle H. When the whole water is evaporated, and all the communicating vessels are emptied into the bottle H, it is found to contain exactly the same quantity which was put into the retort. This experiment therefore is a simple distillation. Water.

Exper. 2. Every thing being disposed as in the last experiment, let 28 grains of pure charcoal, broken into small parts, and which has been exposed to a red heat in a close vessel, be introduced into the tube EF. The experiment is then performed in the same manner as the former. The water is evaporated, and a portion of it is again condensed in the worm SS, and then falls into the bottle H; but at the same time a considerable quantity of an elastic fluid escapes through the tube KK, which is received in vessels. When the water is entirely evaporated, and the tube examined, the 28 grains of charcoal have wholly disappeared.

When the water in the bottle H is examined, it is found to have lost 85.7 grains of its weight; and when the elastic fluid which passed off by the tube KK is weighed, it is found to weigh 113.7 grains, which is exactly the weight which the water has lost, added to the 28 grains of charcoal which had disappeared. The elastic fluid, on examination, is discovered to be of two kinds; namely, 144 cubical inches of carbonic acid gas weighing 100 grains, and 380 cubical inches of a very light gas weighing only 13.7 grains. Now 100 grains of carbonic acid gas consist of 72 grains of oxygene, combined with 28 grains of carbone. It is therefore evident, that the 28 grains of charcoal must have acquired 72 grains of oxygene from the water. It is also evident, that 85.7 grains of water are composed of 72 grains of oxygene, combined with 13.7 grains of a gas capable of being burned.

Exper. 3. Every thing being put in the same order as in the two former experiments, with this difference, that instead of the 28 grains of charcoal, 274 grains of soft iron, in thin plates rolled up spirally, are introduced into the tube EF. The tube is kept red hot while the water is evaporating from the retort. After the water has been distilled, it is found to have lost 100 grains. The gas or elastic fluid weighs 15 grains, and the iron has gained 85 grains additional weight, which put together make up 100 grains, the weight which the water has lost. The iron has all the qualities which it would have received by being burned in oxygene gas. It is a true oxyd (or calx) of iron. We have the same result as in the last experiment, and have therefore another proof for concluding, that 100 grains of water consist of 85 grains of oxygene, and 15 of the base of inflammable gas (B). 15

We have now exhibited two sufficient proofs, that water is composed of oxygene and hydrogene; but as the composition of water is so interesting and important a subject, M. Lavoisier was not satisfied with these proofs alone. He justly concluded, that if water be a compound of two substances, it ought to follow, that by reuniting these two substances, water would be produced. He accordingly proved the truth of this conclusion by the following experiment. Proof of the composition of water by synthesis.

(A) The tube EF should be made of glass which can bear a strong heat without melting. It should also be coated over with a lute composed of clay and powdered stone-ware; and to prevent it from bending during the experiment, it must be supported about the middle by an iron bar.

(B) This elementary substance Mr Lavoisier has denominated *hydrogene*, which signifies "the generative principle of water;" from 'υδωρ "water," and γεινομαι "I produce." When this substance is combined with caloric, it is called *hydrogenous gas*. It is the lightest substance yet known, being $\frac{1}{13}$th of the weight of an equal bulk of atmospheric air. It is very combustible, for it has so great an attraction for oxygene, that it attracts it from caloric; so that its inflammable property is merely its power of decomposing oxygenous gas, for it will not burn by itself. When drawn into the lungs, it produces instant death. See Aerology.

Water.

Exper. 4. He took a large crystal balloon A, fig. 2. containing about 30 pints, and having a large mouth; round which was cemented the plate of copper BC, pierced with four holes, through which four tubes pass. The first tube H*h* is intended to exhaust the balloon of its air, by adapting it to an air pump. The second tube *gg* communicates with a reservoir of oxygenous gas placed at MM. The third tube *d* D *δ* is connected with a reservoir of hydrogenous gas at NN. The fourth tube contains a metallic wire GL, having a knob at its lower extremity L, from which an electric spark is passed to *δ*, in order to set fire to the hydrogenous gas. The metallic wire is moveable in the tube, that the knob L may be either turned towards *δ*, or away from it, as there is occasion. We must also add, that the three tubes H *h*, *g g*, *d* D *δ* are furnished with stop-cocks.

It is necessary that the oxygenous gas, before being put into the reservoir, should be completely purified from carbonic acid. This may be done by keeping it for a long time in contact with a solution of caustic potash. The hydrogenous gas ought to be purified in the same manner. The quantity employed ought to be double the bulk of the oxygenous gas. It is best procured from water by means of iron, as was described in Experiment Third.

Great care must also be taken to deprive the oxygenous and hydrogenous gas of every particle of water. For this purpose they are made to pass in their way to the balloon A, through salts which have a strong attraction for water; as the acetite of potash (a compound of vinegar and vegetable alkali), or the muriate or nitrate of lime (the muriatic or nitric acid combined with lime). These salts are disposed in the tubes MM and NN of one inch diameter, and are reduced only to a coarse powder, that they may not unite into lumps, and interrupt the passage of the gasses.

Every thing being thus prepared for the experiment, the balloon is exhausted of its air by the tube H *h*, and is filled with oxygenous gas. The hydrogenous gas is also pressed in through the tube *d* D *δ* by a weight of one or two inches of water. As soon as the hydrogenous gas enters the balloon, it is set fire to by an electric spark. The combustion can be kept up as long as we please, by supplying the balloon with fresh quantities of these two gasses. As the combustion advances, a quantity of water is collected on the sides of the balloon, and trickles down in drops to the bottom of it. By knowing the weight of the gasses consumed, and the weight of the water produced, we shall find that they are precisely equal. M. Lavoisier and M. Meusnier found that it required 85 parts by weight of oxygenous gas and 15 parts of hydrogenous gas to produce 100 parts of water.

Thus we have complete proofs, both analytical and synthetical, that water is not a simple elementary substance, as it has been long supposed, but is compounded of two elements, oxygene and hydrogene. We must add, that M. Lovoisier used the most scrupulous accuracy in making the experiments which we have described; and that he is of opinion that the proportions given above cannot be $\frac{1}{100}$ from the real truth. Such then is the history and proof of the composition of water. We come next to consider what substances are chemically united or dissolved in it.

Analysis of the different Substances contained in Water.

16 Advantages of analyzing water.

Since it is made certain by observation and experiment, that water contains many different kinds of substances; and as its qualities, and consequently its uses, differ much according to the nature of the substances combined with it—the knowledge of an easy and accurate method of analysing waters is become a matter of the utmost importance. By such an analysis we shall be enabled to select the purest water for the purposes of life, and to avoid water which might be improper and hurtful; or, when good water cannot be had, to separate those substances from it which render it impure. By the same important art we shall find it easy to distinguish those waters which are best adapted to the arts and manufactures; we shall also be able to compare different mineral waters, to explain the causes of their effects in medicine, and to imitate those by art which are most efficacious.

All natural waters are more or less impure; for water has so strong an attraction for different substances, that it imbibes part of them in every situation in which it is found, not only when it flows over beds of earth, but when it filters through strata of metals, and even when it is dissolved in the atmosphere. Water cannot be procured in a pure state without undergoing the process of distillation.

Before we proceed to state the methods by which the different substances found in water may be detected, it will be proper to point out to the reader such sensible qualities of particular waters as may enable him to institute the process by which the analysis ought to be conducted. In every course of experiments, that order ought to be followed which will lead with most ease and certainty to the end which is in view; but unless a man from general knowledge be able to conjecture with some degree of accuracy what are the results to be expected in particular cases, he cannot be able to determine what experiments he ought to make.

The general circumstances which are first to be attended to in the examination of waters, are their colour, smell, taste, specific gravity, temperature, and local situation.

1. The first thing to be attended to in water is its colour. Pure water is transparent like crystal. Muddiness or a brown colour is a certain proof that some extraneous substance is diffused through the water. A green colour indicates the presence of iron, and a blue that of copper. If upon agitation airy bubbles appear in the water, we are sure that it contains carbonic acid or fixed air. The water which is to be examined with respect to colour should be put into a deep glass, that we may look down into a considerable body of it; for we shall thus discover any muddiness much better than by viewing the water horizontally through the glass.

2. We are next to observe whether the water has any smell. If it be pure, it will have no smell; if it diffuse a subtile penetrating odour, we have reason to conclude that it contains carbonic acid; if the smell of putrid eggs or of the scourings of a gun arise from it, we infer that it is impregnated with hepar sulphuris, or sulphur combined with an alkali.

3. Pure water has no taste. Water containing carbonic acid has a mild sourish taste. If it have a bitter taste, it may contain sulphate of soda or Glauber's salt, nitre or the sulphate, nitrate or muriate of magnesia, or lime combined with the nitric or muriatic acid. If the water has a slight austerity of taste, we may expect that it contains lime or gypsum; if it be saltish, it contains common salt; if the taste be lixivious, alkali is present; if æruginous, there is copper; if ferruginous or inky, we have reason to suppose that it contains iron.

4. The specific gravity of water can enable us to discover that it contains some extraneous matter, but does not point out what sort of matter it is. We are always sure that the lightest waters are the purest. The standard to be employed for comparing the specific gravity of water to be examined is distilled water.

5. Another circumstance to be considered is the temperature of the water, whether it be hot, cold, or tepid. We must determine whether the temperature be the same during the whole year, or whether it depends on the weather;

whether it freezes in winter; if hot, whether, when allowed to cool, it deposits any sediment, and loses its taste and smell.

6. The local situation of the water must also be taken into review. We must consider the soil through which it flows, and inquire whether there be mines or veins of metals near, or any kind of substance which water can dissolve. We must also inquire whether the water flows in equal quantity during the whole year, or increases with rain, and decreases with dry weather: whether it is stagnant or flowing; if it flows, whether it flows swiftly or slowly: whether it deposits any sediment; and if it does, of what sort it is, whether a salt, earth, metal, or metallic ochre: whether it petrifies bodies thrown into it: and whether there be any sulphur to be found near it in a sublimed state.

It is also proper to observe whether it be hard or soft; whether any animalcules live or vegetables grow in it; and whether it has any reputation for its effects in medicine.

Water may be divided into two great divisions, *fresh* and *salt water*.—Fresh water may be divided into *atmospheric*, *stagnant*, and *running*.

Salt water comprehends most of the seas on the globe, but especially those of the torrid and the greater part of the temperate zones. It contains common salt in great quantity, sulphate or muriate of magnesia, and sulphate of lime, besides a great quantity of putrid matter brought into it by the rivers, or produced by the decomposition of the numerous tribes of animals which live and die in it. See SEA and *SEA-Water*.

Atmospheric water comprehends rain and snow water. Rain is the water which is evaporated from the sea and land, dissolved in the air, and afterwards discharged on the earth; it ought therefore to resemble distilled water in purity; and it would certainly do so, if the atmosphere did not abound with vapours and exhalations capable of being combined with it. It contains a small quantity of sulphate of lime, together with a very small portion of nitrous acid. The rain that drops from the tops of houses is always mixed with soot. Some showers have contained a quantity of the pollen of flowers, which has given rise to the stories of showers of sulphur. The rain which falls at a distance from towns, or after a long tract of wet weather, is purest; for the atmosphere is then in some measure washed, if we may use the expression, from all heterogeneous substances.—Snow water is contaminated with the same substances as rain water. When newly melted, it is destitute both of common air and of fixed air, or the carbonic acid. It is probably from the want of these that snow water is injurious to health.

Stagnant water forms a lake; and when a great quantity of earth is diffused through it, it forms a marsh. The water of lakes is generally very pure and transparent; for as they are not subject to so much agitation as streams, the substances that happen to fall into them are not much diffused, but soon subside to the bottom. Some lakes are salt.—Marshes are much more impure. They are generally contaminated with the putrid matter produced by the decomposition of animals and vegetables, and are often of a yellowish or brownish colour.

Running water comprehends spring and river water.—Spring water is the rain water, which, after discharging itself upon the earth, and being imbibed by it, again issues out. As it runs below the surface through different substances, it carries along with it such as it can dissolve, and is therefore not so pure as rain water. It often contains salts, earths, or metals.—Rivers consist of a collection of springs, and generally partake of the soil through which they pass. Rivers which run through great towns are loaded with animal and vegetable substances. But those which run at a distance from towns are purer than most springs; because, as they run with more rapidity, and to a greater distance, a great part of their impurities are thus volatilized. If the soil be soft through which a river runs, it will be full of earth; but if hard and rocky, the water is very clear and pure.

Water is called *hard* when it does not dissolve soap, or boil vegetables, or make an infusion of tea. It generally contains some acid combined with absorbent earth, for which it has less attraction than for the alkali of the soap. When soap is put into such water, its alkali is immediately attracted by the acid of the water, the soap is decompounded, and the oil of it swims on the surface of the water. Water is not reckoned hard if it contains less than 10 grains of extraneous substances in the pound weight. 29 Hard water,

If the acid with which the absorbent earth is united be the carbonic, the water may be purified by boiling. But in order to make it agreeable to the palate after the calcareous earth is deposited, it ought to be exposed in the open air in broad shallow vessels. It will thus recover a portion of the air which was expelled by the boiling. But if the earth be suspended by any other acid, the water can be corrected by the addition of some fixed alkali, which immediately joins itself to the acid, while the earth is deposited. A solution of potash, or of any other alkali, may be poured into the water till it cease to produce any turbid appearance, or till no more is precipitated. The water must then be decanted from the sediment, or filtered if necessary. 30 How corrected.

Having now mentioned the different kinds of waters, it will be next proper to describe the most accurate methods of analyzing them. These are two, by precipitation and evaporation. Precipitants are substances which, being thrown into any impure water, separate the impurities, and throw them to the bottom of the vessel. Precipitation is the most expeditious method of examining waters; but it does not enable us to form so accurate an estimate as is often necessary of the precise quantity of extraneous substances contained in them. 31 Two methods of analyzing water by precipitation,

The other method of analyzing water is by evaporation, which consists in separating the water from the impurities, by converting the water into steam, and crystallizing the salts contained in it. Both these methods are often necessary to be employed, either of them separately being defective. As the precipitants indicate the proper method of conducting the evaporation, it will be proper, before we describe how to analyze water by evaporation, to describe particularly the effects produced on it by applying different precipitants. 32 And by evaporation.

Method of analyzing Water by Precipitation.

THE substances hitherto found in water are, common atmospherical air, acids, alkalis, earths, sulphurs, and metals. 33 Substances contained in water.

Acids, when disengaged, may be discovered by turnsol or syrup of violets; and when combined with any base, they may be detected by the nitrate of silver, muriate of barytes, and lime-water. Uncombined alkalis are ascertained by Brazil wood and turmeric; in combination with acids, they may be detected by spirit of wine. Earths are precipitated by the acid of sugar and the acetous acid. Sulphur is discovered by the mineral acids; and metals are precipitated by lime-water and tincture of galls. 34 Tests for discovering them.

Most waters contain common atmospherical air. Fixed air, now called *carbonic acid*, is also found in all waters in quantity from $\frac{1}{25}$th part of the bulk of the water to a bulk equal to the water itself. That some species of air is contained in water, is evident from the small bubbles which 35 Method of analyzing water containing common air and carbonic acid.

Water. may be often seen to rise in it when poured into a glass. These bubbles are still more distinguishable in water placed under the exhausted receiver of an air-pump; for the weight of the atmosphere being removed, the water expands; and the air contained in its interstices is thus let loose, and rises to the surface. The air may also be separated from water by boiling, and may be easily collected by a proper apparatus. Experiments may then be made upon it to determine its species and quantity.

36 Tests for discovering carbonic acid in water, Carbonic acid is known to be contained in water by the following marks: The taste is somewhat pungent, acescent, cooling, and very agreeable. The smell is subtile and penetrating. When agitated, it emits a number of air-bubbles, which give it the appearance of briskness. These are the sensible appearances which aerated water exhibits; but there are tests which chemistry furnishes much more decisive.

From a pigment called *litmus* is obtained a tincture called the *tincture of turnsol*. The litmus is wrapped up in a clean linen cloth, and steeped in distilled water; the water soon assumes a blue or violet colour, and is then fit for use. The tincture enables the chemist to discover the smallest particle of disengaged acid; for a few drops of it poured into water containing an acid immediately communicates a red colour to the whole fluid.

There is a more convenient method of using the turnsol: The saturated tincture is boiled with a little starch, and then a piece of paper is dipped into it, so as to tinge it completely. Paper thus tinged, when dipped into water containing an acid, instantly receives a red colour. The tincture is, however, a more delicate and sensible test than the tinged paper; for water saturated with aerial acid does not make any change in the colour of the paper; yet one part of aerated water gives a distinct red to 50 parts of the tincture.

37 And of collecting it, The method of collecting and ascertaining the elastic fluids contained in water was unknown till the present age. The easiest method is to fill a vessel terminating in a narrow neck with aerated water, then tie to the neck a bladder from which all the air has been carefully squeezed. Let the aerated water be boiled; the elastic fluid is then expelled, and ascends into the bladder, where it is collected. The bladder may then be removed from the vessel, and its mouth tied up.

There is another method, which is much more accurate, for determining the quantity contained in any quantity of water: Fill a bottle or retort with aerated water, and let a stopper be put into its mouth, with a hole in it. Let one end of a crooked tube be inserted into the hole of the stopper, so closely that no air may escape at the joining; and let the other end of the tube be bent upwards into an inverted vessel full of mercury. Fire is then applied to the bottle or retort, and continued till the water boil. The heat carries off the air which is conveyed through the crooked tube into the inverted vessel of mercury. If the water be kept boiling for a short time, the whole or greater part of the elastic fluid will be expelled, and its bulk is estimated by the bulk of mercury which it has displaced. But it must be remembered, that the elastic fluid above the mercury is in a state of greater dilatation than the external air, for it is not pressed by the whole weight of the atmosphere; but, as M. Saussure observes, it is only charged with that weight diminished by the column of mercury.

38 And separate it from common air. When the aerial fluid is thus collected, if we wish to separate the carbonic acid from the common air, the process is easy: Let the aerial fluid be separated from the mercury, while the external air is carefully excluded; and let the vessel containing it be inverted into another vessel containing lime-water. The lime will immediately absorb the carbonic acid, and form calcareous earth, while the atmospherical air is left behind. The calcareous earth may then be weighed; and the carbonic acid being afterwards expelled, the loss of weight will give the quantity of carbonic acid.

The only other acids hitherto found in water besides the carbonic, are the sulphuric and muriatic acids. The presence of the sulphuric acid is most accurately ascertained by the muriate of barytes, which is a compound of the muriatic acid with barytes or ponderous earth. Barytes has so strong an attraction for the sulphuric acid, that it separates it from all other acids, and forms with it a compound called *ponderous spar*, which is insoluble in water. As the carbonate of alkali, or an aerated alkali, may produce a muddiness and precipitation resembling the effects of the sulphuric acid, it is necessary to add to it a few drops of the nitric acid, which will dissolve any portion of barytes precipitated by the aerated alkali.

The muriatic acid may be easily discovered, by throwing into the water impregnated with it a little nitrate of silver (a compound of the nitric acid with silver). If there be the smallest portion of muriatic acid, it instantly seizes the silver, and is precipitated along with it in the appearance of a white mucilage. As the muriatic acid constitutes about one-fourth of the muriate of silver, we may easily determine its quantity, by subtracting one-fourth from the weight of the precipitate. Along with the nitrate of silver a little nitric acid should be added, for the reason mentioned in the last experiment.

Alkalis are known to exist in water by the lixivious or saltish taste which they communicate, by their effervescence with acids, and by several precipitants.

There are three tests which may be employed for discovering the presence of alkalis. 1. Paper tinged blue by the tincture of turnsol, and made red by distilled vinegar, recovers its blue colour when dipped into water containing an alkali. 2. The watery tincture of Brazil wood also serves to discover alkalis. It may either be used in the state of tincture, or a piece of paper may be tinged with it after being boiled with a little starch. In both cases it receives a blue colour from the alkali. One grain of soda dissolved in 4295 grains of water changes the colour of the tinged paper to a blue, which, though delicate, may be easily distinguished. 3. Watery tincture of turmeric is changed to a brown colour by alkalis. Paper tinged with this tincture boiled with starch is also affected in the same way. A single grain of soda dissolved in 859 grains of distilled water will obscure the yellow colour of the tinged paper, and turn it into a brownish hue.

The tincture of Brazil wood is remarkable for its sensibility in discovering the presence of an alkali. The tincture of turmeric is much slower in its decision; but this circumstance enables us, with some degree of accuracy, to estimate the quantity of alkali contained. The turmeric, too, answers best when there is occasion to examine an alkaline water by candle-light, as the change of colour which it produces is easily distinguishable.—Besides these tests now mentioned, any of the infusions of vegetables which are most easily affected by alkalis may be used with success, such as flowers of mallows and syrup of violets; but they are not on all occasions so decisive.

After being assured of the presence of an alkali, we must next determine what alkali it is. The alkalis most commonly found in water are the mineral and volatile, the vegetable seldom occurring. The mineral alkali is combined with the carbonic, sulphuric, or muriatic acid; the volatile is probably communicated by putrid animal or vegetable substances; and the vegetable is united with the sulphuric

or

or muriatic acid, but more frequently with the nitric acid. Bergman says, that mercury, dissolved in the nitric acid without heat, enables us to distinguish these alkalis. When a little of this solution is thrown into water, if a yellowish white substance is precipitated, we may conclude that a caustic vegetable alkali is present; if the precipitate be white, there is vegetable alkali saturated with the carbonic acid. If the precipitate be first yellow, and afterwards become white, mineral alkali is present; and if it be of a greyish black, we know that volatile alkali is present.

The species of alkali may be more easily ascertained, by pouring into the water a little sulphuric acid, or, what Morveau recommends as answering the purpose better, a little distilled vinegar, which with potash forms a deliquescent salt, and with soda a foliated crystallizable salt.

The earths which are mostly found in waters are lime and magnesia. If any other earth has been discovered, it has been by so few chemists, and in such small portions, that it has been little attended to (c). Lime and magnesia are always united with the carbonic or some of the fossil acids. The carbonic acid is easily expelled by boiling the water, and the earth falls to the bottom, and may then be easily examined by applying sulphuric acid. If the earth be calcareous, with sulphuric acid it forms gypsum; if it be magnesia, Epsom salt is produced; and if it be clay, the product is alum.

Scarcely any water is entirely free from lime; even the purest water, after standing 24 hours, deposits some saccharated lime. The acid of sugar is one of the most sensible tests for discovering it. A small quantity of distilled water, in which there is dissolved a single grain of pure lime, will become muddy if the smallest quantity of the acid of sugar be thrown in. The presence of calcareous earth may also be discovered by employing the acetite of lead. It precipitates the earth in the form of a white powder. But as sulphuric acid also precipitates the acetite of lead, to make the experiment accurately, it is necessary to add a little distilled vinegar to the precipitate, and if it consist of calcareous earth, it will be immediately dissolved; but if it be a sulphate of lime, the vinegar will have no effect upon it.—When lime or magnesia is dissolved in any of the mineral acids, it may be detected by adding a little carbonate of potash. The nature of the earth may be afterwards easily determined.

Of the inflammable bodies, perhaps none has been found dissolved in water except sulphur. Sulphur is combined either with an alkali or with hydrogene, forming a sulphuret of hydrogene. Sulphuric or hepatic waters are easily known by the following marks: 1. A fetid smell, which is felt in approaching the spring. 2. The taste is strong, somewhat sweet, not unlike that of putrid eggs, but more disagreeable. 3. When a piece of silver is put into it, it becomes tarnished. 4. But the nicest test is a mark made on paper with the tartarite of bismuth or acetite of lead, which becomes black when exposed to the vapour of the hepatic water.

When we wish to discover the quantity of sulphur which is dissolved in an alkali, it may be precipitated by the sulphuric or muriatic acid, but much more plentifully by the nitric acid. To render the experiment successful, it is necessary that the mixture should be heated. When the nitric acid is dropped in, the sulphureous smell is instantly dissipated, the water grows turbid, and a white subtile powder slowly subsides. When dried, it is found to be genuine sulphur. When the water contains a fixed alkali, the acid has no effect in decomposing the sulphureous water till the alkali be saturated; but after the alkali is saturated, the hepatic air is then driven off by the acid, and the sulphur falls down. Water.

Sulphureous water may easily be formed artificially: A quantity of hepar sulphuris, consisting of equal parts of sulphur and potash, is to be put into a vessel which communicates by a crooked tube with an inverted glass filled with water. Sulphuric acid is then poured into the vessel containing hepar sulphuris, a few drops at a time. The vessel containing the acid must communicate with the vessel containing the hepar sulphuris by a tube, that while the acid may be poured in at pleasure, the elastic gas which issues from the action of the acid on the hepar sulphuris may not be dissipated, but may pass into the inverted glass. This gas, if a candle be applied, will burn, and a residuum of sulphur of a whitish colour remains. The water in the inverted vessel must be frequently agitated, that the gas may be absorbed. 46 Method of making sulphureous water artificially.

The metals hitherto found dissolved in waters are two, iron and copper. The former occurs often, the latter rarely. Iron is united with the carbonic or sulphuric acid, and may generally be detected by a greenish or yellowish colour, by its inky taste, by an ochre which it deposits, by tincture of galls, and by the Prussian alkali. Only the two last of these methods require any description. Spirit of wine saturated with powdered galls precipitates iron slowly; the precipitate is purple when the quantity of iron is small; but when the quantity is large, it is black. In some cases indeed iron may be present in water without giving a dark colour to the galls. This is owing to a superfluity of acid. But if a sufficient quantity of alkali be added to saturate the acid, the black colour will then appear.—The Prussian alkali is prepared from four parts of Prussian blue, boiled with one part of alkali in a sufficient quantity of water. The clear liquor must then be saturated with an acid, and filtered, that it may be freed from the small portion of Prussian blue which is separated. A single drop of this alkali dropped into water containing the sulphate of iron immediately forms a Prussian blue. In making experiments with this alkali, it is proper to add a little muriatic acid. 47

The quantity of iron contained in water may be ascertained with considerable accuracy, by the colour communicated by the tincture of galls: for if the tincture be poured into distilled water, then small pieces of iron may be added, till the liquor has acquired the colour of the chalybeate water; and then we may conclude, that the quantity of iron contained in the chalybeate water is equal to the artificial mixture, if the colour be the same. There is also another way of estimating the quantity of iron. When precipitated, let the residuum be washed in pure water, then dried and weighed. Pour upon it one of the mineral acids, and digest them together, and after pouring it off, wash what remains undissolved; then dry and weigh it again, and from the diminution of weight collect that of the iron. In this experiment the acid employed ought not to be very strong nor great in quantity, nor ought the digestion to be continued long; for if the residuum should contain any selenite which is soluble by acids, the selenite might seize upon a considerable portion of the acid, and consequently the experiment be inaccurate. 48 And its quantity ascertained.

Copper is sometimes united in water with the sulphuric acid. It is discovered by the blue colour which it imparts 49

(c) A small quantity of siliceous earth was found by Bergman in an acidulous spring, as also by Dr Black in the Geyzer spring in Iceland. Clay may also be often found in waters; but it is probably only diffused, not chemically dissolved.

Water. to the water, by an æruginous taste, and by the ochre which it deposits. It may also be detected by throwing into the water a piece of polished iron; the copper will be precipitated upon the iron.

Method of analyzing Water by Evaporation.

50 General circumstances to be attended to. HAVING now described the methods of detecting the various substances contained in water by *precipitation*, we come next to describe how they are discovered by *evaporation*.

The vessels employed in evaporating the water ought to be broad, for fluids evaporate more quickly in proportion to the extent of the surface. If earthen vessels can be found of so close a texture as not to absorb any saline matter, they may be safely employed. Iron and copper vessels are improper, because they are liable to be corroded. The most convenient are thin glass vessels, which may without danger be exposed to a strong heat. The capacity of the vessels depends on the quantity of water which is necessary for the several experiments. The quantity of water may be small if it contain a large proportion of extraneous matter. The evaporation should be slow and gentle. The vessel employed ought to have a cover to keep out dust; but must have a hole several inches in diameter, that the vapours may issue out. The hole should not be opened till the vapour be so much condensed as to issue with such force as to keep the dust from falling in.

51 Order in which substances usually appear while water is evaporating. Some substances require more water to dissolve them than others. As the quantity of water is diminished by evaporation, they appear therefore in an order corresponding to their different degrees of solubility; those which are least soluble appearing first. The following is the order in which they are discovered: First carbonate of lime and carbonate of iron, then gypsum, then the sulphate of potash, then the sulphate of iron, then the nitrate of potash, and next in order the sulphate of copper; afterwards the muriate of potash, then soda, then the muriate of soda, then the sulphate of magnesia, and lastly the deliquescent salts. Aerated magnesia, or carbonate of magnesia, is not separated all at once, but continues to fall during the whole process. This order is often altered by the superabundance of any particular substance.

52 How the residuum should be treated. The different substances may be separated as they successively appear; but it is better to continue the evaporation to dryness. The residuum should be carefully collected and well dried. It is then put into a bottle, and alcohol poured on till it rise an inch above it. The bottle should then be closed and shaken. After standing for a few hours, the liquor may be filtered. What passes through the filter is preserved for a future analysis, and what remains behind has eight times its weight of cold distilled water poured upon it; the mixture is then shaken, allowed to stand for some time, and again filtered. What was dissolved by the water is preserved for future examination, and the residuum is then boiled for a quarter of an hour in somewhat more than four or five hundred times its weight of distilled water, and afterwards filtered.

53 When it shows a brown colour, should be exposed to the air. Being now purified by alcohol, cold water and hot water, the residuum is no longer soluble in alcohol or water. If it show a brown colour, this is a mark that iron is contained in it. To ascertain this point, it may be exposed for some weeks in an open vessel to the rays of the sun, care being taken to moisten it from time to time. By the exposure to the air, the iron will imbibe oxygene, and is then no longer soluble in vinegar. The residuum may then be weighed; a quantity of acetous acid or distilled vinegar is then to be poured on it, and the mixture to be digested. By the digestion the acid will dissolve the carbonate of lime and magnesia, if there be any in the residuum. What the acid has not dissolved may be washed, dried, and weighed, and by its loss of weight it may easily be determined what the acid has taken up.

The matter dissolved by the acetous acid is then to be evaporated to dryness. It may be determined whether it contains calcareous earth or magnesia by this circumstance; if it consist of calcareous earth, it continues dry in a moist air; but if it contain magnesia, it is deliquescent. The same point may also be ascertained by the sulphuric acid. This acid added to calcareous earth, forms gypsum, or the sulphate of lime; but when added to magnesia, it dissolves it, forming the sulphate of magnesia or Epsom salt; or if the residuum contain both lime and magnesia, there will be produced both sulphate of lime and sulphate of magnesia. The precise quantity of the simple substances contained in each may be known by weighing the compound, and remembering that 100 parts of the sulphate of lime contain about 32 of pure lime, 46 of sulphuric acid, and 22 of water (D); and 100 parts of the sulphate of magnesia contain 19 of pure magnesia, 33 of sulphuric acid, and 48 of water (E).

That matter which was not dissolved by the acetous acid is either iron or silex. The iron is soluble by muriatic acid or by an alkali. The portion which resists the action of the muriatic acid is siliceous earth, which may be farther examined by the blow-pipe; for siliceous earth, when added to soda in a state of fusion, combines with it with a violent effervescence, and is thus changed into glass.

Having now shown how to examine the residue which was insoluble in alcohol and water, it will next be proper to describe how to analyze the solutions obtained by alcohol, cold water, and hot water.

1. The solution obtained by alcohol contains lime and magnesia, combined with the muriatic acid or with the nitric acid. To enable us to discover the nature and quantity of the ingredients, we evaporate them to dryness, and then pour sulphuric acid on the residue; the sulphuric immediately displaces the other acids, and unites with the base. If the base be lime, it forms a sulphate of lime; if it be magnesia, it produces the sulphate of magnesia.

2. The solution obtained by cold water must be examined by evaporation. The evaporation ought to be gentle, that the crystals may assume regular forms. The crystals, as they successively appear, are then to be placed on bibulous paper and dried; but not so much as to expel any of the water of crystallization. The species of the salt thus formed may be distinguished by the taste and shape of the crystals. But that they may be distinguished with accuracy, we shall mention other methods: The solution obtained by cold water may contain alkalis, neutral salts, salts united with earths, salts united with metals, and neutral salts combined with earths or metals.

The alkalis can easily be discovered by the methods men-

(D) The proportions given above are Bergman's; but Dr Kirwan estimates them differently. According to him, 100 parts of the sulphate of lime contain 32 of earth, 29,44 of acid, and 38,56 of water. When well dried, it loses about 24 of water, and therefore contains 42 of earth, 39 of acid, and 19 of water.

(E) According to Dr Kirwan, 100 grains of the sulphate of magnesia perfectly dry contain 45,67 of sulphuric acid, 36,54 of pure earth, and 17,83 of water. In crystals they contain 23,75 of acid, 19 of earth, and 57,25 of water.

mentioned above, but the neutral or compound ſalts will occaſion more difficulty. We muſt firſt determine what the acid is, and with what baſe it is united. The ſulphuric acid is detected by the muriate of barytes, as deſcribed above. The nitrous acid, when preſent, is expelled by the ſulphuric acid, and may be eaſily diſtinguiſhed by its ſmell and red fumes. It will be made ſtill more evident by expoſing its fumes to a paper moiſtened with ammonia or volatile alkali. The muriatic acid is eaſily detected by expoſing the fumes of it to a paper moiſtened with water. This acid may alſo be diſcovered by the nitrate of ſilver.

It is more difficult to diſcover the baſes of the neutral ſalts which are always alkalis. We formerly deſcribed the method of detecting them in water when diſengaged, but we have now to ſeparate them from an acid. Potaſh may be ſeparated by barytes, ſoda is expelled by potaſh, and ammonia is expelled either by potaſh or ſoda.

We have mentioned already the method of diſcovering and diſtinguiſhing the earths and metals diſſolved in water; but there is one compound which is extremely difficult to ſeparate, viz. ſoda from common ſalt. The beſt method for effecting this is the proceſs of M. Giaonetti: "It conſiſts (ſays M. Fourcroy) in waſhing the mixed ſalt with diſtilled vinegar. The acid diſſolves the mild ſoda; the mixture is dried, and waſhed afreſh with ſpirit of wine, which is charged with the terra foliata mineralis, without touching the marine ſalt; the ſpirituous ſolution is evaporated to dryneſs, and the reſiduum calcined; the vinegar is decompoſed and burned; we have then nothing but the mineral alkali, whoſe quantity is exactly found."

3. The ſolution obtained by boiling water contains only ſelenite or gypſum. This may be ſeparated in cryſtals by evaporation to dryneſs, or it may be decompoſed by an alkali.

We have now ſaid every thing that is neceſſary reſpecting the two modes of analyzing water by precipitation and evaporation; but as a difficulty may occur to the unexperienced chemiſt reſpecting the order in which he ought to proceed in making his experiments, we ſhall lay before our readers the method recommended by M. Fourcroy.

He firſt examines the ſenſible properties of the water, the taſte, colour, weight, &c. and then pours upon four pounds of water the ſame weight of lime-water. If no precipitate falls in 24 hours, he concludes that the water contains no diſengaged carbonic acid, nor mild fixed alkali, nor earthy ſalts with baſe of aluminous earth or magneſia, nor metallic ſalts. If a precipitate be inſtantly formed, he proceeds to filter the liquid, and to examine the chemical qualities of the precipitate. If it has no taſte, if it is inſoluble in water, if it effervesces with acids, and if it forms with ſulphuric acid an inſipid ſalt almoſt inſoluble in water, he concludes that it is chalk, and that the lime-water attracted only the aerial acid diſſolved in the water. On the contrary, if the precipitate be not copious, if it collects ſlowly, if it excites no efferveſcence, if with the ſulphuric acid it forms a bitter ſalt, it is magneſia; but if with the ſame acid it forms a ſweetiſh aſtringent ſalt, it is aluminous earth or clay. Sometimes it may be a compound of both.

Being now examined by lime-water, he pours upon it other four pounds of the ſame water, a gros or two (F) of volatile cauſtic alkali, or he paſſes it through ſome alkaline gas diſengaged by means of heat. When the water is ſaturated, he leaves it in a cloſe veſſel for 24 hours; then if a precipitate be formed, as it muſt contain ſalts, with iron, magneſia, or aluminous earth for its baſe, he inveſtigates the nature of it. It muſt be obſerved, that the alkaline gas is not to be depended upon alone, but may be uſed as an auxiliary. Water.

M. Fourcroy next pours into a certain quantity of the water under examination a portion of cauſtic mineral alkali diſſolved. He continues to pour it in till no farther muddineſs is produced, as it decompoſes the ſalts with a baſe of aluminous earth, or a baſe of lime. If the precipitate reſembles in form, colour, and quantity, that which is yielded by lime-water, it may be preſumed that the water contains no calcareous earth; but if it be more weighty, copious, and has formed more quickly than the precipitate formed by the lime-water, then it contains lime mixed with magneſia or aluminous earth. If the precipitate contain any iron, it is eaſily detected by its colour and taſte.

Theſe obſervations of M. Fourcroy will be of great uſe to the young chemiſt, in pointing out the order which he may follow with facility and advantage in the analyſis of waters; and after he has formed his opinion concerning the ingredients contained in the water, he may examine the truth of it, by applying the particular teſts which have already been deſcribed.

In the account which we have given of the method of analyzing waters, the chemical reader will obſerve, that we have chiefly followed Bergman. We have done ſo, becauſe we reckon him the beſt writer on the ſubject, and becauſe we have been more anxious to ſtudy truth and utility than novelty. We ardently wiſh that ſome able chemiſt would exhibit an accurate and eaſy mode of analyzing earths, which every farmer could practiſe without a deep knowledge of chemiſtry. Farmers would then be enabled to apply the manures proper to particular ſoils, in which they would be much aſſiſted by Dr Kirwan's valuable Treatiſe on Manures.

Under the title of *MINERAL Waters*, we have given an analyſis of the moſt remarkable waters in Europe. (See alſo SPA, SELTZER, PYRMONT, and the names of other celebrated waters). Thoſe who wiſh for more information concerning the mode of analyzing water, may conſult Bergman's Chemical Eſſays, Fourcroy's Lectures on Chemiſtry, and the different books referred to by theſe authors.

Holy WATER, which is made uſe of in the church of Rome, as alſo by the Greeks, and by the other Chriſtians of the Eaſt of all denominations, is water with a mixture of ſalt, bleſſed by a prieſt according to a ſet form of benediction. It is uſed in the bleſſing of perſons, things, and places; and is likewiſe conſidered as a ceremony to excite pious thoughts in the minds of the faithful.

The prieſt, in bleſſing it, firſt, in the name of God, commands the devils not to hurt the perſons who ſhall be ſprinkled with it, nor to abuſe the things, nor diſquiet the places, which ſhall likewiſe be ſo ſprinkled. He then prays that health, ſafety, and the favour of heaven, may be enjoyed by ſuch perſons, and by thoſe who ſhall uſe ſuch things, or dwell in ſuch places. Veſtments, veſſels, and other ſuch things that are ſet apart for divine ſervice, are ſprinkled with it. It is ſometimes ſprinkled on cattle, with an intention to free or preſerve them from diabolical enchantments; and in ſome ritual books there are prayers to be ſaid on ſuch occaſions, by which the ſafety of ſuch animals, as being a temporal bleſſing to the poſſeſſors, is begged of God, whoſe providential care is extended to all his creatures. The hope which Catholics entertain of obtaining ſuch good effects from the devout uſe of holy water, is grounded

(F) A gros is equal to 59,0703 of Engliſh Troy grains.

Water. grounded on the promise made to believers by Christ (St Mark xvi. 17.), and on the general efficacy of the prayers of the church; the petition of which prayers God is often pleafed to grant; though fometimes, in his Providence, he fees it not expedient to do fo. That fuch effects have been produced by holy water in a remarkable manner, has been afferted by many authors of no fmall weight; as, namely, by St Epiphanius, Haer. 30th; St Hierom, in the Life of St Hilarion; Theodoret *Hift. Eccl.* lib. v. cap. 21.; Palladius, *Hift. Lauf.*; Bede, lib. v. cap. 4.

As a ceremony (fays the Catholic), water brings to our remembrance our baptifm; in which, by water, we were cleanfed from original fin. It alfo puts us in mind of that purity of confcience which we ought to endeavour always to have, but efpecially when we are going to worfhip our God. The falt, which is put into the water to preferve it from corrupting, is alfo a figure of divine grace, which preferves our fouls from the corruption of fin; and is likewife an emblem of that wifdom and difcretion which ought to feafon every action that a Chriftian does, and every word that he fays. It is wont to be bleffed and fprinkled in churches on Sundays, in the beginning of the folemn office. It is kept in veffels at the doors of the fame churches, that it may be taken by the faithful as they enter in. It is alfo often kept in private houfes and chambers (A).

Putrid Water, is that which has acquired an offenfive fmell and tafte by the putrefcence of animal or vegetable fubftances contained in it. It is in the higheft degree pernicious to the human frame, and capable of bringing on mortal difeafes even by its fmell. It is not always from the apparent muddinefs of waters that we can judge of their difpofition to putrefy; fome which are feemingly very pure being more apt to become putrid than others which appear much more mixed with heterogeneous matters. Under the article Animalcule, n° 33, is mentioned a fpecies of infects which have the property of making water ftink to an incredible degree, though their bulk in proportion to the fluid which furrounds them is lefs than that of one to a million. Other fubftances no doubt there are which have the fame property; and hence almoft all water which is confined from the air is apt to become offenfive, even though kept in glafs or ftone-ware veffels. Indeed it is a common obfervation, that water keeps much longer fweet in glafs-veffels, or in thofe of earthen or ftone-ware, than in thofe of wood, where it is exceedingly apt to putrefy. Hence, as fhips can only be fupplied with water kept in wooden cafks, failors are extremely liable to thofe difeafes which arife from putrid water; and the difcovery of a method by which water could eafily be prevented from becoming putrid at fea would be exceedingly valuable. This may indeed be done by quicklime; for when water is impregnated with it, all putrefcent matters are either totally deftroyed, or altered in fuch a manner as never to be capable of undergoing the putrefactive fermentation again. But a continued ufe of lime-water could not fail of being pernicious, and it is therefore neceffary to throw down the lime; after which the water will have all the purity neceffary for preferving it free from putrefaction. This can only be done by means of fixed air; and mere expofure in broad fhallow veffels to the atmofphere would do it without any thing elfe, only taking care to break the cruft which formed upon it. Two methods, however, have been thought of for doing this with more expedition. The one, invented by Dr Alfton, is, by throwing into the water impregnated with lime a quantity of magnefia. The lime attracts fixed air more powerfully than magnefia; in confequence of which the latter parts with it to the lime; and thus becoming infoluble, falls along with the cauftic magnefia to the bottom, and thus leaves the water perfectly pure. Another method is that of Mr Henry, who propofes to throw down the lime by means of an effervefcing mixture of oil of vitriol and chalk put down to the bottom of the water-cafk. His apparatus for this purpofe is as fimple as it can well be made, though it is hardly probable that failors will give themfelves the trouble of ufing it; and Dr Alfton's fcheme would feem better calculated for them, were it not for the expence of the magnefia; which indeed is the only objection made to it by Mr Henry. Putrid water may be reftored and made potable by a procefs of the fame kind.

Of late it has been difcovered that charcoal poffeffes many unexpected properties, and, among others, that of preferving water from corruption, and of purifying it after it has been corrupted. Mr Lowitz, whofe experiments on charcoal have been publifhed in Crell's Chemical Journal, has turned his attention to this fubject in a memoir read to the Economical Society of Peterfburg. He found that the effect of charcoal was rendered much more fpeedy by ufing along with it fome fulphuric acid. One ounce and a half of charcoal in powder, and 24 drops of concentrated fulphuric acid (oil of vitriol), are fufficient to purify three pints and a half of corrupted water, and do not communicate to it any fenfible acidity. This fmall quantity of acid renders it unneceffary to ufe more than a third part of the charcoal powder which would otherwife be wanted; and the lefs of that powder is employed, the lefs is the quantity of water loft by the operation, which, in fea-voyages, is an object worthy of confideration. In proportion to the quantity of acid made ufe of, the quantity of charcoal may be diminifhed or augmented. All acids produce nearly the fame effects: neutral falts alfo, particularly nitre and fea-falt, may be ufed, but fulphuric acid is preferable to any of thefe; water which is purified by means of this acid and charcoal will keep a longer time than that which is purified by charcoal alone. When we mean to purify any given quantity of corrupted water, we fhould begin by adding to it as much powder of charcoal as is neceffary to deprive it entirely of its bad fmell. To afcertain whether that quantity of powdered charcoal was fufficient to effect the clarification of the faid water, a fmall quantity of it may be paffed through a linen bag, two or three inches long; if the water, thus filtrated, ftill has a turbid appearance, a frefh quantity of powdered charcoal muft be added, till it is become perfectly clear: the whole of the water may then be paffed through a filtering bag, the fize of which fhould be proportioned to the quantity of water. If fulphuric acid, or any other, can be procured, a fmall quantity of it fhould be added to the water, before the charcoal powder.

The cleaning of the cafks in which water is to be kept in fea-voyages fhould never be neglected: they fhould be well wafhed with hot water and fand, or with any other fubftance capable of removing the mucilaginous particles, and afterwards a quantity of charcoal-duft fhould be employed, which will entirely deprive them of the mufty or putrid fmell they may have contracted.—The charcoal ufed for purifying water fhould be well burnt, and afterwards beat into a fine powder.

Sea-

(A) This article was furnifhed by an eminent divine of the church of Rome, to whom we are indebted for greater favours.

Sea-Water. See *Sea-Water*.

Water-Carts, carriages constructed for the purpose of watering the roads for several miles round London; a precaution absolutely necessary near the metropolis, where, from such a vast daily influx of carriages and horses, the dust would otherwise become quite insufferable in hot dry weather. Pumps are placed at proper distances to supply their carts.

Water Ordeal. See Ordeal.

Water, among jewellers, is properly the colour or lustre of diamonds and pearls. The term, though less properly, is sometimes used for the hue or colour of other stones.

Water-Bellows. See *Machines for blowing Air into Furnaces*.

Water-Colours, in painting, are such colours as are only diluted and mixed up with gum-water, in contradistinction to oil colours. See *Colour-Making*.

Water-Gang, a channel cut to drain a place by carrying off a stream of water.

Water-Hen. See Parra.

Water-Line of a Ship, certain horizontal lines supposed to be drawn about the outside of a ship's bottom, close to the surface of the water in which she floats. They are accordingly higher or lower upon the bottom, in proportion to the depth of the column of water required to float her.

Water-Logged, the state of a ship when, by receiving a great quantity of water into the hold, by leaking, &c. she has become heavy and inactive upon the sea, so as to yield without resistance to the effects of every wave rushing over her decks. As, in this dangerous situation, the centre of gravity is no longer fixed, but fluctuating from place to place, the stability of the ship is utterly lost: she is therefore almost totally deprived of the use of her sails, which would operate to overset her, or press the head under water. Hence there is no resource for the crew, except to free her by the pumps, or to abandon her by the boats as soon as possible.

Water-Sail, a small sail spread occasionally under the lower studding-sail, or driver-boom, in a fair wind and smooth sea.

Water Ouzel. See Turdus.

Water-Spout, an extraordinary meteor consisting of a large mass of water collected into a sort of column, and moved with rapidity along the surface of the sea.

The best account of the water-spout which we have met with is in the Phil. Transf. Abridged, vol viii. as observed by Mr Joseph Harris, May 21. 1732, about sunset, lat. 32° 30′ N. long. 9° E. from Cape Florida.

"When first we saw the spout (says he), it was whole and entire, and much of the shape and proportion of a speaking trumpet; the small end being downwards, and reaching to the sea, and the big end terminated in a black thick cloud. The spout itself was very black, and the more so the higher up. It seemed to be exactly perpendicular to the horizon, and its sides perfectly smooth, without the least ruggedness. Where it fell the spray of the sea rose to a considerable height, which made somewhat the appearance of a great smoke. From the first time we saw it it continued whole about a minute, and till it was quite dissipated about three minutes. It began to waste from below, and so gradually up, while the upper part remained entire, without any visible alteration, till at last it ended in the black cloud above: upon which there seemed to fall a very heavy rain in that neighbourhood.—There was but little wind, and the sky elsewhere was pretty serene."

Water-spouts have by some been [illegible] electrical in their origin; parti[illegible]

who supported his opinion by [illegible] experiments. [illegible] we attend to the successive phenomena [illegible] tute a complete water-spout through [illegible] we shall be convinced, that recourse must be had to some other principle in order to obtain a complete solution.

Dr Franklin, in his Physical and Meteorological Observations, supposes a water-spout and a whirlwind to proceed from the same cause; their only difference being, that the latter passes over the land, and the former over the water. This opinion is corroborated by M. de la Pryme, in the Philosophical Transactions, where he describes two spouts observed at different times in Yorkshire, whose appearances in the air were exactly like those of the spouts at sea, and their effects the same as those of real whirlwinds.

A fluid moving from all points horizontally towards a centre, must at that centre either mount or descend. If a hole be opened in the middle of the bottom of a tub filled with water, the water will flow [illegible] to the centre, and there descend in a whirl: but air flowing on or near the surface of land or water, from all sides towards a centre, must at that centre ascend; because the land or water will hinder its descent.

The Doctor, in proceeding to explain his [illegible], begs to be allowed two or three positions, as a foundation for his hypothesis. 1. That the lower region of air is often more heated, and so more rarefied, than the upper, and by consequence specifically lighter. The coldness of the upper region is manifested by the hail, which sometimes falls from it in warm weather. 2. That heated air may be very moist, and yet the moisture so equally diffused and rarefied as not to be visible till colder air mixes with it; at which time it condenses and becomes visible. Thus our breath, although invisible in summer, becomes visible in winter.

These circumstances being granted, he presupposes a tract of land or sea, of about 60 miles in extent, unsheltered by clouds and unrefreshed by the wind, during a summer's day, or perhaps for several days without intermission, till it becomes violently heated, together with the lower region of the air in contact with it; so that the latter becomes specifically lighter than the superincumbent higher region of the atmosphere, wherein the clouds are usually floated: he supposes also that the air surrounding this tract has not been so much heated during those days, and therefore remains heavier. The consequence of this, he conceives, should be, that the heated lighter air should ascend, and the heavier descend; and as this rising cannot operate throughout the whole tract at once, because that would leave too extensive a vacuum, the rising will begin precisely in that column which happens to be lightest or most rarefied; and the warm air will flow horizontally from all parts of this column, where the several currents meeting, and joining to rise, a whirl is naturally formed, in the same manner as a whirl is formed in a tub of water, by the descending fluid receding from all sides of the tub towards the hole in the centre.

And as the several currents arrive at this central rising column, with a considerable degree of horizontal motion, they cannot suddenly change it to a vertical motion; therefore as they gradually, in approaching the whirl, decline from right to curve or circular lines, so, having joined the whirl, they ascend by a spiral motion: in the same manner as the water descends spirally through the hole in the tub before mentioned.

Lastly, as the lower air nearest the surface is more rarefied by the heat of the sun, it is more [illegible] current of the surrounding cold and heavy air which is to assume its place, and consequently its motion towards the whirl is swiftest, and so [illegible]

whirl uppermoſt, and the centrifugal force of its particles greateſt. Hence the vacuum which incloſes the axis of the whirl ſhould be greateſt near the earth or ſea, and diminiſh gradually as it approaches the region of the clouds, till it ends in a point.

This circle is of various diameters, ſometimes very large.

If the vacuum paſſes over water, the water may riſe in a body or column therein to the height of about 32 feet. This whirl of air may be as inviſible as the air itſelf, though reaching in reality from the water to the region of cool air, in which our low ſummer thunder-clouds commonly float; but it will ſoon become viſible at its extremities. The agitation of the water under the whirling of the circle, and the ſwelling and riſing of the water in the commencement of the vacuum, renders it viſible below. It is perceived above by the warm air being brought up to the cooler region, where its moiſture begins to be condenſed by the cold into thick vapour, and is then firſt diſcovered at the higheſt part, which being now cooled condenſes what riſes behind it, and this latter acts in the ſame manner on the ſucceeding body; where, by the contact of the vapours, the cold operates faſter in a right line downwards, than the vapours themſelves can climb in a ſpiral line upwards: they climb however; and as by continual addition they grow denſer, and by conſequence increaſe their centrifugal force, and being riſen above the concentrating currents that compoſe the whirl, they fly off, and form a cloud.

It ſeems eaſy to conceive, how, by this ſucceſſive condenſation from above, the ſpout appears to drop or deſcend from the cloud, although the materials of which it is compoſed are all the while aſcending. The condenſation of the moiſture contained in ſo great a quantity of warm air as may be ſuppoſed to riſe in a ſhort time in this prodigiouſly rapid whirl, is perhaps ſufficient to form a great extent of cloud; and the friction of the whirling air on the ſides of the column may detach great quantities of its water, diſperſe them into drops, and carry them up in the ſpiral whirl mixed with the air. The heavier drops may indeed fly off, and fall into a ſhower about the ſpout; but much of it will be broken into vapour, and yet remain viſible.

As the whirl weakens, the tube may apparently ſeparate in the middle; the column of water ſubſiding, the ſuperior condenſed part drawing up to the cloud. The tube or whirl of air may nevertheleſs remain entire, the middle only becoming inviſible, as not containing any viſible matter.

Dr Lindſay, however, in ſeveral letters publiſhed in the Gentleman's Magazine, has controverted this theory of Dr Franklin, and endeavoured to prove, that water-ſpouts and whirlwinds are diſtinct phenomena; and that the water which forms the water-ſpout, does not aſcend from the ſea, as Dr Franklin ſuppoſes, but deſcends from the atmoſphere. Our limits do not permit us to inſert his arguments here, but they may be ſeen in the Gentleman's Magazine, volume li. p. 559, 615; vol. liii. p. 1025; and vol. lv. p. 594. We cannot avoid obſerving, however, that he treats Dr Franklin with a degree of aſperity to which he is by no means intitled, and that his arguments, even if concluſive, prove nothing more than that ſome water-ſpouts certainly do deſcend; which Dr Franklin hardly ever ventured to deny. There are ſome very valuable diſſertations on this ſubject by profeſſor Wilcke of Upſal.

Water-Works. See *Water-Works* (A).

Water-Works for entertainment. See Hydrostatics, ſect. 6.

WATERFORD, a city and ſea-port of Ireland, in a county of the ſame name, with a biſhop's ſee. It is the ſecond place in the kingdom, and is a wealthy, populous city, enjoying many ample privileges. The ſtreets are narrow, and the air is not very healthy; but it has an excellent harbour, ſeated as well for trade as any in the world, and ſhips of the greateſt burden may ride at the quay. It ſtands on the river Sure, 8 miles north of St George's Channel, 26 ſouth of Kilkenny, and 75 ſouth by weſt of Dublin. W. Long. 6. 54. N. Lat. 52. 18.

Waterford, a county of Ireland, 46 miles in length, and 25 in breadth; bounded on the ſouth by St George's Channel; on the weſt by Cork; on the north by the river Sure, which ſeparates it from Tipperary and Kilkenny; and on the eaſt by Waterford Haven, which parts it from Wexford. It contains 71 pariſhes, and ſends 10 members to parliament. It is a fine country, very pleaſant and rich, and the principal place is of the ſame name.

WATERING, in the manufactures, is to give a luſtre to ſtuffs, &c. by wetting them lightly with gum-water, and then paſſing them through the preſs or calender whether hot or cold. The gum-water ought to be pure, thin, and clear, otherwiſe the folds of the ſtuff will all ſtick together: the operation muſt alſo be performed when the water is very hot, that it may penetrate.

Watering Meadows. See Meadows.

WATERLAND (Dr Daniel), a learned Engliſh divine who diſtinguiſhed himſelf greatly in theological controverſies, was born in 1683 at Waſely in Lincolnſhire, of which place his father was rector. He had his academical learning at Magdalen college, Cambridge, where he drew up a uſeful tract, which went through ſeveral editions, intitled, *Advice to a Young Student, with a Method of Study for the firſt four years.* In 1713 he became maſter of the college, was ſoon after appointed chaplain to George I. and in 1720 preached the firſt courſe of lectures founded by lady Moyer in defence of our Lord's divinity. He went through ſeveral promotions; and at the time of his death in 1740, was canon of Windſor, archdeacon of Middleſex, and vicar of Twickenham. Beſides his controverſial writings, he publiſhed two volumes of ſermons.

WATLING-street. See Way.

WATSON (Dr Robert), an elegant hiſtorian, was born at St Andrew's, in Scotland, about the year 1730. He was the ſon of an apothecary of that place, who was alſo a brewer. Having gone through the uſual courſe of languages and philoſophy at the ſchool and univerſity of his native place, and alſo entered on the ſtudy of divinity, a deſire of being acquainted with a larger circle of literati, and of improving himſelf in every branch of knowledge, carried him, firſt to the univerſity of Glaſgow, and afterwards to that of Edinburgh. The period of theological ſtudies

(A) For referring this article from the word Water to the word Works, an apology is due to the Public; and the apology which we have to offer, we are perſuaded, will be ſuſtained. It is this: The gentleman who contributed the articles *Resistance of Fluids* and River, promiſed to furniſh alſo the article *Water-Works;* but ſickneſs has hitherto prevented him from fulfilling that promiſe. We truſt, however, that before our preſſes ſhall reach to the word Works, he may be able to fill up the ſketch which he has long ago drawn of this very important ſubject. And ſuch of our readers as can eſtimate the merit of his two articles, which we have juſt mentioned, will not blame the Editor for deviating a little from the alphabetical order, to give him a chance of furniſhing a third article, to which theſe two are ſo cloſely related.

studies at the universities of Scotland is four years: but during that period, young men of ingenious minds and sufficient leisure to carry on and advance the pursuits of general knowledge. Mr Watson pursued his studies with ardour. Few men ever studied more constantly. It was a rule with him to study eight hours every day; and this law he observed during the whole course of his life. An acquaintance with the polite writers of England, after the union of the two kingdoms, became general in Scotland; and in Watson's younger years, an emulation began to prevail of writing pure and elegant English. Mr Watson applied himself with great industry to the principles of philosophical or universal grammar; and by a combination of these, with the authority of the best English writers, formed a course of lectures on style or language. He proceeded to the study of rhetoric or eloquence; the principles of which he endeavoured to trace to the nature of the human mind. He delivered a course of lectures in Edinburgh on these subjects; and met with the countenance, approbation, and friendship of Lord Kames, Mr Hume, with other men of genius and learning.

At this time he had become a preacher; and a vacancy having happened in one of the churches of St Andrew's, he offered himself a candidate for that living, but was disappointed. Mr Henry Rymer, who then taught logic in St Salvador's College, was in a very infirm state of health, and entertained thoughts of retiring from the cares and emoluments of his office, to live upon his small salary or stipend. Mr Watson understanding this, purchased, for not a great sum of money, what, in familiar phraseology, may be called the good-will of Mr Rymer's place; and, with the consent of the other masters of St Salvador's, was appointed professor of logic. He obtained also a patent from the crown, constituting him professor of rhetoric and belles lettres. The study of logic, in St Andrew's, as in most other places, was at this time confined to syllogisms, modes, and figures. Mr Watson, whose mind had been opened by conversation, and by reading the writings of the wits that had begun to flourish in the Scotch capital, prepared and read to his students a course of metaphysics and logics on the most enlightened plan; in which he analyzed the powers of the mind, and entered deeply into the nature of the different species of evidence of truth or knowledge. By his history of Philip II. Dr Watson attained in his lifetime a considerable degree of celebrity; and his history of Philip III. published after his death, has added to his fame. Of this last performance, however, he has only completed the four first books; the two last were written by the editor of his manuscript, at the desire of the guardians of his children.

On the death of principal Tullideph, Dr Watson, through the earl of Kinnoull, was appointed his successor; in which station he lived only a few years. He married a lady of singular beauty and virtue, daughter to Mr Shaw, professor of divinity in St Mary's college, St Andrew's. By this lady he had five daughters, who survived him.

WATTS (Dr Isaac), a learned and eminent dissenting minister, was born at Southampton in 1674, of parents eminent for piety, and considerable sufferers for conscience-sake. In 1690 he was sent up to London for academical education under the tuition of the Rev. Mr Thomas Rowe; and in 1696 was himself engaged as tutor to the son of Sir John Hartopp, bart. at Stoke Newington. He began to preach in 1698, and met with general acceptance; and after officiating for three years as an assistant to the Rev. Dr Isaac Chauncy, he succeeded in his pastoral charge in 1702, and continued to preside over that church as long as he lived. Though his whole income did not amount to an hundred a-year, he allotted one third of it to the poor. He died in 1748. His numerous works have rendered his name familiar among people of every denomination, both in this and other countries, and some have been translated into a variety of languages. His Lyric Poems, his Psalms and Hymns, and his Divine Songs for Children, are a sufficient proof of his poetical talents, and have had a amazing number of editions. His Logic and [illegible] have been much admired. He also wrote works upon a variety of other subjects, and printed several volumes of his sermons. He was admired for the [illegible] and [illegible] of his composition and the sweetness of his manners. After his death, his works were collected, and published in six volumes quarto.

WAVE, in philosophy, a cavity in the surface of water, or other fluids, with an elevation aside thereof.

The waves of the sea are of two kinds, natural and accidental. The natural waves are those which are exactly proportioned in size to the strength of the wind, whose blowing gives origin to them. The accidental waves are those occasioned by the wind's reacting upon itself by repercussion from hills and mountains, or high shores, and by the washing of the waves themselves; otherwise of the natural kind, against rocks and shoals: all these cases give the waves an elevation, which they can never have in their natural state. For the height of the waves, see SEA.

Stilling Waves by means of Oil. See SEA.

WAVED, in heraldry, is said of a bordure, or any ordinary or charge, in a coat of arms, having its outlines indented in manner of the rising and falling of waves: it is used to denote, that the first of the family in whose arms it stands, acquired its honours by sea service.

WAVING, in the sea-language, is the making signs to a vessel to come near or keep off.

WAX, or *Bees Wax*, in natural history, a firm and solid substance, moderately heavy, and of a fine yellow colour, formed by the bees from the pollen of flowers. See APIS.

The best sort is that of a lively yellow colour, and an agreeable smell, somewhat like that of honey: when new, it is toughish, yet easy to break; but by age it becomes harder and more brittle, loses its fine colour, and in a great measure its smell.

It appears that wax and the pollen have for their basis a fat oil, which passes to the state of resin by its combination with oxygene. If the nitric or muriatic acid be digested upon fixed oil for several months, it passes to a state resembling wax. Wax, by repeated distillations, affords an oil which possesses all the properties of volatile oils. It is reduced into water and carbonic acid by combustion. The colouring matter of wax is insoluble in water and in alcohol.

[illegible] *Chemistry*, vol. iii.

Fixed alkalis dissolve wax, and render it soluble in water. It is this saponaceous solution which forms the punic wax. It may be used as the basis of several colours; and may be made into an excellent paste for washing the hands. Ammoniac likewise dissolves it; and as this solvent is evaporable, it ought to be preferred when it is proposed to use the wax as a varnish.

From the common yellow wax, by bleaching, is formed white-wax, sometimes called, very improperly, *virgin-wax*. The greater the surface is in proportion to the quantity, the sooner and more perfectly this operation is performed. The usual way is to melt the wax in hot water; when melted, they press it through a strainer of tolerably fine linen, and pour it into round and very shallow moulds. When hardened by cooling, it is taken out and exposed to the sun and air, sprinkling it now and then with water, and often turning it: by this means it soon becomes white.

The

Wax, Way.

The best sort is of a clear and almost transparent whiteness, dry, hard, brittle, and of an agreeable smell, like that of the yellow wax, but much weaker.

The common yellow wax is of very great use both in medicine and in many of the arts and manufactures. It has been sometimes given internally in dysenteries and erosions of the intestines; but its great use is in the making ointments and plasters, and the greater part of those of the shops owe their consistence to it. The white wax is also an ingredient in some of the cerates and ointments of the shops; and is used in making candles, and in many of the nicer arts and manufactures where wax is required.

Sealing-Wax, or *Spanish-Wax*, is a composition of gum lac, melted and prepared with resins, and coloured with some suitable pigment.

There are two kinds of sealing-wax in use; the one hard, intended for sealing letters, and other such purposes; the other soft, designed for receiving the impressions of seals of office to charters patents, and such written instruments. The best hard red sealing-wax is made by mixing two parts of shell lac, well powdered, and resin and vermilion, powdered, of each one part, and melting this combined powder over a gentle fire; and when the ingredients seem thoroughly incorporated, working the wax into sticks. Seed lac may be substituted for the shell-lac; and instead of resin, boiled Venice turpentine may be used. A coarser, hard, red sealing-wax, may be made, by mixing two parts of resin, and of shell-lac, or vermilion and red-lead, mixed in the proportion of one part of the vermilion to two of the red lead, of each one part; and proceeding as in the former preparation. For a cheaper kind, the vermilion may be omitted, and the shell-lac also, for very coarse uses. Wax of other colours is made by substituting other colouring matters for vermilion, as verditer for blue, ivory black for black wax. For uncoloured, soft sealing-wax, take of bees wax, one pound; of turpentine, three ounces; and of olive-oil, one ounce; place them in a proper vessel over the fire, and let them boil for some time; and the wax will be then fit to be formed into rolls or cakes for use. For red, black, green, blue, yellow, and purple soft sealing-wax, add to the preceding composition an ounce or more of any ingredients directed above for colouring the hard sealing-wax, and stir the mass till the colouring ingredients be incorporated with the wax.

Wax-Work, the representation of the faces, &c. of persons living or dead; made by applying plaster of Paris in a kind of paste, and thus forming a mould containing the exact representation of the features. Into this mould melted wax is poured, and thus a kind of masks are formed; which being painted and set with glass eyes, and the figures dressed in their proper habits, they bear such a resemblance that it is difficult to distinguish between the copy and the original.

WAY, a passage or road.

The Roman ways are divided into consular, prætorian, military, and public; and of these we have four remarkable ones in England: the first, Watling-street, or Watheling-street, leading from Dover to London, Dunstable, Toucester, Atterston, and the Severn, extending as far as Anglesea in Wales. The second, called *Hikenild* or *Ikenild-street*, stretches from Southampton over the river Isis at Newbridge; thence by Camden and Litchfield; then passes the Derwent near Derby, and ends at Tinmouth. The third, called *Fosse-way*, because in some places it was never perfected, but lies as a large ditch, leads from Cornwall through Devonshire, by Tethbury, near Stow in the Wolds; and beside Coventry to Leicester, Newark, and so to Lincoln. The fourth, called *Erming* or *Erminage-street*, extends from St David's, in Wales, to Southampton.

Way Covert, Gang, Hatch. See COVERT *Way*, GANG, &c.

Way of a Ship, is sometimes the same as her rake, or run forward or backward: but this term is most commonly understood of her sailing.

Way-Leaves, in the coal business. See COALERY, n° 3.

Right of Ways, in law. This may be grounded on a special permission; as when the owner of the land grants to another a liberty of passing over his grounds, to go to church, to market, or the like: in which case the gift or grant is particular, and confined to the grantee alone; it dies with the person; and if the grantee leaves the country, he cannot assign over his right to any other; nor can he justify taking another person in his company. A way may be also by prescription; as if all the owners and occupiers of such a farm have immemorially used to cross another's ground; for this immemorial usage supposes an original grant, whereby a right of way thus appurtenant to land may clearly be created. A right of way may also arise by act and operation of law; for if a man grants me a piece of ground in the middle of his field, he at the same time tacitly and impliedly gives me a way to come at it; and I may cross his land for that purpose without trespass. For when the law doth give any thing to one, it giveth impliedly whatsoever is necessary for enjoying the same. By the law of the twelve tables at Rome, where a man had the right of way over another's land, and the road was out of repair, he who had the right of way might go over any part of the land he pleased: which was the established rule in public as well as private ways. And the law of England, in both cases, seems to correspond with the Roman.

WAYFARING TREE. See VIBURNUM.

WAYWODE, is properly a title given the governors of the chief places in the dominions of the czar of Muscovy. The palatines, or governors of provinces in Poland, also bear the quality of *waywodes*, or *waiwodes*. The Poles likewise call the princes of Wallachia and Moldavia *waywodes*; as esteeming them no other than on the foot of governors; pretending that Wallachia and Moldavia are provinces of Poland. Everywhere else these are called *hospodars*. Du Cange says, that the name *waywode* is used in Dalmatia, Croatia, and Hungary, for a general of an army: and Leunclavius, in his Pandects of Turkey, tells us, it usually signifies *captain* or *commander*.

WEANING, putting a child away from the breast, and bringing it to use common food.

WEAR, or WEER, a great stank or dam in a river, fitted for the taking of fish, or for conveying the stream to a mill. New wears are not to be made, or others altered, to the nuisance of the public, under a certain penalty. See RIVER.

WEARING, or VEERING, in seamanship. See SEAMANSHIP, Vol. XVII. p. 219.

WEASEL, in zoology. See MUSTELA.

WEATHER denotes the state of the atmosphere with regard to heat and cold, wind, rain, and other meteors.

The phenomena of the weather must have at all times attracted much of the attention of mankind, because their subsistence and their comfort in a great measure depended upon them. It was not till the seventeenth century, however, that any considerable progress was made in investigating the laws of meteorology. How desirous soever the ancients might have been to acquire an accurate knowledge of this science, their want of proper instruments entirely precluded them from cultivating it. By the discovery of the barometer and thermometer in the last century, and the invention of accurate electrometers and hygrometers in the present,

present, this defect is now pretty well supplied; and philosophers are enabled to make their observations with [illegible] and accuracy. [illegible] a very great number of such observations have been collected, which have been arranged [illegible] and [illegible], and some general [illegible] deduced from them, [illegible] different theories of the weather have been [illegible]. [illegible]rology is a science so exceedingly difficult, that, notwithstanding the united exertions of some of the [illegible] philosophers o[f] the a[ge], the phenomena of the weather are still very far from being completely understood; nor can we expect to see the veil removed, till accurate tables of observations have been obtained from every part of the world, till the atmosphere has been more completely analysed, and the chemical changes which take place in it ascertained. From the meteorological facts, however, which are already known, we shall draw up the best account of the weather we can. We shall treat of the different phenomena in the following order—heat and cold, wind, rain, thunder, alterations in the gravity of the atmosphere.

I. Though there is a considerable difference in every part of the world between the temperature of the atmosphere in summer and in winter; though in the same season the temperature of almost every day, and even every hour, differs from that which precedes and follows it; though the heat varies continually in the most irregular and [illegible] manner—still there is a certain mean temperature in every climate, which the atmosphere has always a tendency to observe, and which it neither exceeds nor comes short of beyond a certain number of degrees. What this temperature is, may be known by taking the mean of tables of observations kept for a number of years; and our knowledge of it must be the more accurate the greater the number of observations is.

The mean annual temperature is greatest at the equator (or at least a degree or two on the north side of it), and it diminishes gradually towards the poles, where it is least. This diminution takes place in arithmetical progression, or, to speak more properly, the annual temperature of all the latitudes are arithmetical means between the mean annual temperature of the equator and the pole. This was first discovered by Mr Mayer; and by means of an equation which he founded on it, but rendered considerably plainer and simpler, Mr Kirwan has calculated the mean annual temperature of every degree of latitude between the equator and the pole. He proceeded on the following principle. Let the mean annual heat at the equator be m and at the pole $m-n$; put ϕ for any other latitude; the mean annual temperature of that latitude will be $m - n \times \sin \phi^2$. If therefore the temperature of any two latitudes be known, the value of m and n may be found. Now the temperature of north lat. 40 has been found by the best observations to be 62,1°, and that of lat. 50°, 52,9°. The square of the sine of 40° is nearly [illegible], and the square of the sine of 50° is nearly [illegible]. Therefore

$$m - 0{,}41\,n = 62{,}1 \text{ and}$$
$$m - 0{,}58\,n = 52{,}9 \text{ : therefore}$$
$$62{,}1 + 0{,}41\,n = 52{,}9 + 0{,}58\,n, \text{ as each of}$$

them, from the two first equations, is equal to m. From this last equation the value of n is found to be 53 nearly; and m is nearly equal to 84. The mean temperature of the equator therefore is 84°, and that of the pole 31°. To find the mean temperature for every other latitude, we have only to find 88 arithmetical means between 84 and 31. In this manner Mr Kirwan calculated the following table.

Table of the Mean Annual Temperature [illegible], in every Latitude.

[illegible]	[illegible]	[illegible]	[illegible]	Lat.	[illegible]
[illegible]	31,	[illegible]	[illegible]	[illegible]	[illegible]
89	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	31,4	[illegible]	[illegible]	27	[illegible]
[illegible]	31,5	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	32,2	52	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	51	[illegible]	[illegible]	[illegible]
[illegible]	32,9	[illegible]	[illegible]	21	[illegible]
[illegible]	[illegible]	49	[illegible]	[illegible]	77,8
[illegible]	[illegible]	48	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	47	[illegible]	[illegible]	[illegible]
75	[illegible]	46	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
73	[illegible]	44	[illegible]	15	[illegible]
[illegible]	[illegible]	43	[illegible]	14	[illegible]
71	[illegible]	[illegible]	[illegible]	13	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
69	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
67	[illegible]	[illegible]	[illegible]	9	[illegible]
66	39,7	[illegible]	[illegible]	[illegible]	[illegible]
65	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
64	41,2	35	[illegible]	6	[illegible]
[illegible]	[illegible]	34	[illegible]	[illegible]	[illegible]
62	[illegible]	[illegible]	[illegible]	[illegible]	84,

This table, however, only answers for the temperature of the atmosphere of the ocean. It was calculated for that part of the Atlantic ocean which lies between the [illegible] degree of northern and the 45th of southern latitude, and extends westwards as far as the Gulf-stream, and to within a few leagues of the coast of America; and to all that part of the Pacific ocean reaching from lat. 45 north to [illegible] south, from the 20th to the 275th degree of longitude east of London. This part of the ocean Mr Kirwan calls the *standard*; the rest of the ocean is subject to anomalies which will be afterwards mentioned.

Mr Kirwan has also calculated the mean monthly temperature of the standard ocean. The principles on which he went were these: The mean temperature of April seems to approach very nearly to the mean annual temperature; and as far as heat depends on the action of the solar rays, the mean heat of every month is as the mean altitude of the sun, or rather as the sine of the sun's altitude. The mean heat of April, therefore, and the sine of the sun's [illegible] being given, the mean heat of May is found in this manner: As the sine of the sun's mean altitude in April is to the mean heat of April, so is the sine of the sun's mean altitude in May to the mean heat of May. In the same manner the mean heats of June, July, and August, are found; but the rule would give the temperature of the succeeding months too low, because it does not take in the heat derived from the earth, which possesses a degree of heat nearly equal to the mean annual temperature. The real [illegible] of [illegible]

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Table of the Monthly Mean Temperature of the Standard from lat. 80° to lat. 10°.

Lat.	80°	79°	78°	77°	76°	75°	74°	73°	72°	71°	70°	69°	68°	67°	66°	65°	64°	63°	62°	61°	60°	59°	58°
Jan.	22,	22,5	23,	23,5	24,	24,5	25,	25,5	26,	26,5	27,	27,5	27,5	28,	28,	28,	29,	30,	31,	32,	33,	34,	35,
Feb.	23,	23,	23,5	24,	24,5	25,	25,5	26,	26,5	27,	27,5	28,	28,	28,5	29,	30,	31,	32,	33,	34,	35,	36,	37,
Mar.	27,	27,5	28,	28,5	29,	29,5	30,	30,5	31,	31,5	32,	32,5	33,	33,5	34,	35,	36,	37,	38,	39,	40,	41,	42,
Apr.	32,6	32,9	33,2	33,7	34,1	34,5	35,	35,5	36,	36,6	37,2	37,8	38,4	39,1	39,7	40,4	41,2	41,9	42,7	43,5	44,3	45,09	45,
May	36,5	36,5	37,	37,5	38,	38,5	39,	39,5	40,	40,5	41,	41,5	42,	42,5	43,	44,	45,	46,	47,	48,	49,	50,	51,
June	51,	51,	51,5	52,	52,	52,	52,5	53,	53,5	54,	54,	54,5	54,5	54,5	55,	55,	55,5	55,5	56,	56,	56,	56,5	57,
July	50,	50,	50,5	51,	51,	51,	51,5	52,	52,5	53,	53,5	53,5	53,5	54,	54,5	54,5	55,	55,	55,5	55,5	56,	56,5	57,
Aug.	39,5	40,	41,	41,5	42,	42,5	43,	43,5	44,	44,5	45,	45,5	46,	47,	48,	48,5	49,	50,	51,	52,	53,	54,	55,
Sept.	33,5	34,	34,5	35,	35,5	36,	36,5	37,	38,	38,5	39,	39,5	40,	41,	42,	43,	44,	45,	46,	47,	48,	49,	50,
Oct.	28,5	29,	29,5	30,	30,5	31,	31,5	32,	32,5	33,	33,5	34,	34,	35,	36,	37,	37,5	38,	39,	40,	41,	42,	43,
Nov.	23,	23,5	24,	24,5	25,	25,5	26,	26,5	27,	27,5	28,	28,5	29,	30,	31,	32,	32,5	33,	34,	35,	36,	37,	38,
Dec.	22,5	23,	23,5	24,	24,5	25,	25,5	26,	26,5	27,	27,5	28,	28,	29,	30,	30,5	31,	31,	32,	33,	34,	35,	36,

Lat.	56°	55°	54°	53°	52°	51°	50°	49°	48°	47°	46°	45°	44°	43°	42°	41°	40°	39°	38°	37°	36°	35°	34°
Jan.	37,	38,	39,	40,	41,	42,	42,5	42,5	43,	43,5	44,	44,5	45,	45,5	46,	46,5	49,5	51,	52,	53,5	55,	56,5	59,5
Feb.	39,	40,	41,	42,	43,	44,	44,5	44,5	45,	45,5	46,	46,5	47,	48,	49,	50,	53,	56.5	58,	60,	61,	62,	63,
Mar.	44,	45,	46,	48,	49,	50,	50,5	51,	52,5	53,	53,5	54,5	55,5	56,5	58,5	59,5	60,	60,5	61,	62,	63,	64,	65,
Apr.	47,5	48,4	49,2	50,2	51,1	52,4	52,9	53,8	54,7	55,6	56,4	57,5	58,4	59,4	60,3	61,2	62,1	63,	63,9	64,8	65,7	66,6	67,4
May	53,	54,	55,	56,	57,	58,	58,5	59,	60,	61,	62,	63,	64,	65,	66,	67,	68,	69,	70,	70,5	71,	71,5	72,
June	57,5	58,	58,5	59,	59,	60,	61,	62,	63,	64,	65,	66,	67,	68,	69,	70,	70,5	71,	71,	71,	71,5	71,5	72,
July	58,	59,	60,	61,	62,	63,	63,5	64,	65,	66,	67,	68,	69,	69,5	70,	70,	71,	71,	72,	72,	72,5	72,5	72,5
Aug.	57,	58,	59,	60,	61,	62,	63,5	64,	65,	66,	67,	68,	69,	69,5	70,	70,	71,	71,	72,	72,	72,5	72,5	72,5
Sept.	52,	53,	54,	55,	56,	57,	58,5	59,	60,	61,	62,	63,	64,	66,	68,	69,5	70,5	71,	71,5	72,	72,5	72,5	72,5
Oct.	45,	46,	47,	48,	49,	50,	50,5	51,	52,	53,	54,	55,	56,	57,	58,	59,	60,	61,	62,	63,	64,	65,	66,
Nov.	40,	41,	42,	43,	44,5	46,	46,5	47,	48,	49,	50,	51,	52,	53,	54,	55,	56,	57,	58,	59,	60,	61,	62,
Dec.	38,	39,	40,	41,	42,	44,	44,5	45,	46,	47,	48,	49,	50,	51,	52,	53,	54,	55,	56,	57,	58,	59,	60,

2°	31°	30°	29°	28°	27°	26°	25°	24°	23°	22°	21°	20°	19°	18°	17°	16°	15°	14°	13°	12°	11°	10°
3,	63,	63,5	63,	63,5	64,	64,5	65,5	67,	68.	69,	71,	72,	72,5	73,	73,5	74,	74,5	75,	76,	76,5	77,	77,5
6,	67,	68,5	68.5	69 5	69,5	70,5	71,	72,	72,	72,5	74,	75,	76,	76,5	77,	77,	78,	78.5	79,	79,5	79,5	80,
7,5	68,5	69,5	71,	72,	72,5	73,	73,5	74,5	75,	75,5	76,	77,	77,5	78,	78,5	79,	79,5	80,	80,5	81.	81,5	81,5
9,1	69,9	70,7	71,5	72,3	[illegible]	73,8	74,5	75,4	75,9	76,5	77,2	77,8	78,3	78,9	79,4	79,9	80,4	80,8	81,3	81,7	82,	82,3
3,	73,	73.5	74.5	75.5	76,	76,5	77,5	78,	78,5	79.5	80,	80,5	81,	81,5	82,	82,5	83,	83,	83,5	84,	84,	84,3
3,	73,	73,5	74,5	75,5	76,	76.5	78,	78,5	79,	79,5	80,	80,5	81,5	82,	82,5	83,	83.5	83,8	84,	84,3	84,	84,5
3.	73,	73,5	74,5	75,5	76,	76,5	78,	78.5	79,	79,5	80,	80,5	81,5	82,	82,5	83,	83,5	83,8	84,	84,3	[illegible]	[illegible]
3,	73,	73,5	74,5	75,5	76,	76,5	78,	78,5	79,	79,5	80,	80,5	81,5	82,	82,5	83,	83,5	83,8	84,	84,3	[illegible]	84,5
3,	73,	73,5	74	75.5	76,	76,5	77,5	78,	78,5	79,	79,5	80,	81,	81,5	82,	82,5	83,	83,	83,5	84,	84,	[illegible]
8,5	69,5	70,5	71,	72,5	[illegible]	73,	73,5	74,5	75,	75,5	77,	78,	79,	80,	81,	81,5	82,	82,5	[illegible]	[illegible]	[illegible]	[illegible]
4,5	65,5	66,5	68,	69,	69,5	71,5	72,	73,5	74,	74,5	75,	75,5	76,	77,	78,	78,5	79,	79,5	[illegible]	[illegible]	[illegible]	81,
2,5	63,5	64,5	66,	67,	67,5	68,5	69,5	70,5	71,	71,5	72,	72,5	73,	74,	75,	75,5	76,	76,5	77,	77,5	78,	78,5

From this table it appears, that January is the coldeft month in every latitude, and that July is the warmeft month in all latitudes above 48°. In lower latitudes Auguft is generally warmeft. The difference between the hoteft and coldeft months increafes in proportion to the diftance from the equator. Every habitable latitude enjoys a mean heat of 60 for at leaft two months; this heat feems neceffary for the production of corn. Within ten degrees of the poles the temperatures differ very little, neither do they differ much within ten degrees of the equator; the temperature of different years differ very little near the equator, but they differ more and more as the latitudes approach the poles.

The temperature of the earth at the level of the fea is the fame with that of the ftandard ocean; but this temperature gradually diminifhes as we afcend above that level till, at a certain height, we arrive at the region of perpetual congelation. This region varies in height according to the latitude of the place; it is higheft at the equator, and defcends gradually nearer the earth as we approach the poles. It varies alfo according to the feafon, being higheft in fummer and loweft in winter. M. Bouguer found the cold on the top of Pinchinca, one of the Andes, to extend from feven to nine degrees below the freezing point every morning immediately before fun-rife. He concluded, therefore, that the mean height of the *term of congelation* (the place where it firft freezes during fome part of the day all the year round) between the tropics was 15,577 feet above the level of the fea; but in lat. 28° he placed it in fummer at the height of 13,440 feet. Now, if we take the difference between the temperature of the equator and the freezing point, it is evident that it will bear the fame proportion to the term of congelation at the equator that the difference between the mean temperature of any other degree of latitude and the freezing point bears to the term of congelation in that latitude. Thus the mean heat of the equator being 84°, the difference between it and 32 is 52; the mean heat of lat. 28° is 72.3°, the difference between which and 32 is 40.3: Then 52 : 15577 : : 40 3 : 12072. In this manner Mr Kirwan calculated the following table,

Lat.	Mean Height of the Term of Congelation. Feet.	Lat.	Mean Height of the Term of Congelation. Feet.
0	15577	45	7658
5	15457	50	6260
10	15067	55	4912
15	14498	60	3684
20	13719	65	2516
25	13030	70	1557
30	11592	75	748
35	10664	80	120
40	9016		

If the elevation of a country above the level of the fea proceeds at a greater rate than fix feet *per* mile, we muft, according to Mr Kirwan *, for every 200 feet of elevation, diminifh the annual temperature of the ftandard in that latitude as follows. If the elevation be at the rate of 6 Method of [illegible]

6 feet *per* mile 1/4 of a degree
7 feet - 1/3
13 feet - 4/10
15 or upwards 1/2

According to him † alfo, for every 50 miles diftance from the ftandard ocean, the mean annual temperature in different latitudes is to be depreffed or raifed nearly at the following rate:

From lat. 70° to lat. 35° cooled 1/7 of a degree
35 - [illegible]
30 - [illegible]
25 warmed [illegible]
20 - [illegible]
10 - [illegible]

The caufe of the heat of the atmofphere is evidently the fun's rays; this has been obferved and acknowledged in all ages. The heat which they produce is lefs according as they fall more obliquely; hence the temperature conftantly diminifhes from the equator to the pole becaufe their obliquity conftantly increafes with the latitude. But if the heat depended on the folar rays alone, it would difappear in the 7 Caufe of

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the polar regions during winter when the fun ceafes to rife. This, however, is by no means the cafe; the mean temperature, even at the pole, is 31°; and we find within the arctic circle as hot weather as under the equator. The reafon of this is, that the fun's rays heat the earth confiderably during fummer: this heat it retains and gives out flowly during winter, and thus moderates the violence of the cold; and fummer returns before the earth has time to be cooled down beyond a certain degree. This is the reafon that the coldeft weather does not take place at the winter folftice, but fome time after when the temperature of the earth is loweft; and that the greateft heat takes place alfo fome confiderable time after the fummer folftice, because then the temperature of the earth is higheft. The pure air is not heated by the folar rays which pafs through it, but acquires flowly the temperature of the earth with which it is in contact. This is the reafon why the temperature decreafes according to the elevation above the level of the fea (a).

3
And of the difference between the temperature on land and fea.

Since the atmofphere is heated by contact with the fuperficies of the earth, its temperature muft depend upon the capacity of that fuperficies for receiving and tranfmitting heat. Now this capacity differs very much in land and water. Land, efpecially when dry, receives heat with great readinefs, but tranfmits it through its own fubftance very flowly. Dr Hailes found, that in 1724, when the air and furface of the earth were both at 88°, a thermometer placed only two inches below the furface ftood at 85°; another 16 inches below the furface, at 70°; and another 24 inches deep, at 68°. The two laft-mentioned thermometers retained the fame temperature till the end of the month, though the temperature of the air frequently varied, and then fell only to 63° or 61°. The earth, at about 80 or 90 feet below its furface, conftantly retains the fame temperature; and this is nearly equal to the mean annual heat of the country. Hence the mean annual temperature of any country may be found out pretty accurately, by examining the heat of deep wells or fprings. Water, on the contrary, receives heat flowly, on account of its tranfparency; but what it does receive, is very quickly transfufed through the whole mafs.

Land is often heated and cooled to a much greater degree than fea is. Dr Raymond often found the earth in the neighbourhood of Marfeilles heated to 170°, but he never found the fea above 77°: in winter the earth was often cooled down to 14°, but the fea never lower than 45°. The fea atmofphere, therefore, ought to preferve a much more uniform temperature than the land atmofphere; and we find this in fact to be the cafe. The caufe of the greater equability of water than land is evident. In fummer the urface of the fea is conftantly cooled down by evaporation; and in winter, whenever the furface is cooled, it defcends to the bottom from its increafed gravity, and its place is fupplied by warmer water. This procefs goes on continually, and the winter is over before the atmofphere has been able to cool down the water beyond a certain degree. It muft be remembered alfo, that water has a greater capacity for heat than land has, and therefore is longer either in heating or cooling.

Thefe obfervations will enable us to explain the difference which takes place between the annual temperature of the atmofphere above the ocean and that of places at fome confiderable diftance from it. As the fea is never heated fo highly as the land, the mean fummer temperature at fea may be confidered, all over the world, as lower than on land. During winter, when the power of the fun's rays in a great meafure ceafes, the fea gives out heat to the air much more readily than the earth: the mean winter temperature, therefore, at fea is higher than on land; and in cold countries the difference is fo great, that it more than counterbalances the difference which takes place in fummer; fo that in high latitudes the mean annual temperature ought to be greater at fea than on land. Accordingly from lat. 70° to 35°, to find the temperature of a place, the ftandard temperature for the fame latitude ought, according to Dr Kirwan, to be depreffed ½d of a degree for every 50 miles diftance; for the cold which takes place in winter always increafes in proportion to the diftance from the ftandard. At a lefs diftance than 50 miles the temperatures of land and fea are fo blended together by fea and land winds, that there is little difference in the annual mean. In lower latitudes than 30°, the rays of the fun, even in winter, retain confiderable power; the furface of the earth is never cooled very low, confequently the difference between the annual temperatures of the fea and land becomes lefs. As we approach nearer to the equator, the power of the folar rays during winter increafes fo that the mean winter temperature of the land atmofphere approaches nearer and nearer to that of the fea, till at laft at the equator it equals it. After we pafs lat. 30°, therefore, the mean annual land temperature gradually exceeds that of the fea more and more till at the equator it exceeds it a degree for every 50 miles diftance.

Such then, in general, is the method of finding the mean annual temperature over the globe. There are, however, feveral exceptions to thefe general rules, which come now to be mentioned.

That part of the Pacific ocean which lies between north lat. 52° and 66° is no broader at its northern extremity than 42 miles, and at its fouthern extremity than 1300 miles: it is reafonable to fuppofe, therefore, that its temperature will be confiderably influenced by the furrounding land, which confifts of ranges of mountains covered, a great part of the year, with fnow; and there are befides a great many high, and confequently cold, iflands fcattered through it. For thefe reafons Mr Kirwan concludes, that its temperature is at leaft 4 or 5 degrees below the ftandard. But we are not yet furnifhed with a fufficient number of obfervations to determine this with accuracy.

It is the general opinion, that the fouthern hemifphere, beyond the 40th degree of latitude, is confiderably colder than the correfponding parts of the northern hemifphere. The caufe of this we fhall endeavour to affign in the article WIND.

Small feas furrounded with land, at leaft in temperate and cold climates, are generally warmer in fummer and colder in winter than the ftandard ocean, becaufe they are a good deal influenced by the temperature of the land. The Gulph of Bothnia, for inftance, is for the moft part frozen in winter; but in fummer it is fometimes heated to 70°, a degree of heat never to be found in the oppofite part of the Atlantic *. The German fea is above three degrees colder in winter, and five degrees warmer in fummer, than the Atlantic ‡. The Mediterranean Sea is, for the greater part of its extent, warmer both in fummer and winter than the

(a) It was fome time ago the favourite opinion of philofophers, that the heat of the earth was derived from a mafs of fire in its centre. But there does not feem any probability in the opinion, as the heat of the earth does not increafe the deeper we go, but remains conftant nearly at the mean heat of the place. In the mine of Joachimftahl in Bohemia, one of the deepeft exifting, Mr Monnet found the temperature at the depth of 1700 feet to be 50°. The temperature of the earth has even been found to diminifh the deeper we go, though never lower than 56°.

the Atlantic, which therefore flows into it. The Black Sea is colder than the Mediterranean, and flows into it ‡.

The eastern parts of North America are much colder than the opposite coast of Europe, and fall short of the *standard* by about 10° or 12°, as appears from American Meteorological Tables. The causes of this remarkable difference are many. The highest part of North America lies between the 40th and 50th degree of north latitude, and the 100th and 110th degree of longitude west from London; for there the greatest rivers originate. The very height, therefore, makes this spot colder than it otherwise would be. It is covered with immense forests, and abounds with large swamps and morasses, which render it incapable of receiving any great degree of heat: so that the rigour of winter is much less tempered by the heat of the earth than in the old continent. To the east lie a number of very large lakes; and farther north, Hudson's Bay; about 50 miles on the south of which there is a range of mountains which prevent its receiving any heat from that quarter. This bay is bounded on the east by the mountainous country of Labrador and by a number of islands. Hence the coldness of the north-west winds and the lowness of the temperature. But as the cultivated parts of North America are now much warmer than formerly, there is reason to expect that the climate will become still milder when the country is better cleared of woods, though perhaps it will never equal the temperature of the old continent.

Islands are warmer than continents in the same degree of latitude; and countries lying to the windward of extensive mountains or forests are warmer than those lying to the leeward. Stones or sand have a less capacity for heat than earth has, which is always somewhat moist; they heat or cool, therefore, more rapidly and to a greater degree. Hence the violent heat of Arabia and Africa, and the intense cold of Terra del Fuego. Living vegetables alter their temperature very slowly, but their evaporation is great; and if they be tall and close, as in forests, they exclude the sun's rays from the earth, and shelter the winter snow from the wind and the sun. Woody countries, therefore, are much colder than those which are cultivated.

Thus we have endeavoured to ascertain the mean temperature of every climate, and to assign the causes by which that temperature is governed. Mr Kirwan, in his admirable Treatise on the Temperature of Different Latitudes, has done much to reduce this part of meteorology to regularity, and to subject it to calculation; and he has in some measure succeeded. To enable our readers to judge how far his rules agree with facts, we shall subjoin a table of the mean temperature of a variety of places drawn up from actual observations.

Table of the Mean Temperature of different Places.

Latitude.	Years of Observation.	Places.	Mean Heat of the Ther.
11° 20′	10	Chandernagor *	92°
11 56	4	Pondicherry *	85
13 5	2	Madras *	82,4
20 10	10	Isle of France *	80,6
39 54	6	Pekin *	54,7
41 54	6	Rome ‡	60
42 36	7	Bastia *	65,4
42 44	12	Perpignan *	59,6
43 16	8	Rieux *	56,9
43 18	13	Marseilles *	58,5
43 37	11	Montpellier *	59,4
43° 50′	36	Lucca †	60,8
43 51	5	Nismes *	[illegible],3
44 50	16	Bourdeaux *	56,[illegible]
45 22	7	Padua *	53,8
	6	St Gothard *	[illegible]
45 28	16	Milan §	54,[illegible]
46 31	10	Lausanne ‖	4[illegible],5
46 35	15	Poitiers *	5[illegible],7
47 12	13	Chinon *	53,6
47 14	11	Besançon *	51,3
48 27	12	Chartres *	5[illegible]
48 31	12	St Brieux *	5[illegible],47
48 50	26	Paris *	5[illegible],47
48 56	6	Ratisbon *	49,1
48 59	22	Montmorenci *	[illegible],9
49 26	6	Manheim *	51,[illegible]
49 46	24	Neufchatel *	[illegible]
50 17	14	Arras *	48,2
50 51	5	Breda *	51,1
51 31	19	London ¶	5[illegible]
51 41	7	Copenhagen *	51,1
52 4	8	Hague *	51,[illegible]
52 30	15	Lynden § §	4[illegible],3
52 32	11	Berlin *	49,1
53 11	13	Francker *	52,25
55 45	4	Moscow *	4[illegible],1
57	3	Nain *	27,5
59 20	15	Stockholm *	44,37
59 56	18	Petersburg ‡ ‡	39,5
60 27	10	Abo *	41,9
		America.	
		Peru *	77
6° 16′	2	Surinam *	7[illegible],9
16 20		Guadaloupe *	83
	20	Leogane, St Domingo *	79
37 10	3	Williamsburgh *	58
39 57		Philadelphia †	52,5
42 25	3	Cambridge *	48
46 55	4	Quebec *	[illegible]

Weather.

14
Causes of the daily variations of temperature.

As to the daily variations of the temperature of the atmosphere, they are owing to a variety of causes; many of which are probably unknown. Some of them, however, are the following: 1. Wind. It is evident that winds flowing from cold countries must produce cold, and from hot countries heat; and that whatever has a tendency to produce such winds must be the cause of unusual cold or heat.—2. Evaporation. Water always absorbs a quantity of heat when it assumes the state of vapour. Hence the coldness of marshy countries, and the cold which we often experience during and after violent rains. Hence also we may expect a cold winter after a rainy summer, because the unusual evaporation carries off the heat of the earth.—3. Vapour, when condensed, gives out a quantity of heat; a country, therefore, may be heated by the condensation of vapour brought from a distance. Hence the [illegible] often felt before rain.—4. Vapours, when they remain long over any country, may produce cold by obstructing the passage of the sun's rays to the earth. To this cause Dr Franklin ascribed the very severe winter which followed 1783; a year remarkable for the thick fog which overspread Europe and

Weather. America during ſeveral months.—5. When, from any of theſe cauſes, the winter has been ſeverer than uſual, prodigious quantities of ice may accumulate about the pole, which may contribute ſomething perhaps towards lowering the temperature of ſeveral ſucceeding years.

15
Of WINDS.

II. The winds evidently have a very great influence on the weather; the cauſes which produce them, therefore, ought to be examined with the greateſt attention. Were we able to regulate their motions, we might, in a great meaſure, mould the climate of any country according to our pleaſure; were we able to forſee them, it would be of the greateſt imporance to navigation and agriculture. In the torrid zone, where they are regular, the mean annual temperature remains almoſt always the ſame; their irregularity increaſes as we approach the pole, and in the ſame manner the difference between the mean annual temperature increaſes with the latitude.

Wind is produced chiefly by the action of the ſun on the atmoſphere; there are many other cauſes, however, and ſome perhaps of which we are yet ignorant. But we ſhall reſerve this part of our ſubject, on account of its importance and extent, for a ſeparate article.

16
Of RAIN.

III. We come now to the moſt difficult part of our ſubject, the phenomena and cauſes of rain. It has been long known, that water is conſtantly riſing from the whole ſurface of the globe, in the form of vapour, and mixing with the atmoſphere. Evaporation has been aſcribed to various cauſes; but the greater number of philoſophers have for ſome time paſt acquieſced in the theory firſt advanced by Dr Halley, that it was produced by a real ſolution of water in air, juſt as ſugar or ſalt is diſſolved in water. This theory is ſupported by a great many very plauſible arguments, which at the firſt view ſeem to eſtabliſh its truth.—Theſe arguments, however, are not all of them ſo concluſive as they appear. Thus it was thought, that becauſe evaporation was promoted by heat, and retarded by cold, it bore an exact reſemblance to the ſolution of ſalts in liquids: but it is now known that evaporation is not ſo much retarded by cold as was at firſt ſuppoſed; that in ſome circumſtances it is even promoted by it; and that it does not depend ſo much upon the abſolute degree of heat or cold, as upon the difference of temperature between the atmoſphere and the evaporating ſurface. Beſides, water evaporates much more rapidly in a vacuum than in the open air, which could not poſſibly be the caſe if evaporation were owing to the ſolution of water in air.

17
Cauſes of evaporation.

Evaporation, then, cannot be owing to ſolution of water in air; it is produced by the combination of a certain quantity of caloric with the particles of water, by which it is converted into an elaſtic fluid lighter than air, which therefore immediately aſcends and mixes with the atmoſphere. This was long ago ſhown by Dr Black to be the way in which ſteam or the vapour ariſing from boiling water is produced. The ſame principles were afterwards applied by Mr De Luc to ſpontaneous evaporation; and the proofs upon which this theory reſts are quite convincing. But though evaporation is not produced by air, vapour would very ſoon condenſe and return to its former ſtate by contact with colder bodies, unleſs it were attracted and ſupported by air.

18
Qualities of vapour.

We are indebted to the experiments of Sauſſure and De Luc for much of our knowledge of the qualities of vapour. It is an elaſtic inviſible fluid like common air, but lighter; being to common air, according to Sauſſure, as 10 to 14, or, according to Kirwan, as 10 to 12: it cannot paſs beyond a certain maximum of denſity, otherwiſe the particles of water which compoſe it unite together, and form ſmall, hollow, viſible veſicles, called *veſicular vapour*; which is of the ſame ſpecific gravity with atmoſpherical air. It is of this vapour that clouds and fogs are compoſed. This maximum increaſes with the temperature; and at the heat of boiling water is ſo great, that ſteam can reſiſt the whole preſſure of the air, and exiſt in the atmoſphere in any quantity. See METEOROLOGY, n° 7—23.

Evaporation, at leaſt in our climate, is about four times greater during the ſummer than the winter half-year: other things being equal, it is ſo much the more abundant the greater the difference is between the temperature of the air and of the evaporating ſurface; ſo much the leſs, the nearer they approach to the ſame temperature; and leaſt of all when they actually arrive at it. Whenever the atmoſphere is more than 15 degrees colder than the evaporating ſurface, little evaporation takes place at all. Evaporation is powerfully promoted by winds, eſpecially cold winds blowing into warm countries, or warm winds blowing into cold countries *. Tracts of land covered with trees or vegetables emit more vapour than the ſame ſpace covered with water. From the experiments of Mr Williams, the quantity appears to be one-third more ‡. But the method in which theſe experiments were made (the ſame objection lies againſt ſeveral of Dr Hailes's experiments, the original diſcoverer of the fact) prevented him from aſcertaining exactly the quantity of vapour emitted by plants. He made the plants grow in a box well cloſed up from the air, meaſured the quantity of water with which he ſupplied them, and at the end of the experiment weighed the box and the plants themſelves. By this means he knew pretty accurately the quantity of water which the plants had abſorbed, and which had afterwards diſappeared; and all this he concluded had been emitted by the plants in the ſtate of vapour. But it is well known that plants have the power of decompounding water, of retaining the hydrogen, and throwing off the oxygen. A part of the water then was decompounded and changed into air; and the quantity of this ought to have been aſcertained and ſubtracted. Still, however, the quantity of vapour emitted by vegetables is very great. Evaporation is promoted by heat, and is therefore much greater in the torrid zone than in our latitudes. There, too, the difference between the quantities in ſummer and winter is much leſs than in our climate, becauſe the difference between the temperature of the two ſeaſons is leſs. Animals alſo are continually throwing off vapour by inſenſible perſpiration; the quantity of which is exceedingly different, according to the climate, ſeaſon, and temperament, and cannot therefore be calculated exactly. According to Keil, a ſingle man perſpires 31 ounces of vapour in 24 hours, and conſequently 707 pounds of water in a year. The quantity of vapour then which is emitted by animals alone muſt be very great.

From an experiment made by Dr Watſon in England, during ſummer, when the earth had been burnt up by a month's drought without rain, it appears that 1600 gallons of water were evaporated from a ſingle acre in 12 hours.—If we were to ſuppoſe that this repreſented the mean daily evaporation all over the globe, it would be eaſy to calculate the quantity of water annually evaporated from the whole of its ſurface. And if we conſider the ſtate of the earth when the experiment was made, the ſituation of England nearer the pole than the equator, and the evaporation conſtantly going on from animals and vegetables, which is not taken in, we will ſurely not think the mean aſſumed too great. 1600 gallons in 12 hours is 3200 in 24 hours. Let us call it only 3000, which is equal to 693,000 cubic inches. An acre contains 272,640 ſquare inches; ſo that the daily evaporation from every ſquare inch will be about .11 of a cubic inch. This in a year will amount to ſomewhat more than 40 cubic inches for every ſquare inch. From the expe-

experiments of Mr Williams *, it appears, that in Bradford in New England the evaporation during 1772 amounted to 42,65 inches; but from the way that his experiments were conducted, the amount was probably too great. These experiments, however, serve to show, that our calculation is not perhaps very remote from the truth. 40 inches from every square inch on the superficies of the globe makes 107,942 cubic miles, equal to the water annually evaporated over the whole globe.

Were this prodigious mass of water all to subsist in the atmosphere at once, it would increase its mass by about a twelfth, and raise the barometer nearly three inches. But this never happens, no day passes without rain in some part of the earth; so that part of the evaporated water is constantly precipitated again. Indeed it would be impossible for the whole of the evaporated water to subsist in the atmosphere at once, at least in the state of vapour.

M. De Saussure has shown, that when the thermometer is at 66°, a cubic foot of air cannot contain more vapour than what is equivalent to 8 grains of water. If more than this be added, it will pass its maximum, be converted into vesicular vapour, and at last fall down in drops of rain. At the temperature of 32° a cubic foot of air can contain only 4 grains, and the quantity it can contain is increased .1109 of a grain by every additional degree of heat. Supposing then that the whole atmosphere was saturated with water, it would not amount to the hundredth part of the quantity of water evaporated annually.

The quantity of vapour existing in the atmosphere is indicated by the hygrometer. Water has the property of arriving at a state of equilibrium in hygroscopic substances: that is, supposing a certain quantity of water attached to a hygroscopic substance, if another hygroscopic substance be brought into contact with it containing less water, some of the water attached to the first substance will leave it, and attach itself to the other, till both contain the same proportion of water. Air is a hygroscopic substance, and so is every thing of which hygrometers are made. Now the hygrometer never points at extreme moisture while the air continues transparent, and consequently contains nothing but invisible vapour; the atmosphere therefore, while transparent, never contains the greatest possible quantity of vapour.

The higher regions of the atmosphere contain less vapour than the strata near the surface of the earth. This was observed both by M. De Saussure and M. De Luc, who mentions several striking proofs of it. See METEOROLOGY, n° 10, &c.

At some height above the tops of mountains the atmosphere is probably still drier; for it was observed both by Saussure and De Luc, that on the tops of mountains the moisture of the air was rather less during the night than the day. And there can be little doubt that every stratum of air descends a little lower during the night than it was during the day, owing to the cooling and condensing of the stratum nearest the earth. Vapours, however, must ascend very high, for we see clouds forming far above the tops of the highest mountains.

Rain never begins to fall while the air is transparent: the invisible vapours first pass their maximum, and are changed into vesicular vapours; clouds are formed, and these clouds gradually dissolve in rain. Clouds, however, are not formed in all parts of the horizon at once; the formation begins in one particular spot, while the rest of the air remains clear as before: this cloud rapidly increases till it overspreads the whole horizon, and then the rain begins.

It is remarkable, that though the greatest quantity of vapours exist in the lower strata of the atmosphere, clouds never begin to form there, but always at some considerable height. It is remarkable, too, that the part of the atmosphere at which they form has not arrived at the point of extreme moisture, nor near that point even a moment before their formation. They are not formed then, because a greater quantity of vapour had got into the atmosphere than could remain there without passing its maximum. It is still more remarkable, that when clouds are formed, the temperature of the spot in which they are formed is not always lowered, though this may sometimes be the case. On the contrary, the heat of the clouds themselves is sometimes greater than that of the surrounding air †. Neither then is the formation of clouds owing to the capacity of air for combining with moisture being lessened by cold. So far from that, we often see clouds, which had remained in the atmosphere during the heat of the day, disappear in the night, after the heat of the air was diminished.

The formation of clouds and rain, then, cannot be accounted for by a single principle with which we are acquainted. It is neither owing to the saturation of the atmosphere, nor the diminution of heat, nor the mixture of airs of different temperatures, as Dr Hutton supposes; for clouds are often formed without any wind at all either above or below them; and even if this mixture constantly took place, the precipitation, instead of accounting for rain, would be almost imperceptible.

It is a very remarkable fact, that evaporation often goes on for a month together in hot weather without any rain. This sometimes happens in this country; it happens every year in the torrid zone. Thus at Calcutta, during January 1785, it never rained at all *: the mean of the thermometer for the whole month was 66½ degrees: there was no high wind, and indeed during great part of the month little wind at all.

The quantity of water evaporated during such a drought must be very great; yet the moisture of the air, instead of being increased, is constantly diminishing, and at last disappears almost entirely. For the dew, which is at first copious, diminishes every night; and if Dr Watson's experiment formerly mentioned be attended to, it will not be objected that the quantity of evaporation is also very much diminished. Of the very dry state to which the atmosphere is reduced during long droughts, the violent thunder-storms with which they often conclude is a proof, and a very decisive one. Now what becomes of all this moisture? It is not accumulated in the atmosphere above the country from which it was evaporated, otherwise the whole atmosphere would in a much less period than a month be perfectly saturated with moisture. If it be carried up daily through the different strata of the atmosphere, and wafted to other regions by superior currents of air, how is it possible to account for the different electrical state of the clouds situated between different strata, which often produces the most violent thunder-storms? Are not vapours conductors of the electric fluid; and would they not have daily restored the equilibrium of the whole atmosphere through which they passed? Had they traversed the atmosphere in this manner, there would have been no negative and positive clouds, and consequently no thunder-storms. They could not have remained in the lower strata of the atmosphere, and been daily carried off by winds to other countries; for there are often no winds at all during several days to perform this office: nor in that case would the dews diminish, nor could their presence fail to be indicated by the hygrometer.

It is impossible for us to account for this remarkable fact upon any principle with which we are acquainted. The water can neither remain in the atmosphere, nor pass through it

Weather. it in the ſtate of vapour. It muſt therefore aſſume ſome other form; but what that form is, or how it aſſumes it, we know not.

26 Its converſion into oxygen and hydrogen improbable.

It will immediately occur to every body, that vapour is decompoſed in the atmoſphere, and changed into oxygen and hydrogen gas. But is it true that a greater quantity of oxygen exiſts in the atmoſphere after a long drought than immediately after rain? Have ſuch prodigious quantities of hydrogen been found in the atmoſphere as muſt always exiſt in it if this hypotheſis were true? Has any hydrogen ever been found in analyzing atmoſpheric air? Or if hydrogen, from its lightneſs, aſcends to the higher regions of the atmoſphere, what cauſes it to deſcend at particular times, contrary to that lightneſs, in order to come into contact with oxygen? Do not clouds often form on mountains round the habitations of men? Yet has the preſence of hydrogen been ever aſcertained by any phenomena? Would it not produce dangerous conflagrations when it came into contact with fire? But has this been the caſe in a ſingle inſtance? If this hypotheſis were true, could rain take place at all without a conflagration in the atmoſphere? Yet has any ſuch conflagration been ever obſerved? The hypotheſis, then, that vapour is changed into oxygen and hydrogen in the atmoſphere, and that rain is produced by the reunion of theſe elements, cannot be admitted, though it is not improbable that ſome ſmall part of it actually undergoes this change. See WIND.

We do not take notice of M. De Luc's conjecture about the compoſition of the atmoſphere, becauſe it is not ſupported by a ſingle proof, and becauſe he refuſes to believe the analyſis of the atmoſphere reſulting from the very deciſive experiments of Scheele, Lavoiſier, and Prieſtley, though he has ſeen them often performed, and has nothing to urge againſt their force. There is no philoſopher to whom meteorology lies under greater obligations than to M. De Luc. His diſcoveries have been many and important, his experiments ingenious, and his application unwearied; but his conjectures are like thoſe of every other man who attempts to fathom the wiſdom of the Almighty. Were we poſſeſſed of an underſtanding equal to that of the Author of Nature, we might expect, with reaſon, to dive by our conjectures into the myſteries of his operations; but in our preſent ſtate they are vain.

Evaporation goes on longeſt without producing rain in the torrid zone, where the heat is greateſt; it goes on longeſt alſo in every place in ſummer, when the heat is alſo greateſt: heat therefore ſeems to be an agent.

27 Theory of rain imperfect.

There are then two ſteps of the proceſs between evaporation and rain, of which at preſent we are completely ignorant: 1. What becomes of the vapour after it enters into the atmoſphere? 2. What makes it lay aſide the new form which it muſt have aſſumed, and return again to its ſtate of vapour, and fall down in rain? And till theſe two ſteps be diſcovered by experiments and obſervations, it will be impoſſible for us to give a rational or a uſeful theory of rain.

28 Whether owing to electricity.

It has for ſome time paſt been the opinion of philoſophers, that electricity is the principal agent in producing rain; and M. Bertholon aſſures us, that by raiſing proper conductors to draw off the electrical matter from the atmoſphere, the quantity of rain may be diminiſhed at pleaſure. That the electric fluid acts a very important part in nature, cannot be doubted, and it is not improbable that it may be the agent in producing rain. This ſuppoſition indeed is ſupported by many facts. Dew at leaſt exhibits a great many electrical phenomena; it is attracted by points, and attaches itſelf to ſome ſubſtances, while it avoids others. Whenever there are no clouds, the electricity of the atmoſphere is always poſitive; but the formation of clouds produces conſiderable changes in the ſtate of its electricity. The atmoſphere alſo gives ſigns of electricity conſtantly during rain; and clouds are evidently attracted by mountains.—In what manner, however, the electrical fluid produces rain (if it is the agent at all) is ſtill unknown. Some philoſophers aſſure us, that clouds are induced to diſſolve in rain by becoming negative, others by becoming ſtrongly poſitive, and both ſupport their opinion by experiments. We do not ſee the analogy, however, between clouds and plates of metal covered with drops of water. And even if their opinion were well founded, the production of the clouds themſelves would remain to be accounted for.

The mean annual quantity of rain is greateſt at the equator, and decreaſes gradually as we approach the poles. 29 Quantity of rain different according to the latitude.

Thus at * Granada, Antilles,	12° N. lat.	it is 126 inches.	
* Cape François, St Domingo	19° 46′	120	* Cotte Journ. de Phyſ. Oct. 1791, p. 26.
‡ Calcutta -	22 23	81	‡ Aſia Reſearches, vol. i. and Appendix.
* Rome -	41 54	39	‖ Phil. Tranſ.
‖ England -	33	32	¶ Edin. Tranſ. vol. ii. p.
¶ Peterſburgh	59 16	16	

On the contrary, the number of rainy days is ſmalleſt at the equator, and increaſes in proportion to the diſtance from it. From north latitude 12° to 43° the mean number of rainy days is 78; from 43° to 46° the mean number is 103; from 46° to 50° it is 134; from 51° to 60°, 161 †.

The number of rainy days is often greater in winter than in ſummer; but the quantity of rain is greater in ſummer than in winter ‡. At Peterſburgh, the number of rainy or ſnowy days during winter is 84, and the quantity which falls is only about five inches; during ſummer the number of rainy days is nearly the ſame, but the quantity which falls is about 11 inches ‖. 31 Seaſons. † P. Cotte, ibid. ‡ Ibid. ‖ Edin. Tranſ. vol. ii. p.

More rain falls in mountainous countries than in plains. Among the Andes it is ſaid to rain almoſt perpetually, while in Egypt it hardly ever rains at all.—If a rain-gauge be placed on the ground, and another at ſome height perpendicularly above it, more rain will be collected into the lower than into the higher; a proof that the quantity of rain increaſes as it deſcends, owing perhaps to the drops attracting vapour during their paſſage through the lower ſtrata of the atmoſphere where the greateſt quantity reſides. This, however, is not always the caſe, as Mr Copland of Dumfries diſcovered in the courſe of his experiments *. He obſerved alſo, that when the quantity of rain collected in the lower gauge was greateſt, the rain commonly continued for ſome time; and that the greateſt quantity was collected in the higher gauge only either at the end of great rains, or during rains which did not laſt long. Theſe obſervations are important, and may, if followed out, give us new knowledge of the cauſes of rain. They ſeem to ſhow, that during rain the atmoſphere is ſomehow or other brought into a ſtate which induces it to part with its moiſture; and that the rain continues as long as this ſtate continues. Were a ſufficient number of obſervations made on this ſubject in different places, and were the atmoſphere carefully analyſed during dry weather, during rain, and immediately after rain, we might ſoon perhaps diſcover the true theory of rain. 32 And ſituation. * Mancheſter Tranſ. vol. iv. p.

Rain falls in all ſeaſons of the year, at all times of the day, and during the night as well as the day; though, according to M. Toaldo, a greater quantity falls during the day than the night. The cauſe of rain, then, whatever it may be, muſt be ſomething which operates at all times and ſeaſons. Rain falls alſo during the continuance of every wind, but ofteneſt when the wind blows from the ſouth. Falls of rain often happen likewiſe during perfect calms.

It

It appears from a paper published by M. Cotte in the *Journal de Physique* for October 1791, containing the mean quantity of rain falling at 147 places, situated between north latitude 11° and 60°, deduced from tables kept at these places, that the mean annual quantity of rain falling in all these places is 34.7 inches. Let us suppose then (which cannot be very far from the truth) that the mean annual quantity of rain for the whole globe is 34 inches. The superficies of the globe consists of 170,981,012 square miles, or 686,401,498,471,475,200 square inches. The quantity of rain therefore falling annually will amount to 23,337,650,812,030,156,800 cubic inches, or somewhat more than 91,751 cubic miles of water. This is 16,191 cubic miles of water less than the quantity of water evaporated. It seems probable therefore, if the imperfection of our data warrant any conclusion, that some of the vapour is actually decomposed in the atmosphere, and converted into oxygen and hydrogen gas.

The dry land amounts to 52,745,253 square miles (see the article SEA, n° 1.); the quantity of rain falling on it annually therefore will amount to 30,960 cubic miles. The quantity of water running annually into the sea (see SEA, n° 3.) is 13,140 cubic miles; a quantity of water equal to which must be supplied by evaporation from the sea, otherwise the land would soon be completely drained of its moisture.

The quantity of rain falling annually in Great Britain may be seen from the following table:

Years of observation.	Places.	Rain in inches.
3	Dover §	37,52
5	Ware, Hertfordshire §	23,6
8	London †	17,5
8	Kimbolton ‡	23,9
45	Lyndon ‖	22,210
5	Chatsworth, Derbyshire §	27,865
8	Manchester §	43,1
18	Liverpool §	34,41
7	Lancaster §	40,3
5	Kendal §	61,223
14	Dumfries §	36,127
10	Branxholm, 44 miles south-west of Berwick ¶	31,26
5	Langholm ¶	36,73
5	Dalkeith ¶	25,124
20	Glasgow *	31
8	Hawkhill * *	28,966
	Mean	32,532

In this country it generally rains less in March than in November, in the proportion at a medium of 7 to 12. It generally rains less in April than October in the proportion of 1 to 2 nearly at a medium. It generally rains less in May than September, the chances that it does so are at least as 4 to 3; but when it rains plentifully in May (as 1.8 inches or more), it generally rains but little in September; and when it rains one inch or less in May, it rains plentifully in September *.

IV. Thunder has been explained at such great length in the article ELECTRICITY, that we shall content ourselves at present with a few remarks.

Thunder is exceedingly frequent in the torrid zone, and it seems to decrease gradually till we approach latitude 60°, or perhaps farther north. During the year 1785, for instance, there were 90 thunder-storms at Calcutta. According to Professor Muschenbroek, it thunders at Utrecht at a medium 15 times annually: in this country the medium is considerably below that number. Thunder, too, seems to be very common in some polar regions. The Abbé Chappe informs us, that he observed thunder much more frequently at Tobolski and in other parts of Siberia than in any other country. Muschenbroek, however, affirms, we know not upon what authority, that it never thunders at all in Greenland and at Hudson's Bay. Thunder-storms happen almost always during the summer, and very seldom in winter. During the year 1785 above mentioned, it never thundered at Calcutta in January, November, nor December. In this country a thunder-storm during winter is exceedingly rare.

The phenomena of thunder are now no longer a secret, since the great Franklin discovered the identity of lightening and electricity; a discovery inferior to none in the annals of philosophy. But though we can explain the nature of thunder in general, and the manner in which it is produced, there are several difficulties still remaining, which future experiments and observations only can remove. Air is an electric *per se*, and cannot therefore when dry conduct electrical matter from one part to another. We know from the experiments of Dr Franklin and others, that the atmosphere constantly contains in it a quantity of electric matter. If a stratum of dry air were electrified positively, it would occasion a negative electricity in the neighbouring stratum. Suppose now that an imperfect conductor were to come into contact with each of these strata, we know from the principles of electricity that the equilibrium would be restored, and that this would be attended with a loud noise, and with a flash of light. Clouds which consist of vesicular vapours mixed with particles of air, are imperfect conductors; if a cloud therefore come into contact with two such strata, a thunder clap would follow. If a positive stratum be situated near the earth, the intervention of a cloud will, by serving as a stepping stone, bring the stratum within the striking distance, and a thunder clap will be heard when the electrical fluid is discharging itself into the earth. If the stratum be negative, the contrary effects will take place. It does not appear, however, that thunder is often occasioned by a discharge of electric matter from the earth into the atmosphere. The accidents, most of them at least, which were formerly ascribed to this cause, are now much more satisfactorily accounted for by Lord Stanhope's Theory of the Returning Stroke. Neither does it appear that electricity is often discharged into the earth, as the effects of few thunder-storms are visible upon the earth; that it is so sometimes, however, is certain. The experiments of Mr Saussure have demonstrated, that electrical matter is carried into the atmosphere by simple evaporation; so that there is no difficulty in understanding how particular strata of air may be supplied with a sufficient quantity of electrical fluid to be charged positively; and we know that in that case a negative state must be produced in the neighbouring stratum. In what particular manner, however, this electrical matter is accumulated in particular strata of air, and how it comes to be separated from the vapour to which it was united, remain still secrets. They are intimately connected with the causes of evaporation and rain, whatever they may be, and probably the discovery of the causes of either would lead to that of the others.

V. The gravity of the atmosphere was first demonstrated by Torricelli, the disciple of Galileo (see PNEUMATICS, n° 25). A column of air, the basis of which is a square inch, weighs at a medium 15 pounds. The weight of the atmosphere is measured by the barometer. It is greatest

at

Weather. at the level of the sea, because there the column of air is longest: there the mean height of the barometer is 30 inches. This Sir George Shuckburgh found to be the case in the Mediterranean and the Channel, in the temperature of 55° and 60°; Mr Bouguer, on the coast of Peru, in the temperature of 84°; and Lord Mulgrave, in latitude 80°. The mean height of the barometer is less the higher any place is situated above the level of the sea, because the column of air which supports the mercury is the shorter

35 Indicated by the barometer. The barometer has accordingly been used for measuring heights. It indicates, too, with a great deal of accuracy, all the variations in the gravity of the atmosphere; falling when the atmosphere is lighter, and rising when it is heavier, than usual. These changes have attracted the attention of philosophers ever since the discovery of the barometer; and many attempts have been made to explain them, some of which have been mentioned under the word BAROMETER. These variations come naturally to be examined here, because the causes which produce them, whatever they are, must have a great deal of influence on the weather.

Between the tropics the variations of the barometer are exceedingly small; and it is remarkable, that in that part of the world it does not descend above half as much for every 200 feet of elevation as it does beyond the tropics *.—In the torrid zone, too, the barometer is elevated about two-thirds of a line twice every day; and this elevation happens at the same time with the tides of the sea §.

* M. Cassan Journal de Physique, April 1790, p. 268.
§ Ibid.

36 Range of the barometer. As the latitude advances towards the poles, the range of the barometer gradually increases, till at last it amounts to two or three inches. This gradual increase will appear from the following table:

TABLE of the Range of the Barometer.

Latitude.	Places.	Range of the Barometer,	
		Greatest.	Annual.
0°	Peru	0,20 *	—
22 23	Calcutta	0,77 †	—
40 55	Naples	1,00 *	—
51 8	Dover	2,47 §	1,80
53 13	Middlewick	3,00 §	1,94
53 23	Liverpool	2,89 §	1,96
59 56	Petersburgh	3,45 ‡	2,77

* Kirwan, Irish Trans. vol. iii. p. 47.
† Asiatic Researches, vol ii. Appendix.
§ Manchest Trans. vol. iv.
‡ Edin. Trans. vol ii. p.
¶ Trans. Phil. del. vol ii. p. 142.

In North America, however, the range of the barometer is a great deal less than in the corresponding European latitudes. In Virginia, for instance, it never exceeds 1.1 ¶.

The range of the barometer is greater at the level of the sea than on mountains, and in the same degree of latitude the extent of the range is in the inverse ratio of the height of the place above the level of the sea.

From a table published by Mr Cotte in the *Journal de Physique* †, it seems exceedingly probable that the barometer has always a tendency to rise from the morning to the evening; and that this tendency is greatest between two o'clock in the afternoon and nine at night, at which hour the greatest elevation takes place; that the elevation of nine o'clock differs from that of two by $\frac{4}{12}$ths, while that at two differs from the morning elevation only by $\frac{1}{12}$th; and that in certain climates the greatest elevation takes place at two o'clock. We shall insert a part of the table on which these observations are founded, which we have reduced to the English standard.

† Aug. 1790, p. 110.

37 Phenomena of the variations of the barometer

Places.	Years of observation.	Mean height of Barometer.			
		Morning.	Noon.	Evening.	Year.
Arles	6	29,9347	29,9347	29,9413	29,9347
Arras	6	29,6683	26,6683	29,6832	29,6758
Bourdeaux	11	29,7212	29,8385	29,8385	29,8385
Cambray	13	29,8756	29,8682	29,8756	29,8756
Chinon	12	29,7719	29,7795	29,8001	29,7869
Dunkirk	8	29,9199	29,9347	29,9347	29,9273
Hagenau	10	29,5648	29,5648	29,5741	29,5648
Laon	7	29,3354	29,3206	29,3429	29,3354
Lisle	6	29,91[illegible]	[illegible]9,9274	29,9347	29,9077
Mayenne	7	29,7[illegible]72	29,7059	29,7127	29,7127
Manheim	5	29,6167	29,5[illegible]	[illegible]9,6167	29,609[illegible]
Montmorenci	22	29,653[illegible]	29,6536	29,6610	29,6536
Mulhausen	7	29,1873	29,1800	29,1873	29,1873
Obernheim	12	29,48[illegible]4	[illegible]9,4665	29,4764	29,4764
Paris	67	29,8902	[illegible]9,86[illegible]7	29,8756	29,8756
Poitiers	12	29,7276	29,7276	29,7276	29,7276
Rouen	11	29,8607	29,8535	29,8535	29,8535
Rome	3	29,8607	[illegible]9,8460	29,8756	29,8607
St Maurice le Gerard	10	29,8016	29,8016	29,8[illegible]9[illegible]	29,8016
Troyes	10	29,6885	29,6979	29,6885	29,68[illegible]5

The range of the barometer is greater in winter than in summer. Thus at Kendal the mean range of the barometer for five years, during October, November, December, January, February, March, was 7.982; and for the six summer months 5.447 *.

In serene and settled weather it is generally high; and low in calm weather, when the air is inclined to rain; it sinks on high winds, rises highest on easterly and northerly winds, and sinks when the wind blows from the south †.—At Calcutta §, however, it is always highest when the wind blows from the north-west and north, and lowest when it blows from the south-east.

* M[illegible] Trans. iv. p.
† Dr [illegible]ley.
§ Asia Resear. vol. ii Appendix

The barometer falls suddenly before tempests, and undergoes great oscillations during their continuance.—Mr Copland || of Dumfries has remarked, that a high barometer is attended with a temperature above, and a low barometer with one below, the monthly mean.—Such are the variations of the barometer as far as they have yet been observed. Let us now endeavour to account for them as well as we can.

|| Ma[illegible] Trans. iv.

3[illegible] Accou[illegible] for

It is evident that the density of the atmosphere is least at the equator, and greatest at the poles; for at the equator the centrifugal force, the distance from the centre of the earth, and the heat, all of which tend to diminish the density of the air, are at their maximum, while at the pole they are at their minimum. The mean height of the barometer at the level of the sea, all over the globe, is 30 inches; the weight of the atmosphere, therefore, is the same all over the globe. The weight of the atmosphere depends on its density and height: where the density of the atmosphere is greatest, its height must be least; and, on the contrary, where its density is least, its height must be greatest. The height of the atmosphere, therefore, must be greatest at the equator, and least at the poles; and it must decrease gradually between the equator and the poles, so that its upper surface will resemble two inclined planes, meeting above the equator their highest part *.

* Kir[illegible] Irish T[illegible] vol. ii. 43, &c

During summer, when the sun is in our hemisphere, the mean

mean heat between the equator and the pole does not differ so much as in winter. Indeed the heat of northern countries at that time equals the heat of the torrid zone: thus in Russia, during July and August, the thermometer rises to 85° †. Hence the rarity of the atmosphere at the pole, and consequently its height, will be increased. The upper surface of the atmosphere, therefore, in the northern hemisphere will be less inclined; while that of the southern hemisphere, from contrary causes, will be much more inclined. The very reverse will take place during our winter.

The density of the atmosphere depends in a great measure on the pressure of the superincumbent column, and therefore decreases, according to the height, as the pressure of the superincumbent column constantly decreases. But the density of the atmosphere in the torrid zone will not decrease so fast as in the temperate and frigid zones; because its column is longer, and because there is a greater proportion of air in the higher part of this column. This accounts for the observation of Mr Cassan, that the barometer only sinks half as much for every 200 feet of elevation in the torrid as in the temperate zones (B). The density of the atmosphere at the equator, therefore, though at the surface of the earth it is less, must at a certain height equal, and at a still greater surpass, the density of the atmosphere in the temperate zones and at the poles.

In the article Wind we shall endeavour to prove, that a quantity of air is constantly ascending at the equator, and that part of it at least reaches and continues in the higher parts of the atmosphere. From the fluidity of air, it is evident that it cannot accumulate above the equator, but must roll down the inclined plane (C) which the upper surface of the atmosphere assumes towards the poles. As the surface of the atmosphere of the northern hemisphere is more inclined during our winter than that of the southern hemisphere, a greater quantity of the equatorial current of air must flow over upon the northern than upon the southern atmosphere; so that the quantity of our atmosphere will be greater during winter than that of the southern hemisphere: but during summer the very reverse will take place. Hence the greatest mercurial heights take place during winter, and the range of the barometer is less in summer than in winter.

The density of the atmosphere is in a great measure regulated by the heat of the place: wherever the cold is greatest, there the density of the atmosphere will be greatest, and its column shortest. High countries, and ranges of lofty mountains, the tops of which are covered with snow the greatest part of the year, must be much colder than other places situated in the same degree of latitude, and consequently the column of air over them much shorter. The current of superior air will linger and accumulate over these places in its passage towards the poles, and thus occasion an irregularity in its motion, which will produce a similar irregularity in the barometer. Such accumulations will be formed over the north-western parts of Asia, and over North America: hence the barometer usually stands higher, and varies less there, than in Europe. Accumulations are also formed upon the Pyrenees, the Alps, the mountains of Africa, Turkey in Europe, Tartary, and Tibet. When these accumulations have gone on for some time, the density of the air becomes too great to be balanced by the surrounding atmosphere; it rushes down on the neighbouring countries, and produces cold winds which raise the barometer. Hence the rise of the barometer which generally attends north-east winds in Europe, as they proceed from accumulations in the north-west of Asia, or about the pole; hence, too, the north-west wind from the mountains of Tibet raises the barometer at Calcutta.

Weather.

We shall endeavour to prove in the article Wind, that considerable quantities of air are occasionally destroyed in the polar regions. When this happens, the atmosphere to the south rushes in to fill up the void. Hence south-west winds take place, and the barometer falls.

As the mean heat of our hemisphere differs in different years, the density of the atmosphere, and consequently the quantity of equatorial air which flows towards the poles, must also be variable. Hence the range of the barometer is different in different years. Does this range correspond to the mean annual heat; that is to say, is the range greatest when the heat is least, and least when the heat is greatest? In some years greater accumulations than usual take place in the mountainous parts in the south of Europe and Asia, owing, perhaps, to earlier falls of snow, or to the rays of the sun having been excluded by long continued fogs. When this takes place, the atmosphere in the polar regions, will be proportionably lighter. Hence the prevalence of southerly winds during some winters more than others.

As the heat in the torrid zone never differs much, the density, and consequently the height of the atmosphere, will not vary much. Hence the range of the barometer within the tropics is comparatively small; and it increases gradually as we approach the poles, because the difference of the temperature, and consequently of the density of the atmosphere increases with the latitude.

The diurnal elevation of the barometer in the torrid zone corresponding to the tides, observed by Mr Cassan and others, must be owing to the influence of the moon on the atmosphere. This influence, notwithstanding the ingenious attempts of D'Alembert and several other philosophers, seems altogether inadequate to account for the various phenomena of the winds. It is not so easy to account for the tendency which the barometer has to rise as the day advances, which seems to be established by Mr Cotte's table. Perhaps it may be accounted for by the additional quantity of vapour added to the atmosphere, which, by increasing the quantity of the atmosphere, may possibly be adequate to produce the effect.

The falls of the barometer which precede, and the oscillations which accompany, violent storms and hurricanes, show us that these phenomena are produced by very great rarefactions, or perhaps destruction of air, in particular parts of the atmosphere. The falls of the barometer, too, that accompany winds proceed from the same cause. The observation made by Mr Copland, that a high barometer is accompanied with a temperature above the mean, will be easily accounted for by every one acquainted with Dr Black's theory of latent heat. The higher the mercury stands, the denser the atmosphere must be; and the denser it becomes, the more latent heat it must give out. It is well known that air evolves heat when condensed artificially.

1 The

(B) Should it not be examined whether the number of parts which the mercury sinks for every 200 feet of elevation be not proportioned to the latitude of the place?

(C) It is of no consequence whether the surface of the atmosphere actually forms an inclined plane, or, [illegible] in a very slow ratio (as is probably the case), ascends much higher than the place at which the equatorial currents begin to flow towards the poles; for still the different heights of air of the same density in different parts of the atmosphere will in fact form an inclined plane, over which these currents will roll, notwithstanding the very rare air which they may [illegible].

Weather.

The failing of the barometer which generally precedes rain remains still to be accounted for; but we know too little about the causes by which rain is produced to be able to account for it in a satisfactory manner. Probably a rarefied state of the atmosphere is favourable to the production of rain; we know, at least, that it is favourable to evaporation. Supposing the observations which we made upon the changes which vapour undergoes in the atmosphere well founded, may not the vapour in its new form accumulate at a considerable height in the atmosphere? and is not the height at which clouds are always formed a proof of this? May not this substance, whatever it is, when by some means or other it returns to the state of vapour, passes its maximum, and begins to fall in drops of rain, and consequently is no longer supported by the atmosphere, cause the barometer to fall suddenly, at least till new air rushes in to supply its place?

40
Of prognosticating the weather.

Thus we have endeavoured to describe the various phenomena of the weather, and to account for them as far as the present state of our meteorological knowledge enables us to go.

It will be expected that we should not pass by unnoticed that branch of meteorology which has in all ages attracted the attention of mankind, and in which, indeed, every other part of the science, as far as utility is concerned, evidently centres; we mean the method of prognosticating the weather. All philosophers who have dedicated their attention to meteorology, have built upon the hope of being able to discover, by repeated observations, some rules concerning the periods of the seasons and the changes of the weather, convinced that such discoveries would be of the highest utility, especially in agriculture; for by foreseeing, even in part, the circumstances of the seasons, we would have it in our power to prevent at least a part of the losses arising from them, as by sowing, for instance, the kind of corn best adapted for the rain or the drought which is to ensue.

41
Moon supposed to influence the weather;

The influence of the moon on the weather has in all ages been believed by the common people; the ancient philosophers embraced the same opinion, and engrafted upon it their pretended science of astrology. Several modern philosophers have thought the opinion worthy of notice; among whom Messrs Lambert, Cotte, and Toaldo, deservedly take the lead. These philosophers, after examining the subject with the greatest attention, have embraced the opinion of the common people, though not in its full extent. To this they have been induced both by the certainty that the moon actually has an influence on the atmosphere as it has on the sea, and by observing that certain situations of the moon in her orbit have almost constantly been attended with changes of the weather either to wind, to calm, to rain, or to drought.

42
Especially in *ten* situations,

There are ten situations in every revolution of the moon in her orbit, when she must particularly exert her influence on the atmosphere, and when consequently changes of the weather most readily take place. These are (1) the new and (2) full moon, when she exerts her influence in conjunction with or opposition to the sun; (3 and 4) the quadratures; (5) the perigee and (6) apogee (for the difference in the moon's distance from the earth is about 27,000 miles), the two passages of the moon over the equator, one of which, Mr Toaldo calls (7) the *moon's ascending*, and (8) the other the *moon's descending equinox*, the two lunistices as M. de la Lande has called them, (9) the *boreal lunistice*, when the moon approaches as near as she can in each lunation to our zenith, (10) the *austral*, when she is at the greatest distance from it, for the action of the moon varies greatly according to her obliquity. With these ten points Mr Toaldo compared a table of 48 years observations for Lombardy, and found the result as follows:

Lunar Points.	Attended with a change of weather.	Attended with no change.	Proportions reduced to the lowest terms.
New moons -	522	82	6 : 1
Full moons - -	506	92	5 : 1
First quarters	424	189	2½ : 1
Last quarters -	429	182	2½ : 1
Perigees -	546	99	7 : 1
Apogees - -	517	130	4 : 1
Ascending equinoxes	465	142	3⅓ : 1
Descending equinoxes	446	152	2¾ : 1
Southern lunistices	446	154	3 : 1
Northern lunistices	448	162	2¾ : 1

And after examining a number of other tables of observations, and combining them with his own, he found the proportions between those lunar points on which changes of the weather took place, and those which passed without any change when reduced to the lowest terms, to be as in the last column of the above table: so that we may wager six to one, that this or that new moon will bring a change of weather, and five to one that a full moon will be attended by a change, and so on. Several of these lunar points often coincide with one another, occasioned by the inequality of the moon's periodical, anomalistical, and synodical revolutions, and by the progressive motion of the apses. Thus the new and full moon sometimes coincide with the apogees, the perigees, &c. These coincidences are the most efficacious. Their changing power, according to Mr Toaldo, is as follows:

New moon coinciding with the perigee	33 : 1
———————with the apogee	7 : 1
Full moon coinciding with the perigee	10 : 1
———————with the apogee	8 : 1

It ought to remarked, that these changes of the weather seldom or never take place exactly when the moon is in these lunar points, but some time before or after; just as the tide, say the philosophers who contend for the influence of the moon, is not at its height till after the moon has passed the meridian.

The power of the moon over the ocean and the atmosphere is displayed in a particular manner during the apses, in consequence of her different distances from the earth during these two situations. Now the apses advance about 40° in the zodiac every year, and complete a revolution in about eight years and ten months. It is probable that the seasons and the constitutions of years have a period nearly equal to this revolution, and that therefore nearly the same seasons return every ten years. This periodical return of the seasons, as Pliny (D) seems to inform us, was observed by the ancients. 43
And to occasion a period of ten years,

Mr Toaldo found, that in Lombardy the quantities of rain which fell during periods of nine successive years were nearly equal; but that this was not true of other periods, for instance, of six, eight, or ten years. By comparing in like manner the quantities of rain published by the Royal Academy of Sciences at Paris, from 1699 to 1752, he found, that

(D) "Tempestates ardores suos habere quadrinis annis.—Octonis vero augeri easdem centesima revolventi se luna." *Lib.* 18. *c.* 25.

that of ſix ſeries of nine years, three were greater and three ſmaller, but on both ſides almoſt equal to one another.

During the revolution of the apſes, there are four remarkable points, the two equinoctial and two ſolſtitial points; in which, when the moon is in perigee, her effect will be moſt powerful on the weather. The moon paſſes from one equinoctial point to another in about four years; in them its power is greateſt: it is probable, therefore, that when an extraordinary year happens, a return of another may be expected in about four years. As the apſes after their revolution return again in the ſame order as before, it is probable that the return of the ſeaſons will be nearly the ſame in every ſeries of nine years.

Such, according to Mr Toaldo, is the period at the end of which we are to expect a return of the ſeaſons. Mr Cotte, however, though he does not deny the influence of the revolution of the apſes, places greater confidence in the *lunar period* of 19 years; at the end of which, the new and full moons return to the ſame day in the Julian year. He ſuppoſes, that in like manner the ſeaſons correſpond with one another every 19 years. The ſimilarity, he informs us, is ſtriking between the temperatures of the years 1701, 1720, 1739, 1758, and 1777. That of 1758, upon which we have obſervations much detailed by M. du Hamel, has a remarkable coincidence with 1777; there was ſcarcely any difference in the temperatures of the correſponding months. The years 1778, 1779, and 1780, have been hot and dry, and they correſpond with years which have had the ſame character. The years correſponding with 1782, eſpecially 1725 and 1763, have been ſingularly cold, humid, and late, as was the caſe with 1782 †.

Such is an imperfect view of the opinions of thoſe philoſophers who have endeavoured to eſtabliſh the influence of the moon over the weather. The moſt important of their maxims for prognoſticating the weather are the following:

1. When the moon is in any of the ten lunar points above mentioned, a change of the weather may be expected. The moſt efficacious of theſe points are the conjunctions and apſes.

2. The coincidence of the conjunctions with the apſes is extremely efficacious: that of the new moon with the perigee gives a moral certainty of a great perturbation.

3. The new and full moons, which ſometimes produce no change on the weather, are ſuch as are at a diſtance from the apſes.

4. A lunar point commonly changes the ſtate into which the weather was brought by the preceding point. For the moſt part the weather never changes but with ſome lunar point.

5. The apogees, quadratures, and ſouthern luniſtices, commonly bring fair weather, for the barometer then riſes; the other points tend to make the air lighter, and thereby to produce bad weather.

6. The moſt efficacious lunar points become ſtormy about the equinoxes and ſolſtices.

7. A change of weather ſeldom happens on the ſame day with a lunar point, but ſometimes before and ſometimes after it.

8. At the new and full moons about the equinoxes, and even the ſolſtices, eſpecially the winter ſolſtice, the weather is commonly determined to good or bad for three, or even ſix months.

9. The ſeaſons and years have a period of eight or nine years correſponding with the revolution of the lunar apſes, and another of 19 correſponding to the *lunar period*.

Would it not be worth while to publiſh a meteorological kalendar yearly, marking the time, to which the lunar points correſpond, at which changes of the weather may be expected, eſpecially when any of theſe points coincide; and marking the probability of a change at any particular time? and might not this be attended by a diary of the weather for the 9 or 19 correſponding years? By this means, if there is any probability in the opinion that the moon has influence over the weather, men would be enabled to foreſee changes with a conſiderable degree of probability; and at any rate, we would be able, by the united obſervations of a whole nation, to determine whether there be any truth in the opinion; and if there be, as its univerſality would lead one to ſuppoſe, ſucceeding obſervations would gradually correct the imperfection of our preſent rules, and enable us to bring our prognoſtics of the weather to the greateſt exactneſs.

46
Remarks on the lunar influence.

We are not ſo ſanguine, however, as Mr Toaldo and P. Cotte on this ſubject. Even allowing the influence of the moon on the weather to be as great as they could deſire, and ſuppoſing, which is very far from being the caſe, that it is not influenced by any other cauſe, we do not ſee how the ſeaſons could return in the ſame order every 9th or 19th year. The motions of the heavenly bodies (eſpecially the moon) are, ſtrictly ſpeaking, incommenſurable. The lunar apogee returns to the ſame ſituation in eight years ten months (without reckoning hours and minutes): at its firſt return it will be two months or ſigns removed from the ſame ſituation with the ſun; at the end of the ſecond period, four months; and at the end of the third, ſix months; ſo that if the ſeaſon was winter at the beginning, after three revolutions it will be the middle of ſummer. Now, how in this caſe can the ſame ſeaſons return? Suppoſing the equinoctial points to produce conſtantly great changes on the weather, if one of them during the firſt revolution happened in winter, in the ſecond it would happen in ſpring, and the third in ſummer; ſo that what would during the firſt revolution produce a particular winter, would in the ſecond act upon the ſpring, and in the third on the ſummer. Would it in theſe caſes produce ſimilar changes on the weather? Surely not. And whether it did or not, would the ſame ſeaſons return in every revolution? In ſix complete revolutions, indeed, or 53 years, the lunar perigee returns to the ſame ſituation as at firſt, very nearly, in the ſame ſeaſon: it might be expected then that the ſeaſons would perform a complete revolution every 53 years, and that the 54th would exactly reſemble the firſt, and ſo on. This may poſſibly be the caſe, but it is by no means probable; for when Mr Toaldo compared the quantity of rain which fell at Paris during 1699, 1700, 1701, 1702, &c. with what fell in 1752, 1753, 1754, &c. though the firſt years in each ſeries correſponded pretty exactly, the difference being only eight lines, there was no ſuch reſemblance between any of the following years.

Neither are we convinced that the influence of the moon can have ſuch an effect on the weather as the above mentioned philoſophers ſuppoſe. The moon only acts, as far as we know at leaſt, by producing tides in the atmoſphere; for the refined ſpeculations of Mr Toaldo about its electrical influence we cannot admit, as the electricity of the atmoſphere is leſs during the night, when the moon's influence ſhould be greateſt, than during the day. Now we do not ſee how theſe tides, ſuppoſing them greater than they are, can be adequate to the effects aſcribed to them.

Mr Kirwan † has lately endeavoured to diſcover probable rules for prognoſticating the different ſeaſons, as far as regards Britain and Ireland, from tables of obſervations alone. On peruſing a number of obſervations, taken in England from 1677 to 1789, he found,

† *Iriſh Tranſ.* vol. v. p. 19.

Mr Kirwan's method of prognoſticating the weather.

1. That when there has been no ſtorm before or after the vernal equinox, the enſuing ſummer is generally *dry* at leaſt five times in ſix.

2. That

Weather.

2. That when a storm happens from an easterly point, either on the 19th, 20th, or 21st of May, the succeeding summer is generally *dry* four times in five.

3. That when a storm arises on the 25th, 26th, or 27th of March (and not before), in any point, the succeeding summer is generally *dry* four times in five.

4. If there be a storm at south-west or west-south-west on the 19th, 20th, 21st, or 22d of March the succeeding summer is generally *wet* five times in six.

In this country winters and springs, if dry, are most commonly cold; if moist, warm: on the contrary, dry summers and autumns are usually hot, and moist summers cold. So that if we know the moistness or dryness of a season, we can judge pretty accurately of its temperature.

From a table of the weather kept by Dr Rutty, in Dublin, for 41 years, Mr Kirwan endeavoured to calculate the probabilities of particular seasons being followed by others. Though his rules relate chiefly to the climate of Ireland, yet as probably there is not much difference between that island and Britain in the general appearance of the seasons, we shall mention his conclusions here.

In 41 years there were 6 wet springs, 22 dry, and 13 variable; 20 wet summers, 16 dry, and 5 variable; 11 wet autumns, 11 dry, and 19 variable. A season, according to Mr Kirwan, is counted *wet* when it contains two wet months. In general the quantity of rain which falls in dry seasons is less than five inches, in wet seasons more: variable seasons are those in which there falls between 30lb. and 36lb. a lb. being equal to .157639 of an inch.

The order in which the different seasons followed each other was as in the following table:

	Has been followed by a		Times.	Probability.
A dry spring	dry	Summer.	11	$\frac{11}{22}$
	wet		8	$\frac{8}{22}$
	variable		3	$\frac{3}{22}$
A wet spring	dry		0	0
	wet		5	$\frac{5}{6}$
	variable		1	$\frac{1}{6}$
A variable spring	dry		5	$\frac{5}{13}$
	wet		7	$\frac{7}{13}$
	variable		1	$\frac{1}{13}$
A dry summer	dry	Autumn.	5	$\frac{5}{16}$
	wet		5	$\frac{5}{16}$
	variable		6	$\frac{6}{16}$
A wet summer	dry		5	$\frac{5}{20}$
	wet		3	$\frac{3}{20}$
	variable		12	$\frac{12}{20}$
A variable summer	dry		1	$\frac{1}{5}$
	wet		3	$\frac{3}{5}$
	variable		1	$\frac{1}{5}$
A dry spring and dry summer	dry		3	$\frac{3}{11}$
	wet		4	$\frac{4}{11}$
	variable		4	$\frac{4}{11}$
A dry spring and wet summer	dry		2	$\frac{2}{8}$
	wet		0	0
	variable		6	$\frac{6}{8}$
A wet spring and dry summer	dry		0	0
	wet		0	0
	variable		0	0
A wet spring and wet summer	dry		2	$\frac{2}{5}$
	wet		1	$\frac{1}{5}$
	variable		2	$\frac{2}{5}$
A wet spring and variable summer	dry		1	$\frac{1}{1}$
	wet		0	0
	variable		0	0
A dry spring and variable summer	dry		0	0
	wet		2	$\frac{2}{3}$
	variable		1	$\frac{1}{3}$
A variable spring and dry summer	dry		2	$\frac{2}{4}$
	wet		0	0
	variable		2	$\frac{2}{4}$
A variable spring and wet summer	dry		1	$\frac{1}{7}$
	wet		1	$\frac{1}{7}$
	variable		5	$\frac{5}{7}$
A variable spring and variable summer	dry		0	0
	wet		1	$\frac{1}{1}$
	variable		0	0

Hence Mr Kirwan deduced the probability of the kind of seasons which would follow others. This probability is expressed in the last column of the table, and is to be understood in this manner: The probability that a dry summer will follow a dry spring is $\frac{11}{22}$; that a wet summer will follow a dry spring $\frac{8}{22}$; that a variable summer will follow a dry spring $\frac{3}{22}$; and so on.

This method of Mr Kirwan, if there is such a connection between the different seasons that a particular kind of weather in one has a tendency to produce a particular kind of weather in the next, as it is reasonable to expect from theory, may in time, by multiplying observations, come to a great degree of accuracy, and may at last, perhaps, lead to that great desideratum, a rational theory of the weather. As we wish to throw as much light as possible on this important subject, we shall add to these a few maxims, the truth of which have either been confirmed by long observation, or which the knowledge we have already acquired of the causes of the weather has established on tolerably good grounds.

45 Maxims for prognosticating the weather.

1. A moist autumn with a mild winter is generally followed by a cold and dry spring, which greatly retards vegetation.—Such was the year 1741 *.

2. If the summer be remarkably rainy, it is probable that the ensuing winter will be severe; for the unusual evaporation will have carried off the heat of the earth. Wet summers are generally attended with an unusual quantity of seed on the white thorn and dog-rose bushes. Hence the unusual fruitfulness of these shrubs is a sign of a severe winter.

3. The appearance of cranes and birds of passage early in autumn announces a very severe winter; for it is a sign that it has already begun in the northern countries.

4. When it rains plentifully in May, it will rain but little in September, and *vice versa*.

5. When the wind is south-west during summer or autumn, and the temperature of the air unusually cold for the season, both to the feeling and the thermometer, with a low barometer, much rain is to be expected †.

6. Violent temperatures, as storms or great rains, produce a sort of crisis in the atmosphere, which produces a constant temperature, good or bad, for some months ||.

7. A rainy winter predicts a steril year.—A severe autumn announces a windy winter ‡.

Thus we have endeavoured to describe the various phenomena of the weather, and to explain them as far as the infant state of our knowledge of the atmosphere furnished us with principles.

Notwithstanding the imperfection of our present knowledge of this subject, the numbers and the abilities of the philosophers who are at present engaged in the study cannot fail at last of being crowned with success; and perhaps a rational and satisfactory theory of the weather is not so far distant as we at present suppose. It is a pity, however, that in a science attended with so much difficulty as meteorology is, various artificial difficulties should have been thrown in the way, which contribute very much to obstruct its progress. There are no fewer than four thermometers

* Du Hamel.

† Manchester Trans. vol. v. p. 63.

|| P. Cotte.

‡ Toaldo.

ther meters used at present in different parts of Europe; and the observations made by each of them must be reduced to one common standard before it is possible to compare them with one another. This is a tedious enough business, but it is nothing at all to the reduction of observations of rain and of the barometer to one common standard. Every nation has its own peculiar measure; and the French, to add to the difficulty, have reckoned by lines, and twelfths of lines, instead of by decimal parts of an inch. Whether, however, this be the case at present or not, we know not, as we have seen no meteorological tables drawn up in France later than 1797. Philosophers ought certainly to fix upon some common standard of weights and measures, otherwise the labour in meteorology, and even in chemistry, must soon become intolerable. The only other possible way to remedy this evil would be, to construct accurate tables, in which the various weights and measures used by philosophers are reduced to one common standard. This has already been done in part; but no table of this kind which we have seen is sufficient to remedy the evil: few of them descend to decimal parts of small weights or measures; yet without this they seldom can save the trouble of calculation.

WEATHER, in sea-language, is used as an adjective, and applied by mariners to every thing lying to windward of a particular situation: thus, a ship is said to have the weather-gage of another, when she is farther to windward. Thus also, when a ship under sail presents either of her sides to the wind, it is then called the *weather-side* or *weather-board*; and all the rigging and furniture situated thereon are distinguished by the same epithet, as the *weather-shrouds*, the *weather-lifts*, the *weather-braces*, &c.

To WEATHER, in sea-language, is to sail to windward of some ship, bank, or head-land.

Weather-Cock, a moveable vane, in form of a cock, or other shape, placed on high, to be turned round according to the direction of the wind, and point out the quarter from whence it blows.

Weather-Glass. See BAROMETER.

WEATHERING, among sailors, signifies the doubling or sailing by a head-land or other place.

WEAVING, the art of working a web of cloth, silk, or other stuff, in a loom with a shuttle. For an idea of the manner in which this is performed, see CLOTH.

Weaving-Loom, a machine for weaving cloth, silk, &c. by raising the threads of the warp in order to throw in the shoot, and strike it close. Of these there are various kinds, distinguished by the different sorts of cloths, stuffs, silks, &c. in which they are employed; and which are chiefly distinguished by the number and variety of the threads they raise in order to work the warp, either plain or in figures, by making more or less of the woof or shoot appear through the warp. In order to give a general idea of weaving, we shall here describe the parts of the common weaver's loom. See Plate DXXXIX. fig. 1. in which *ef*, *ef* are the front posts, and *g*, *g* the back posts of the loom; *ll*, *mm*, *mm* are the *lams* in their place at Q, or, as they are called in some parts of Scotland, the *hiddles*, and in others the *slaves*. They are composed of strong threads, stretched between two horizontal bars, an upper and a lower. The threads of one lam are so disposed as to pass between the upper threads of the warp, while they admit the lower threads to pass through loops or small holes in them, and the disposition of the threads of the other lam is such, that while they pass between the lower threads of the warp, they admit the upper threads to pass through the small holes just mentioned. The lams are suspended from the cross bar or *lam-bearer* HH, by means of ropes *n*, *n* passing from the upper bars of the *lams* over the pulleys at EE, and balanced by weights at the other ends. From the lower bar of each *lam* or *hiddle* a rope passes to the *treadles* or moveable bars at OO; so that when a foot presses a treadle, the lam fastened to it sinks, while the other rises by means of the balancing weight suspended from the pulley at E. The workman then throws in the woof by means of the shuttle, and closes it by one or two strokes of the *lay* or *batten*, of which WB, WB are called the *swords*, CC the *cap*, or in Scotland the upper *shell*, DD the *block* or under *shell*, and PP the *reed* or *comb* contained between these shells. LL is the bench on which the workmen sit; for the loom which our figure represents is constructed for weaving cloth of such a breadth as to require two workmen, who have their quills in a box *d* on the middle of the bench on which they sit. Between the workmens bench and the *batten* or *lay* is the *breast-bar* I, I, a smooth square beam, in which there is an opening to let the web through as it is wove. From this opening the web SS passes to the *knee roll* or *web beam* GG, round which it is rolled by means of the spokes, visible in the figure, and kept from being unrolled by a wheel with teeth and clench, visible likewise in the figure. In some looms the web passes from the knee-roll to the wooden frame X, to be dried as it is wove. Opposite to the breast-bar, and on the other side of the *batten* or *lay*, is the *cane-roll* or *yarn-beam*, on which the warp is rolled when put into the loom, and from which it is gradually unrolled as the work proceeds. TT are bobbins filled with yarn of the warp to mend such threads of it as may be broke in the weaving; and B *b*, B *b* are clues of the same kind of yarn with the borders of the warp, to mend such threads as may there be broken.

Weaving.

Fig. 2. represents the common shuttle with the vacuity in the middle, in which the quill with the woof is placed on a spindle or axis. As this shuttle is thrown with one hand in at one side of the warp, and received with the other hand at the other side, it is obvious, that when the web is of a breadth too great for a man to reach from one side of it to the other, two workmen must be employed and much time lost. To remedy this inconveniency, a new shuttle has, in this country, been lately brought into very general use, and called the *flying shuttle*, because it flies through the warp with wonderful rapidity on two steel rollers RR (fig. 3.) This shuttle is not thrown with the hand, but moved backwards and forwards by a very simple piece of machinery, of which fig. 4. will give the reader a sufficiently accurate conception. To each end of the *batten* or *lay* L is fastened a kind of open box B, *b*, with the bottom or horizontal side exactly on a level with the threads of the warp of the intended web. In each of these boxes is a vertical piece of wood D, *d*, of considerable thickness, called a *driver*. This driver is moved easily on an iron spindle or axis from one end of the box to the other by means of a slender rope CCCD, and a handle H is seen in the figure. When the weaver is to begin his work, he lays the shuttle on its rollers in the box B with the iron tip T (fig. 3.) touching, or almost touching, the driver D (fig. 4.) Then moving the handle H, with a sudden jerk, towards the box *b*, the driver D forces the shuttle with a rapid motion thro' the warp till it strikes *d*, which is impelled by the stroke to the farther end of the box *b*. The two drivers D and *d* have now changed their positions in their respective boxes; so that the driver which was at the front of its box before, is now at the farther end of it, and *vice verse*. Then by a sudden jerk of the hand towards B the shuttle is driven back till it strike D; and thus is the work continued without the weaver having occasion ever to stretch his arms from one margin of the web to the other. That the shuttle may not, by the unsteadiness of the work-

man's hand, be driven *zig-zag* through the warp or out of the place in which it ought to move, the guiding or driving rope CCCD is made to paſs through ſmooth holes or loops C, C, at the ends of the ropes EC, EC, ſuſpended either from the croſs bar on the top of the loom or from the ſwords of the batten.

This ſhuttle, we ſhould think, a great improvement in every kind of weaving loom, though ſome of the older tradeſmen, with whom we have converſed on the ſubject, contend, that it is valuable only in what they call light work, ſuch as cotton or linen cloth, or when the web, if woollen, is very broad.

WEB, a ſort of tiſſue or texture formed of threads interwoven with each other; ſome whereof are extended in length, and called the *warp;* others are drawn acroſs, and called the *woof*.

WEDGE, one of the mechanical powers. See MECHANICS.

WEDNESDAY, the fourth day of the week, ſo called from a Saxon idol named *Woden*, ſuppoſed to be Mars, worſhipped on this day.

Aſh-WEDNESDAY, the firſt day of Lent, ſo called from the cuſtom obſerved in the ancient Chriſtian church of penitents expreſſing their humiliation at this time, by appearing in ſack-cloth and aſhes.

WEED, a common name for all rank and wild herbs, that grow of themſelves, to the detriment of other uſeful herbs they grow among.

WEED, in the miners language, denotes the degeneracy of a load or vein of fine metal into an uſeleſs marcaſite.

WEEDS, alſo denote a peculiar habit, worn by the relicts of perſons deceaſed, by way of mourning.

WEEK, in chronology, a diviſion of time compriſing ſeven days. See *PLANETARY Days* and SABBATH.

Paſſion-WEEK, or the *Holy WEEK*, is the laſt week in Lent, wherein the church celebrates the myſtery of our Saviour's death and paſſion.

WEEK or WYCK, in geography, a parliament and port-town of Scotland, in the ſhire of Caithneſs. W. Long. 3. 2. N. Lat. 58. 30.

WEEKS Ember. See EMBER.

Feaſt of WEEKS. See PENTECOST.

WEEVEL, *Method of deſtroying*. See GRANARY.

WEEVER, in ichthyology. See TRACHINUS.

WEEVIL, in zoology, a ſpecies of curculio. See CURCULIO.

WEIGH, a weight of cheeſe, wool, &c. containing 256 pounds avoirdupois. Of corn, the weigh contains 40 buſhels; of barley or malt, ſix quarters. In ſome places, as Eſſex, the weigh of cheeſe is 300 pounds.

WEIGHING, the act of examining a body in the balance to find its weight.

WEIGHING Anchor, is the drawing it out of the ground it had been caſt into, in order to ſet ſail, or quit a port, road, or the like.

WEIGHT, in phyſics, a quality in natural bodies, whereby they tend downwards towards the centre of the earth. Or, weight may be defined in a leſs limited manner, to be a power inherent in all bodies whereby they tend to ſome common point, called the *centre of gravity*, or, to ſpeak more accurately, to one another: and that with a greater or leſs velocity, as they are more or leſs denſe, or as the medium they paſs through is more or leſs rare. See MECHANICS.

WEIGHT, in commerce, denotes a body of a known weight appointed to be put in the balance againſt other bodies whoſe weight is required.

The ſecurity of commerce depending, in a good meaſure, on the juſtneſs of weights, which are uſually of lead, iron, or braſs, moſt nations have taken care to prevent the falſification thereof, by ſtamping or marking them by proper officers, after being adjuſted by ſome original ſtandard. Thus, in England, the ſtandard of weights is kept in the exchequer by a particular officer, called the *clerk of the market*.

Weights may be diſtinguiſhed into ancient and modern.

I. ANCIENT WEIGHTS.

1. Thoſe of the ancient Jews, reduced to the Engliſh troy weight, will ſtand as in the following table:

			lb.	oz.	dwt.	gr.
		Shekel	0	0	9	$2\frac{4}{7}$
60		Maneh	2	3	6	$10\frac{2}{7}$
3000	50	Talent	113	10	1	$10\frac{2}{7}$

2. Roman weights, reduced to Engliſh troy weight, will ſtand as in the following table:

										oz.	dwt.	gr.
									Lentes	0	0	$0\frac{85}{112}$
4									Siliquæ	0	0	$3\frac{1}{28}$
12	3								Obolus	0	0	$9\frac{3}{28}$
24	6	2							Scriptulum	0	0	$18\frac{3}{14}$
72	18	6	3						Drachma	0	2	$6\frac{9}{14}$
96	24	8	4	$1\frac{1}{3}$					Sextula	0	3	$0\frac{6}{7}$
144	36	12	6	2	$1\frac{1}{2}$				Sicilicus	0	4	$13\frac{2}{7}$
192	48	16	8	$2\frac{2}{3}$	2	$1\frac{1}{3}$			Duella	0	6	$1\frac{5}{7}$
576	144	48	24	8	6	4	3		Uncia	0	18	$5\frac{1}{7}$
6912	1728	576	288	96	72	48	36	12	Libra	10	18	$13\frac{5}{7}$

The Roman ounce is the Engliſh avoirdupois ounce, which they divided into 7 denarii, as well as 8 drachmas.

3. *Attic Weights*.

			English Troy Weight. lb.	oz.	dwt.	gr.
		Drachma	0	0	2	16.9
100		Mina	1	1	10	10
6000	60	Talent	67	7	5	0

II. MODERN WEIGHTS.

1. *Engliſh Weights*.— Mr Renardſon, in a paper publiſhed in the Philoſophical Tranſactions, has proved, that at firſt there was but one weight in England, and that this was the avoirdupois. Troy weight was introduced in the time of Henry VII: At preſent, both the troy and avoirdupois weights are uſed in England. Troy weight ſeems to have derived its name from *Troyes*, a town in France, where a celebrated fair was kept. It is uſed for weighing gold, ſilver, jewels, ſilk, and all liquors. The avoirdupois is uſed for weighing other things.

TABLE

Fig. 1.

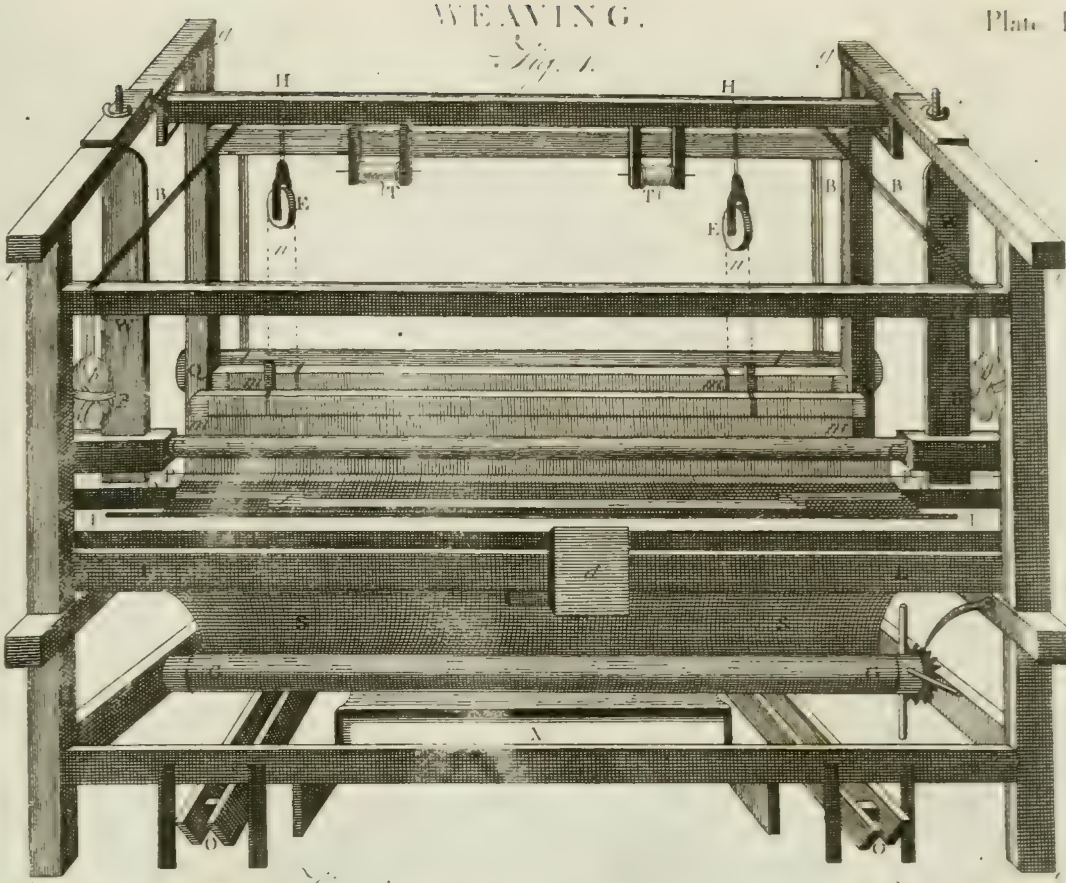


Fig. 3.

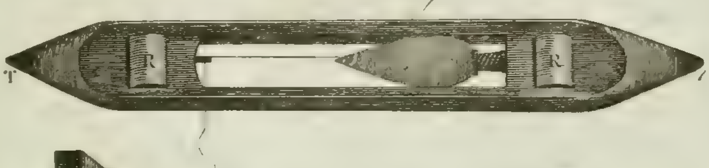
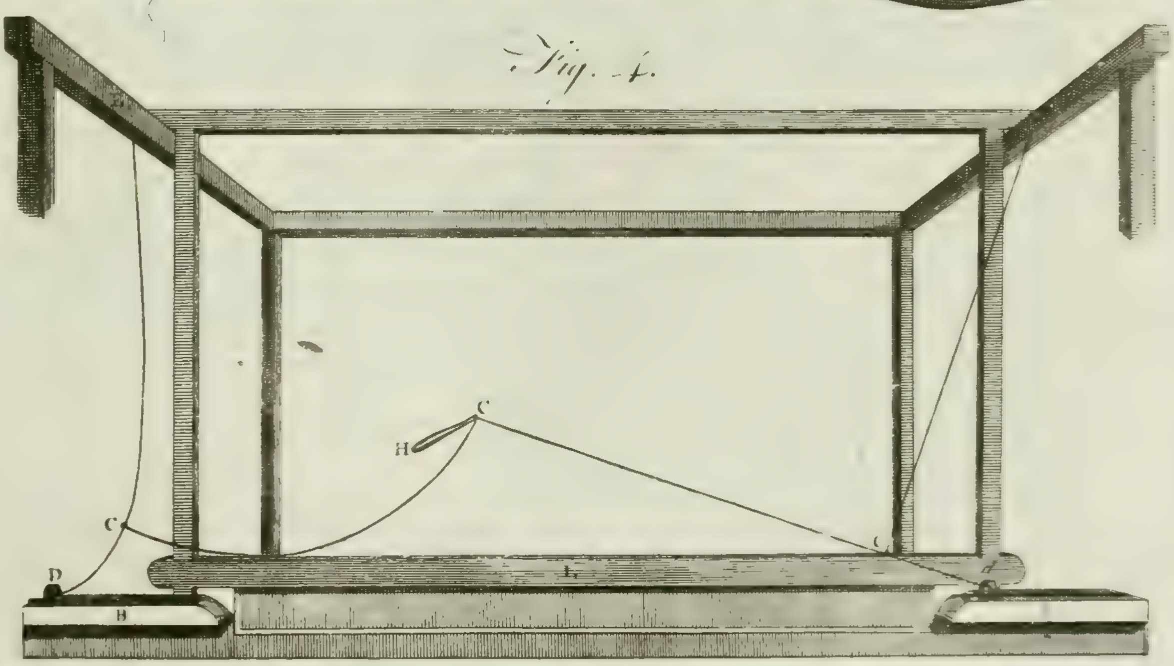


Fig. 2.

Fig. 4.



Weight.

Table of Troy Weight, as uſed by the

Goldſmiths, &c.

Grains.			
24	Penny-weight.		
480	20	Ounce.	
5760	240	12	Pound.

Apothecaries.

Grains.				
20	Scruple. ℈			
60	3	Dram. ʒ		
480	24	8	Ounce. ℥	
5760	288	96	12	Pound.

The troy pound in Scotland, which by ſtatute is to be the ſame as the French pound, is commonly ſuppoſed equal to 15 ounces and three quarters troy Engliſh weight, or 7560 grains. But by a mean of the ſtandards kept by the dean-of-guild of Edinburgh, it weighs $7599\frac{2}{32}$ or 7600 grains.

Table of Avoirdupois Weight.

Drams.					
16	An ounce.				
256	16	A pound.			
7168	448	28	A quarter.		
28672	1792	112	4	A hundred.	
573440	35840	2240	80	20	A ton.

The avoirdupois pound is equal to 7004 troy grains, the avoirdupois ounce to 437.75 grains; and it follows of conſequence, that the troy pound is to the avoirdupois pound as 88 to 107 nearly; for as 88 to 107, ſo is 5760 to 7003.636: that the troy ounce is to the avoirdupois ounce as 80 to 73 nearly; for as 80 to 73, ſo is 480 to 438. An avoirdupois pound is equal to 1 lb. 2 oz. 11 dwts. 20 gr. troy; a troy ounce is equal to 1 oz. 1.55 dr. avoirdupois; an avoirdupois dram contain 27.34375 grains; 175 troy pounds are equal to 144 avoirdupois pounds.

The moneyers have a peculiar ſubdiviſion of the grain troy: thus,

$$\text{The}\left\{\begin{array}{l}\text{Grain}\\ \text{Mite}\\ \text{Droit}\\ \text{Periot}\end{array}\right\}\text{into}\left\{\begin{array}{l}\text{20 Mites.}\\ \text{24 Droits.}\\ \text{20 Periots.}\\ \text{24 Blanks.}\end{array}\right.$$

The Engliſh weights are uſed in the United Provinces of America.

2. *French Weights.*—Different weights were formerly uſed in moſt of the different provinces of France: we believe that they have lately undergone ſeveral alterations; a project of this kind is given in the article Revolution of France. Be that as it may, a knowledge of the ancient weights of that country is of importance on account of the books in which they are uſed. The Paris pound contains 16 ounces, and is divided two ways.

Grains.					
24	Penny-weight.				
72	3	Gros.			
576	24	8	Ounce.		
4608	192	64	8	Marc.	
9216	384	128	16	2	Pound.

Half-ounce.						
2	Ounce.					
4	2	Half-quarter pound.				
8	4	2	Quarter-pound.			
16	8	4	2	Half pound.		
32	16	8	4	2	Pound.	
3200	1600	800	400	200	100	Quintal.

The weights of the firſt diviſion are uſed to weigh gold, ſilver, and the richer commodities; and the weights of the ſecond diviſion for commodities of leſs value.

The Paris 2 marc, or pound weight, is equal to 7560 grains troy, and the Paris ounce equal to 472.5 grains troy.

	lb.	oz.	dwt.	gr.	
The Paris pound =	1	3	15	0	troy
The Paris ounce =	0	0	19	16.5	troy.

A grain troy = 1.2186507 of a Paris grain.

But the pound was not the ſame throughout France. At Lyons, *e. gr.* the city pound was only 14 ounces: ſo that 100 Lyons pounds made only 86 Paris pounds. But beſide the city pound, they had another at Lyons for ſilk, containing 15 ounces. At Thouloufe, and throughout the Upper Languedoc, the pound was 13 ounces and a half of Paris weight. At Marſeilles, and throughout Provence, the pound was $13\frac{1}{2}$ ounces of Paris weight. At Rouen, beſide the common Paris pound and marc, they had the weight of the vicomte; which was 16 ounces, a half, and five-ſixths of the Paris weight. The weights enumerated under the two articles of Engliſh and French weights are the ſame that are uſed throughout the greateſt part of Europe; only under ſomewhat different names, diviſions, and proportions.

French weights are uſed in all the French American ſettlements.

3. *Dutch Weights.*—The weight uſed in Amſterdam and all over Holland is called *Troy weight*, and is exactly the ſame with that uſed at Bruſſels. The Dutch weights are as follows:

Deuskens.						
2	Troyken.					
4	2	Vierling.				
16	8	4	As.			
512	256	128	32	Angle.		
10240	5120	2560	640	20	Ounce.	
8192	40960	20480	5120	160	8	Marc.

The marc is equal, according to M. Tillet, to 4620 French grains.

The Amſterdam pound uſed in commerce is divided into 16 ounces, 32 loots, or 128 drachms. This pound contains 2 marcs troy, and ought therefore to weigh only 10240 *as*: but it weighs 10280; ſo that it is a little heavier than the troy pound of Amſterdam: 256 lb. of commerce are equal to 257 lb. troy of Holland. Two different pounds are uſed by apothecaries; the one containing 2 marcs, the other only $1\frac{1}{2}$. The firſt is called *arſenic* pound weight;

Weight. weight; it contains 16 ounces, the ounce 8 drachms, the drachm 8 scruples, the scruple 20 grains. The second is called the *apothecary's* pound; it is divided into 12 ounces, or 24 loots. Three arsenic pounds are equal to 4 apothecary's pounds.

The Dutch stone	=	8 commercial lb.
The Lispundt, or Ll.	=	15
The hundred weight	=	100
The Schippondt, or Sch. lb.	=	300

4. *Spanish Weights.*—The marc of Castile, used for weighing gold and silver, is divided as follows:

Grains (gold weight).								
$1\frac{1}{24}$	Grain (silver weight).							
12	$11\frac{13}{25}$	Tomine (gold weight).						
$12\frac{1}{2}$	12	$1\frac{1}{24}$	Tomine (silver weight).					
$37\frac{1}{2}$	36	$3\frac{1}{8}$	3	Adarme.				
75	72	$6\frac{1}{4}$	6	2	Ochava.			
96	$92\frac{4}{25}$	8	$7\frac{17}{25}$	$2\frac{14}{25}$	$1\frac{7}{25}$	Castellano.		
600	576	50	48	16	8	$6\frac{1}{4}$	Ounce.	
4800	4608	400	384	128	64	50	8	Marc.

The marc, according to Tillet, is equal to 7 oz. 4 gros, 8 grains French, which is equal to 4785 *as* of Holland. One hundred marcs of Castile = about $93\frac{1}{2}$ marcs of Holland; 100 marcs of Holland = 107 marcs of Castile. Medicines are sold by the same marc; but it is divided differently, containing 8 ounces, 64 drachms, 192 scruples, 384 obolos, 1152 caracteras, 4608 grains.

The Spanish commercial pound is divided into two marcs, called *marcs of Tejo*, each of which is equal to the marc of Castile. This pound is divided into 16 ounces, 256 adarmes, 9,216 grains.

5. *Weights of Portugal.*—The Lisbon marc for essaying silver consists of 12 deniers, and the denier of 24 grains. The marc of Portugal for weighing gold and silver is equal, according to Tillet, to 7 ounces, $3\frac{1}{2}$ gros, and 34 grains French, which makes 4770 *as* of Holland; so that it is exactly the same with the Lisbon pound. It is divided into 8 ounces, 64 outavas, 192 scruples, 4608 grains.

The pound consists of 2 marcs, 16 ounces, or 96 outavas. The arroba of 32 lb. the quintal of 4 arrobas, or 128 lb. 100 Oporto pounds make $87\frac{1}{6}$th pounds of commerce of Amsterdam.

6. *Weights of Italy.—Genoa.* Two kinds of weights are used at Genoa, the *peso grosso* (heavy weight), and the *peso sottile* (light weight): the latter is used for weighing gold and silver, the former for other things. The pound of the peso sottile is equal, according to Tillet, to 1 marc, 2 ounces, $2\frac{1}{2}$ gros, 30 grains French. It is divided into 8 ounces, the ounce into 24 deniers, and the denier into 24 grains. The pound of the peso grosso is equal to 1 marc, 2 ounces, 3 gros, 5 grains, French. It is divided into 12 ounces:

The cantaro	=	100 lbs. peso grosso.
The rubbo	=	25 lbs.
The rotolo	=	$1\frac{1}{4}$ lb.

100 lbs. peso grosso = $64\frac{1}{7}$ lb. of commerce of Amsterdam.
100 lbs. peso sottile = 129 marcs troy of Holland.

Rome. The Roman pound consists of 12 ounces, the ounce of 24 deniers, the denier of 24 grains. The Roman pound, according to Tillet, is equal to 1 marc, 3 ounces $\frac{1}{2}$ gros, 14 grains, French.

Venice. The marc for weighing gold and silver contains 8 ounces, 32 quarti, 1152 carati, or 4608 grani. A hundred marcs of Venice = $97\frac{1}{7}$ marcs troy of Holland. 100 marcs of Holland = 103 of Venice. In Venice they also use a *peso grosso* and *peso sottile*. 100 lbs. peso grosso = $94\frac{4}{7}$ commerical lbs. of Amsterdam. 100 lbs. peso sottile = $61\frac{1}{7}$ ditto.

7. *Swedish Weights.*—The marc for weighing gold and silver is equal to 16 lods, 64 quentins, or 4384 as. The pound of 32 lods, used for weighing food, is equal, according to Tillet, to 1 marc, 5 ounces, 7 gros, 8 grains French which makes $8848\frac{1}{4}$ as troy of Holland. This answers exactly to the weight of the different pounds, as fixed in Sweden, viz. 8848 as = the pound for weighing articles of food; $7821\frac{29}{33}$ as = marc used in the mines; $7450\frac{2}{33}$ as = marc used in towns and in the country; $7078\frac{2}{7}$ as = marc used for weighing iron; 7416 as = pound used in medicine.

The skippound	=	400 lbs. for weighing food.
The centner	=	120 lbs.
The waag	=	165 lbs.
The sten	=	32 lbs.
The Swedish as	=	1 as of Holland troy.

8. *German Weights.—Vienna.* The marc of Vienna for weighing gold and silver is divided into 16 loths, 64 quintals, or 256 deniers or pfenings; the loth into 4 quintals, or 16 pfenings. This marc, according to Tillet, is equal to 1 marc, 1 ounce, 1 gros, 16 grains, French, = 5831 as troy Holland. The pound of Vienna is divided into 2 marcs, or 4 viertings; the mark into 8 ounces, 16 loths, 64 quintals, or 266 pfenings.

Hamburgh. The marc for essaying gold is divided into 24 carats; the carat into 12 grains. The marc for silver is divided into 16 loths, and the loth into 18 grains. These marcs consist each of 288 grains, and are therefore equal. This marc, used in Hamburg for gold and silver, is the marc of Cologne, which is equal, according to Tillet, to 7 ounces, 5 gros, $7\frac{1}{2}$ grains, French, = 4866 as troy of Holland. It is divided into 8 ounces, 16 loths, 64 quentins, 256 pfenings, 4352 eschens, or 65536 richt pfenings theile. The apothecary pound used in Hamburgh, and almost all Germany, is divided into 12 ounces, 96 drachms, 288 scruples, or 5760 grains; an ounce is equal to 621 as of Holland. The pound of commerce is equal, according to Tillet, to 10085 as of Holland; for half a pound is equal to 7 ounces, 7 gros, 23 grains, French. This pound is divided into 16 ounces, 32 loths, 128 quentins, or 512 pfenings.

9. *Russian Weights.*—The berckowitz = 400 lbs.
The poud - - = 40 lbs.

The pound is divided into 32 loths, or 96 solotnuks. One hundred Russian lbs. = $166\frac{1}{2}$ marcs, or $82\frac{4}{7}$ lbs. of Amsterdam. One hundred lbs. of commerce of Amsterdam = $120\frac{5}{7}$th lbs. of Russia.

10. *Weights used in the several parts of Asia, the East Indies, China, Persia, &c.*—In Turkey, at Smyrna, &c. they use the batman, or battemant, containing $7\frac{1}{2}$ occos; the occo contains 4 chekys or pounds, each of which, according to Tillet, is equal to 1 marc 2 oz. 3 gros. 28 gr. French. The Turkish weights are divided as follows:

Cantaras.		Batmans.		Occos.		Rottolos.		Chekis.		Metcals.		Drachms.
1	=	$7\frac{1}{2}$	=	44	=	100	=	176	=	$11733\frac{1}{3}$	=	17609
		1	=	6	=	$13\frac{1}{3}$	=	24	=	1600	=	2400
				1	=	$2\frac{3}{11}$	=	4	=	$266\frac{2}{3}$	=	400
						1	=	$1\frac{19}{25}$	=	$117\frac{1}{3}$	=	176
								1	=	$66\frac{2}{3}$	=	100
										1	=	$1\frac{1}{2}$

At

At Aleppo there are three sorts of rottos; the first 720 drachms, making about 7 pounds English, and serving to weigh cottons, galls, and other large commodities; the second is 680 drachms, used for all silks but white ones, which are weighed by the third rotto of 700 drachms. At Seyda the rotto is 600 drachms.

The other ports of the Levant not named here, use some of these weights; particularly the occa, or ocqua, the rottoli, and rotto.

The Chinese weights are the piece for large commodities; it is divided into 100 catis, or cattis; though some say into 125; the cati into 16 taels, or tales; each tael equivalent to $1\frac{1}{3}$ of an ounce English, or the weight of 1 rial and $\frac{1}{11}$, and containing 12 mas, or masses, and each mas 10 condrins. So that the Chinese piece amounts to 137 pounds English avoirdupois, and the cadi to 1 pound 8 ounces. The picol for silk containing 66 catis and $\frac{3}{4}$; the bahar, bakaire, or barr, containing 300 catis.

Tonquin has also the same weights, measures, &c. as China. Japan has only one weight, viz. the cati; which, however, is different from that of China, as containing 20 taels. At Surat, Agra, and throughout the states of the Great Mogul, they use the man, or maund, whereof they have two kinds; the king's man, or king's weight; and the man simply; the first used for the weighing of common provisions, containing 40 seers, or serres; and each seer a just Paris pound. The common man, used in the weighing of merchandise, consists likewise of 40 seers, but each seer is only estimated at 12 Paris ounces, or $\frac{3}{4}$ of the other seer.

The man may be looked upon as the common weight of the East Indies, though under some difference of name, or rather of pronunciation; it being called *mao* at Cambaya, and in other places *mein*, and *maun*. The seer is properly the Indian pound, and of universal use; the like may be said of the bahar, tael, and catti, above mentioned.

The weights of Siam are the piece, containing two shans or cattis; but the Siamese catti is only half the Japanese, the latter containing 20 taels, and the former only 10; though some make the Chinese catti only 16 taels, and the Siamese 8. The tael contains 4 baats or ticals, each about a Paris ounce; the baat 4 selings or mayons; the mayon 2 fouangs; the fouang 4 payes; the paye 2 clams; the sompaye half a fouang.

It is to be observed, that these are the names of their coins as well as weights; silver and gold being commodities there sold, as other things, by their weights.

In the isle of Java, and particularly at Bantam, they use the gantan, which amounts to near 3 Dutch pounds. In Golconda, at Visapour, and Goa, they have the furatelle, containing 1 pound 14 ounces English; the mangalis, or mangelin, for weighing diamonds and precious stones, weighing at Goa 5 grains, at Golconda, &c. $5\frac{1}{2}$ grains. They have also the rotolo, containing $14\frac{1}{2}$ ounces English; the metricol, containing the sixth part of an ounce; the wall for piastres and ducats, containing the 73d part of a rial.

In Persia they use two kind's of batmans or mans; the one called *cahi* or *cheray* which is the king's weight, and the other *batman of Tauris*. The first weighs 13 pounds 10 ounces English; the second $6\frac{1}{2}$ pounds. Its divisions are the ratel, or a 16th; the derhem, or drachm, which is the 50th; the meschal, which is half the derhem; the dung, which is the sixth part of the metchal, being equivalent to 6 carat grains; and, lastly, the grain, which is the fourth part of the dung. They have also the vakie, which exceeds a little our ounce; the sah-cheray, equal to the 1170th part of the derhem; and the toman, used to weigh out large payments of money without telling; its weight is that of 50 thassis.

11. *Weights at Cairo in Egypt.*—Almost every kind of goods has its own weight; these are regulated by the cantaren or principal weight.

		Rotels.
The ordinary cantaren, or hundred weight, weighs		100
The cantaren of quicksilver and tin	.	102
coffee, wine, and iron	-	105
ivory	- -	100
almonds and other fruits	-	115
woods for dying	-	120
arsenic and other drugs	-	125
minium and cinnabar	-	130
gum-arabic, aloes, and other aromatics	- -	133

The rotel or rotoli is nearly equal to the pound of Marseilles; 100 lbs. of Marseilles are equal to 110 rotels. The Marseilles pound consists of 13 ounces of Paris; so that 100 lbs. of Marseilles are equal to 81 lbs. Paris, and 100 lbs. Paris = 122 lbs. of Marseilles.

We shall subjoin here Mr Ferguson's table for comparing the English avoirdupois pound with foreign pounds:

London pound	1.0000	Hamburgh	1.0865
Antwerp	1.04	Lisbon	1.135
Amsterdam	1.1111	Leghorn	0.75
Abeville	1.0789	Norimberg	1.1363
Ancona	0.78	Naples	0.71
Avignon	0.8928	Paris	1.1235
Bourdeaux	1.0989	Prague	1.2[illegible]
Bologna	0.8	Placentia	0.72
Bruges	1.0204	Rochelle	0.8928
Calabria	0.73	Rome	0.7[illegible]
Calais	0.9345	Rouen	1.108[illegible]
Dieppe	1.0989	Seville	0.9259
Dantzic	0.862	Thoulouse	0.8925
Ferrara	0.75	Turin	0.82
Flanders	0.9433	Venice	1.06
Geneva	1.07	Vienna	1.23
Genoa, gross	0.7		

In order to show the proportion of the several weights used throughout Europe, we shall add a reduction of them to one standard, viz. the London pound.

The 100 lb. of England, Scotland, and Ireland are equal to

lb.	oz.	
91	8	of Amsterdam, Paris, &c.
96	8	of Antwerp or Brabant.
88	0	of Rouen, the viscounty weight.
106	0	of Lyons, the city weight.
90	9	of Rochelle.
107	11	of Tholouse and Upper Languedoc.
113	0	of Marseilles or Provence.
81	7	of Geneva.
93	5	of Hamburgh
89	7	of Francfort, &c.
96	1	of Leipsic, &c.
137	4	of Genoa.
132	11	of Leghorn.
153	11	of Milan.
152	0	of Venice.
154	10	of Naples.
97	0	of Seville, Cadiz, &c.
104	13	of Portugal.
96	5	of Leige.
112	$\frac{2}{3}$	of Russia.
107	$\frac{1}{11}$	of Sweden.
89	$\frac{1}{2}$	of Denmark.

A curious weighing machine was some time ago invented by M. Hanin of Paris, whereby the weights of the principal coun-

Weight. countries in Europe, and the relative proportions they bear to each other, are ſhown at one view. For this he received a bounty of 20 guineas from the Society inſtituted at London for the Encouragement of Arts, Manufactures, and Commerce. We ſhall inſert a deſcription and figure of this ingenious machine.

Plate DCXXVIII. Figure 1. repreſents the back of the machine, which being ſuſpended by the ring A, and a weight hung to the hook B, the ſpring C, C, C, made faſt by ſtrong ſcrews at *g*, is drawn downwards; and the bar D, having a rack thereon at *e*, turns the pinion *f*, in proportion to the weight of the body hanging thereto. Figure 2. ſhows the face of the machine, on which are a number of concentric circles, and the weights of ſeveral countries of Europe engraved thereon, as expreſſed by the words on a line with them. In the centre of this face is a ring fixed to the ſmall plate, turned by the pinion *f*, ſhown at figure 1. From this ring a hand projects, which, by the turning of the pinion, points to ſuch part of the circle as is marked with the weight, hung to the hook B; and thereby ſhows what weight of any of the countries mentioned, is equal to the pounds troy of London, which are engraved on the outer circle, or to the pounds avoirdupois, which are engraved on the ſecond circle, and ſo of the reſt. A ſlider moves on the hand, which may be brought to any of the circles at pleaſure, in order to point out the relative weight with greater preciſion.

Many attempts have been made to introduce an uniformity of weights and meaſures into the commercial world; but hitherto they have all failed. The accompliſhment of ſuch an undertaking would be of infinite advantage to mankind, and certainly claims the moſt ſerious attention of thoſe who by their ſituation can alone bring it about. The undertaking is indeed difficult, but ſurely not impoſſible. Something of this kind has lately been attempted in France; and if it ſucceed, as the method is ſimple, and exceedingly well adapted for calculation, it ſurely deſerves to be imitated. See *Revolution of France*.

Weight of Air. See Pneumatics, nº 14—19.

Regulation of Weights and Meaſures, is a branch of the king's prerogative. See Prerogative and Measure.

As weight and meaſure are things in their nature arbitrary and uncertain, it is therefore expedient that they be reduced to ſome fixed rule or ſtandard: which ſtandard it is impoſſible to fix by any written law or oral proclamation; for no man can, by words only, give another an adequate idea of a foot rule, or a pound weight. It is therefore neceſſary to have recourſe to ſome viſible, palpable, material ſtandard; by forming a compariſon with which all weights and meaſures may be reduced to one uniform ſize; and the prerogative of fixing this ſtandard, our ancient law veſted in the crown, as in Normandy it belonged to the duke. This ſtandard was originally kept at Wincheſter: and we find in the laws of king Edgar, near a century before the conqueſt, an injunction that the one meaſure, which was kept at Wincheſter, ſhould be obſerved throughout the realm. Moſt nations have regulated the ſtandard of meaſures of length by compariſon with the parts of the human body; as the palm, the hand, the ſpan, the foot, the cubit, the ell (*ulna* or arm), the pace, and the fathom. But as theſe are of different dimenſions in men of different proportions, our ancient hiſtorians inform us, that a new ſtandard of longitudinal meaſure was aſcertained by king Henry the Firſt; who commanded that the *ulna*, or ancient ell, which anſwers to the modern yard, ſhould be made of the exact length of his own arm. And one ſtandard of meaſure of length being gained, all others are eaſily derived from thence; thoſe of greater length by multiplying, thoſe of leſs by dividing, that original ſtandard. Thus, by the ſtatute called *compoſitio ulnarum et perticarum*, five yards and an half make a perch; and the yard is ſubdivided into three feet, and each foot into 12 inches; which inches will be each of the length of three grains of barley. Superficial meaſures are derived by ſquaring thoſe of length; and meaſures of capacity by cubing them. The ſtandard of weights was originally taken from corns of wheat, whence the loweſt denomination of weights we have is ſtill called a *grain*; 32 of which are directed, by the ſtatute called *compoſitio menſurarum*, to compoſe a pennyweight, whereof 20 make an ounce, 12 ounces a pound, and ſo upwards. And upon theſe principles the firſt ſtandards were made; which, being originally ſo fixed by the crown, their ſubſequent regulations have been generally made by the king in parliament. Thus, under king Richard I. in his parliament holden at Weſtminſter, A. D. 1197, it was ordained that there ſhould be only one weight and one meaſure throughout the kingdom, and that the cuſtody of the aſſize, or ſtandard of weights and meaſures, ſhould be committed to certain perſons in every city and borough; from whence the ancient office of the king's aulnager ſeems to have been derived, whoſe duty it was, for a certain fee, to meaſure all cloths made for ſale, till the office was aboliſhed by the ſtatute 11th and 12th William III. c. 20. In king John's time this ordinance of king Richard was frequently diſpenſed with for money; which occaſioned a proviſion to be made for enforcing it, in the great charters of king John and his ſon. Theſe original ſtandards were called *pondus regis*, and *menſura domini regis*, and are directed by a variety of ſubſequent ſtatutes to be kept in the exchequer chamber, by an officer called the *clerk of the market*, except the wine gallon, which is committed to the city of London, and kept in Guildhall.

The *Scottiſh* ſtandards are diſtributed among the oldeſt boroughs. The elwand is kept at Edinburgh, the pint at Stirling, the pound at Lanark, and the firlot at Linlithgow.

Various ſtatutes have been enacted for regulating and enforcing an uniformity of weights and meaſures; and by the articles of union, the Engliſh ſtandards are eſtabliſhed by law over all Great Britain. But the force of cuſtom is ſo ſtrong, that theſe ſtatutes have been ill obſerved. The Scottiſh ſtandards are ſtill univerſally retained for many purpoſes; and likewiſe a variety of local weights and meaſures are uſed in particular places of both countries, which differ from the general ſtandards of either.

WELD, or Wold, in botany. See Reseda.

WELDING-heat, in ſmithery, a degree of heat given to iron, &c. ſufficient to make the ſurfaces of two pieces incorporate upon being beaten together with a hammer.

WANMANNIA, in botany: A genus of plants of the claſs *octandria*, order *monogynia*, and arranged in the natural claſſification with thoſe plants the order of which is doubtful. The calyx is four-leaved, the corolla has four petals, and the capſule is bilocular and biroſtrated. There are four ſpecies, none of which are natives of Britain.

WELL, a hole under ground, uſually of a cylindrical figure, and walled with ſtone and mortar: its uſe is to collect the water of the ſtrata around it.

Well, an apartment formed in the middle of a ſhip's hold to incloſe the pumps, from the bottom to the lower deck. It is uſed as a barrier to preſerve thoſe machines from being damaged by the friction or compreſſion of the materials contained in the hold, and particularly to prevent the entrance of ballaſt, &c. by which the tubes would preſently be choked, and the pumps rendered incapable of ſervice. By means of this incloſure, the artificers may likewiſe more readily deſcend into the hold, in order to examine

amine the ftate of the pumps, and repair them as occafion requires.

Well-room of a Boat, the place in the bottom where the water lies, between the ceiling and the platform of the ftern-fheets, whence it is thrown out into the fea with a fcoop.

Burning-Well. See *Burning-Springs*.

Well of a Fifhing-veffel, an apartment in the middle of the hold, which is entirely detached from the reft, being lined with lead on every fide, and having the bottom thereof penetrated with a competent number of fmall holes, paffing alfo through the fhip's floor; fo that the falt-water running into the well is always kept as frefh as that in the fea, and yet prevented from communicating itfelf to the other parts of the hold.

Well-hole, in building, is the hole left in a floor for the ftairs to come up through.

WELLS, a city of Somerfetfhire, and fee of a bifhop; the bifhop of Bath being alfo that of Wells.—It is fuppofed to take its name from the many fprings and wells that are near it. It is not very large; but is adorned with handfome buildings, both public and private. Its cathedral is a very beautiful ftructure, adorned with images and carved ftone-work. The bifhop's palace joins to the cathedral; and on the other fide are the houfes for the prebendaries. In the market-place is a fine market-houfe, fupported by pillars. It is governed by a mayor, and fends two members to parliament. The chief manufacture is knit hofe. W. Long. 2. 37. N. Lat. 51. 12.

WEN, a tumor or excrefcence arifing on different parts of the body, and containing a cyftus or bag filled with fome peculiar kind of matter. See Nævus.

WEREGILD, the price of *homicide*; paid partly to the king for the lofs of a fubject, partly to the lord whofe vaffal he was, and partly to the next of kin of the perfon flain.

WERST, Wurst, or *Verft*, a Ruffian meafure equal to 3500 Englifh feet. A degree of a great circle of the earth contains about 104 werfts and a half.

WERTURIAN or *Uralian Mountains*, a famous chain of mountains forming part of the boundary of Afia. It begins diftinctly (for it may be traced interruptedly farther fouth) near the town of Kungur, in the government of Kafan, in latitude 57. 20.; runs north, and ends oppofite to the Waygatz ftrait, and rifes again in the ifle of *Nova Zemlja*. The Ruffians alfo call this range *Semennoi Poias*, or, *the girdle of the world*; from a fuppofition that it encircled the univerfe. Thefe were the *Riphæi montes: Pars mundi damnata a natura rerum, et denfa merfa caligine* §; of which only the fouthern part was known to the ancients, and that fo little as to give rife to numberlefs fables. Beyond thefe were placed the happy *Hyperborei*, a fiction moft beautifully related by Pomponius Mela. Moderns have not been behind-hand in exaggerating feveral circumftances relative to thefe noted hills. Ybrand Ides, who croffed them in his embaffy to China, afferts that they are 5000 toifes or fathoms high; others, that they are covered with eternal fnow. The laft may be true in their more northern parts; but in the ufual paffages over them, they are free from it three or four months.

The heights of part of this chain have been taken by M. l'Abbé d'Auteroche; who, with many affurances of his accuracy, fays, that the height of the mountain Kyria near Solikamfkaia, in latitude 60, does not exceed 471 toifes from the level of the fea, or 286 from the ground on which it ftands. But, according to M. Gmelin, the mountain Pauda is much higher, being 752 toifes above the fea. From Peterfburg to this chain is a vaft plain, mixed with certain elevations or platforms, like iflands in the midft of an ocean. The eaftern fide defcends gradually to a great diftance into the wooded and morafly Siberia, which forms an immenfe inclined plane to the Icy Sea. This is evident from all the great rivers taking their rife on that fide, fome at the amazing diftance of latitude 46°; and, after a courfe of above 27 degrees, falling into the Frozen Ocean, in latitude 73. 30. The Yaik alone, which rifes near the fouthern part of the eaftern fide, takes a fouthern direction, and drops into the Cafpian Sea. The Dwina, the Petzora, and a few other rivers in European Ruffia, flow the inclined plane of that part. All of them run to the Northern Sea; but their courfe is comparatively fhort. Another inclination directs the Dnieper and the Don into the Euxine, and the vaft Wolga into the Cafpian Sea.

Wefley.

WESLEY (John), one of the moft extraordinary characters that ever exifted; whether we confider him as a various and voluminous writer, a zealous and indefatigable preacher, or the founder of the moft numerous fect in the Chriftian world; was the fon of the Reverend Samuel Wefley, rector of Epworth in the ifle of Axholme in Lincolnfhire, and was born in that village in the year 1703. His very infancy was diftinguifhed by an extraordinary incident. The parfonage-houfe at Epworth was burnt to the ground, and the flames had fpread with fuch rapidity, that few things of value could be faved. His mother, in a letter to her fon Samuel Wefley, then on the foundation at Weftminfter fchool, thanks God that no lives were loft, although for fome time they gave up *Poor Jacky*, as fhe expreffes herfelf; for his father had twice attempted to refcue the child, but was beaten back by the flames. Finding all his efforts ineffectual, he refigned him to Divine Providence. But parental tendernefs prevailed over human fears, and Mr Wefley once more attempted to fave his child. By fome means equally unexpected and unaccountable, the boy got round to a window in the front of the houfe, and was taken out, by one man's leaping on the fhoulders of another, and thus getting within his reach. Immediately on his refcue from this very perilous fituation the roof fell in. This extraordinary efcape explains a certain device, in a print of Mr John Wefley, engraved by Vertue, in the year 1745, from a painting by Williams. It reprefents a houfe in flames, with this motto from the prophet, "Is he not a brand plucked out of the burning?" Many have fuppofed this device to be merely emblematical of his fpiritual deliverance; but from this circumftance it is apparent that it has a primary as well as a fecondary meaning; it is real as well as allufive. This fire happened when Mr Wefley was about fix years old.

In the year 1713 he was entered a fcholar at the charterhoufe in London, where he continued feven years under the tuition of the celebrated Dr Walker, and of the Reverend Andrew Tooke author of The Pantheon. Being elected to Lincoln college, Oxford, he became a fellow of that college about the year 1725, took the degree of Mafter of Arts in 1726, and was joint tutor with the Reverend Dr Hutchins the rector. He difcovered very early an elegant turn for poetry. Some of his gayer poetical effufions are proofs of a lively fancy and a fine claffical tafte; and fome tranflations from the Latin poets, while at college, are allowed to have great merit. He had early a ftrong impreffion, like Count Zinzendorf, of his deftination to fome extraordinary work. This impreffion received additional force from fome domeftic incidents; all which his active fancy turned to his own account. His wonderful prefervation, already noticed, naturally tended to cherifh the idea of his being defigned by Providence to accomplifh fome purpofe or other, that was out of the ordinary courfe of human events. The late Reverend Samuel

Wesley. Samuel Badcock, in a letter inserted in the Bibliotheca Topographica Britannica, No XX. says, "There were some strange phenomena perceived at the parsonage at Epworth, and some uncommon noises heard there from time to time, which he was very curious in examining into, and very particular in relating. I have little doubt that he considered himself the chief object of this wonderful visitation, indeed his father's credulity was in some degree affected by it; since he collected all the evidences that tended to confirm the story, arranged them with scrupulous exactness, in a manuscript consisting of several sheets, and which is still in being. I know not what became of the ghost of Epworth; unless, considered as the prelude to the noise Mr John Wesley made on a more ample stage, it ceased to speak when he began to act."

"The dawn of Mr Wesley's public mission (continues Mr Badcock) was clouded with mysticism; that species of it which affects silence and solitude; a certain inexplicable introversion of the mind, which abstracts the passions from all sensible objects; and, as the French Quietists express it, perfects itself by an absorption of the will and intellect, and all the faculties, into the Deity." In this *palpable obscure* the excellent Fenelon led himself when he forsook the shades of Pindus, to wander in quest of *pure love* with Madam Guyon! Mr Wesley pursued for a while the same *ignis fatuus* with Mr William Law and the Ghost of De Renty. A state, however, so torpid and ignoble, ill-suited the active genius of this singular man. His elastic mind gained strength by compression; thence bursting glorious, he passed (as he himself somewhere says) "the immense chasm, upborne on an eagle's wings."

The reading of the writings of this Mr William Law, the celebrated author of Christian Perfection, and of A Serious Address to the Christian World, contributed moreover, to lead Mr John Wesley and his brother Charles, with a few of their young fellow-students, into a more than common strictness of religious life. They received the sacrament of the Lord's Supper every week; observed all the fasts of the church; visited the prisons; rose at four in the morning; and refrained from all amusements. From the exact method in which they disposed of every hour, they acquired the appellation of *Methodists*; by which their followers have been ever since distinguished.

But a more particular account of the origin of this sect, we shall give from a celebrated publication. "The Methodists (says the editor of this work) form a very considerable class, principally of the lower people in this country. They sprung up about fifty years ago at Oxford, and were soon divided into two parties; the one under the direction of Mr George Whitfield, and the other under that of two brothers, John and Charles Wesley. These leaders, and, if we except Mr William Law, founders of the Methodists, were educated at Oxford, received episcopal ordination, and always professed themselves advocates for the articles and liturgy of the established church; though they more commonly practised the dissenting mode of worship. But conceiving a design of forming separate communities, superior in sanctity and perfection to all other Christian churches, and impelled to a very considerable degree by a zeal of an extravagant and enthusiastic kind, they became itinerant preachers; and, being excluded from most of our churches, exercised their ministry in private houses, fields, &c. not only in Great Britain and Ireland, but also in America; thus collecting a very considerable number of hearers and proselytes, both among the members of the established church and the dissenters. The theological system of Mr Whitfield and his followers is Calvinistic; that of Mr Wesley and his disciples Arminian; and the latter maintains the possibility of attaining sinless perfection in the present state. The subordinate teachers of both these classes of Methodists are generally men of no liberal education; and they pretend to derive their ministerial abilities from special communications of the spirit. The Methodists of both parties, like other enthusiasts, make true religion to consist principally in certain affections and inward feelings which it is impossible to explain; but which, when analysed, seem to be mechanical in their spring and operation; and they generally maintain, that Christians will be most likely to succeed in the pursuit of truth, not by the dictates of reason, or the aids of learning, but by laying their minds open to the direction and influence of divine illumination; and their conduct has been directed by impulses."

Our readers will judge for themselves, according to their various modes of education, and to the different lights in which they may respectively view the doctrines of our common Christianity, whether this representation of the origin of the Methodists, and of their distinguishing tenets, be accurate and just.—Not presuming to sit in judgment on the religious opinions of any man, we shall only observe, that an appellation originally given in reproach, has been gloried in ever since by those who have distinguished themselves as the followers either of Mr Whitfield or of Mr Wesley. "After the way called *Methodism*, so worship they the God of their fathers." But the ridicule and contempt which the singularity of their conduct produced, both John and Charles Wesley were well qualified to bear. They were not to be intimidated by danger, actuated by interest, or deterred by disgrace

The boundaries of this island were soon deemed by Mr Wesley too confined for a zeal which displayed the piety of an apostle; and of an intrepidity to which few missionaries had been superior. In 1735 he embarked for Georgia, one of our colonies, which was at that time in a state of political infancy; and the great object of this voyage was to preach the gospel to the Indian nations in the vicinity of that province. He returned to England in 1737. Of his spiritual labours, both in this country and in America, he himself has given a very copious account, in a series of Journals, printed at different periods. These journals drew upon our laborious preacher and his coadjutors some severe animadversions from two right reverend prelates; Dr George Lavington bishop of Exeter, and Dr William Warburton bishop of Gloucester. The former published, in three parts, The Enthusiasm of the Methodists and Papists compared; the third part of this performance containing a personal charge of immoral conduct. Mr Wesley, in his vindication, published a letter to his Lordship, which produced a reply from the latter.

Bishop Warburton's attack is contained in his celebrated treatise, entitled The Doctrine of Grace: or, The Office and Operations of the Holy Spirit vindicated from the Insults of Infidelity, and the Abuses of Fanaticism: concluding with some thoughts, humbly offered to the consideration of the Established Clergy, with regard to the Right Method of defending Religion against the Attacks of either Party; 2 vols, small 8vo. 1762. There is much acute reasoning, and much poignant and sprightly wit, in his Doctrine of Grace; but there is too much levity in it for a grave bishop, and too much abuse for a candid Christian. On this occasion, Mr Wesley published a letter to the bishop, in which, with great temper and moderation, as well as with great ingenuity and address, he endeavoured to shelter himself from his Lordship's attacks; not only under the authority of the Holy Scriptures, but of the church itself, as by law established.

On his return from Georgia, Mr Wesley paid a visit to Count

Count Zinzendorf, the celebrated founder of the sect of Moravians, or Hernhutters, at Hernuth in Upper Lusatia. In the following year he appeared again in England, and with his brother Charles, at the head of the Methodists. He preached his first field-sermon at Bristol, on the 2d of April 1738, from which time his disciples have continued to increase. In 1741, a serious altercation took place between him and Mr Whitfield. In 1744, attempting to preach at an inn at Taunton, he was regularly silenced by the magistrates. Although he chiefly resided for the remainder of his life in the metropolis, he occasionally travelled through every part of Great Britain and Ireland, establishing congregations in each kingdom. In 175[illegible] he married a lady, from whom he was afterwards separated. By this lady, who died in 1781, he had no children.

We have already mentioned Mr Wesley as a very various and voluminous writer. Divinity, both devotional and controversial, biography, history, philosophy, politics, and poetry, were all, at different times, the subjects of his pen: and, whatever opinion may be entertained of his theological sentiments, it is impossible to deny him the merit of having done very extensive good among the lower classes of people. He certainly possessed great abilities, and a fluency which was well accommodated to his hearers, and highly acceptable to them. He had been gradually declining for three years before his death; yet he still rose at four in the morning, and preached, and travelled, and wrote as usual. He preached at Leatherhead, in Surrey, on the Wednesday before that event. On the Friday following, appeared the first symptoms of his approaching dissolution. The four succeeding days he spent in praising God; and he left this scene, in which his labours had been so extensive and so useful, at a quarter before ten in the morning of the 2d of March 1791, in the 88th year of his age. His remains, after lying in a kind of state at his chapel in the city-road, dressed in the sacerdotal robes which he usually wore, and on his head the old clerical cap, a bible in one hand, and a white handkerchief in the other, were, agreeably to his own directions, and after the manner of the interment of the late Mr Whitfield, deposited in the cemetry behind his chapel, on the morning of the 9th March, amid an innumerable concourse of his friends and admirers; many of whom appeared in deep mourning on the occasion. One singularity was observable in the funeral service. Instead of, "We give thee hearty thanks, for that it hath pleased thee to deliver this our brother;" it was read "our father." A sermon, previously to the funeral, had been preached by Dr Thomas Whitehead, one of the physicians to the London hospital; and on the 13th the different chapels of his persuasion in London were hung with black.

It has been justly observed of Mr Wesley, that his labours were principally devoted to those who had no instructor; to the highways and hedges; to the miners in Cornwall, and the coalliers in Kingswood. These unhappy creatures married and buried among themselves, and often committed murders with impunity, before the Methodists sprung up. By the humane and active endeavours of Mr Wesley and his brother Charles, a sense of decency, morals, and religion, was introduced into the lowest classes of mankind; the ignorant were instructed, the wretched relieved, and the abandoned reclaimed. His personal influence was greater, perhaps, than that of any other private gentleman in any country.—But the limits of this article will not permit us to expatiate further on the character of this extraordinary man.

WEST (Gilbert), was the son of Dr West, prebendary of Winchester, and chaplain to king George I. but at 12 years of age lost his father. He studied at Winchester and Eton schools, and from thence was placed in Christ-church college, Oxford. His friends and fortune then inclined him to take orders; but lord Cobham, his uncle, diverted him from that pursuit, and gave him a cornetcy in his own regiment. This profession he soon quitted, on account of an opening of another nature, which presented him with a flattering prospect of advancement in life. A number of young gentlemen were to be elected from the universities, and, at the expence of the government, were to be taught foreign languages; and then sent to the secretaries office, to be initiated into business, and trained there for public services, as envoys, ambassadors, &c. Mr Gilbert West was one of the few pitched upon; and on his first introduction into that office, lord Townsend, secretary of state, treated him with singular marks of regard, and the strongest inclinations to serve him were testified from all quarters. But his uncle lord Cobham's strong opposition to the measures of the government, rendered these advantages entirely fruitless; and the ministers honestly told Mr West, that he must not expect them to distinguish his merit, as any favours conferred upon him would be imputed as done to his uncle lord Cobham. Mr West now left that office, and all his views of making his fortune; and entering into marriage, retired to Wickham in Kent, where he lived in great domestic comfort and tranquil happiness. He was there visited by his valuable friends, who held the most delightful converse of wit, humour, and learning, supported upon the principles of virtue, sound reasoning, and solid friendship, which rendered the whole cheerful, animating, and instructive. Mr William Pitt, who was one of those that composed this happy society, becoming paymaster, appointed Mr West treasurer to Chelsea-hospital; and he obtained a seat at the council board, in consequence of a friendship contracted at school with one of the duke of Devonshire's sons, who procured of his grace his being nominated one of the clerks extraordinary of that office. Towards the latter part of Mr West's life, he wholly applied himself to the study of the Scriptures; being extremely anxious to try his utmost endeavours to reconcile the seeming inconsistencies which gave the enemies to revealed religion a handle to doubt and discredit their authenticity. His observations on the resurrection, which, it has been said, were written to confirm the wavering faith of his great friends Pitt and Lyttleton, bear ample testimony to his reasoning powers and the sincerity of his religion; while his translations of Pindar show him to have been an eminent Greek scholar, and very considerable poet. He had a mind replete with virtue, and was an honour to his country; but died at 5[illegible] years of age.

West, one of the cardinal points of the horizon, diametrically opposite to the east; and strictly defined the intersection of the prime vertical with the horizon on that side the sun sets in.

WESTMINSTER, a city which forms the west part of the capital of Britain, but has a government distinct from the rest. This city had its name from the situation of its abbey, anciently called a *minster*, in respect of that of St Paul. That part properly called the city of Westminster, comprehending the parishes of St John and St Margaret, was once an island formed by the Thames, called *Thorney island*, from the thorns with which it was overrun; and the abbey that stood in it, Thorney-abbey. The liberties of Westminster contain the several parishes of St Martin in the Fields, St James's, St Anne, St Paul, Covent-garden, St Mary le Strand, St Clement, Danes, St George, Hanover Square, and the precinct of the Savoy. The government, both of the city and liberties, is under the jurisdiction of the dean and chapter of Westminster, in civil as well as ecclesiastical affairs; and their authority extends to

Westmoreland, Westphalia. to the precinct of St Martin le Grand, by Newgate-street, and in some towns of Essex, that are exempted from the jurisdiction of the bishop of London and the archbishop of Canterbury; but the management of the civil part has, ever since the Reformation, been in the hands of laymen, elected from time to time, and confirmed by the dean and chapter. The chief of these laymen are the high-steward, the deputy-steward, and the high-bailiff, who hold their offices for life. There are also 16 burgesses and their assistants, out of which are elected two head-burgesses, one for the city, and the other for the liberties. Another officer is the high constable, who has all the other constables under his direction.

WESTMORELAND, a county of England, bounded on the north and north-west by Cumberland; on the south and south-east by Yorkshire; and on the south and south-west by Lancashire. Its extent from north east to south, is 40 miles, and its breadth from the east projection to that in the west, 42. It is generally divided into the baronies of Kendal and Westmoreland: the former is very mountainous, but the latter is a large champaign country. These are the only principal divisions of this county, which contains 8 market towns and 26 parishes. It lies partly in the diocese of Chester, and partly in that of Carlisle. The earl of Thanet is hereditary sheriff of the county, which sends only four members to parliament. The air is clear, sharp, and salubrious, the natives being seldom troubled with diseases, and generally living to old age. The soil is various; that on the mountains is very barren, while that in the valleys is fertile, producing good corn and grass, especially in the meadows near the rivers. In the hilly parts on the western borders it is generally believed there are vast quantities of copper ore, and veins of gold; some mines of copper are worked, but most of the ore lies so deep that it will not answer the expence. This county yields the finest slate, and abundance of excellent hams are cured here. The principal rivers are, the Eden, the Lone, and the Ken. It has also several fine lakes, the principal of which is Winander Mere, or Windermere Water. In the forest of Martindale, to the south of Ulls-water, the breed of red deer still exists in a wild state.—Appleby is the county town.

WESTPHALIA, a duchy of Germany, bounded to the east by the bishopric of Paderborn, and the territories of Waldeck and Hesse; to the south by the counties of Witgenstein and Nassau, and the duchy of Berg; to the north by the bishopric of Munster and the county of Lippe. It is about 40 miles in length and 30 in breadth. The lower part of it is very fruitful, yielding plenty of corn and cattle, and some salt-springs. The higher affords iron ore, calamine, lead, copper, some silver and gold, fine woods, cattle, game, fish, with a little corn. The rivers, that either pass through the duchy or along its borders, are the Rahr, the Lenne, the Bigge, the Dimel, and the Lippe. There are 28 towns in it, besides boroughs and cloisters. The provincial diets are held at Arensberg. In the year 1180, the emperor Fred. I. made a donation of this duchy to the archbishopric of Cologne, which was confirmed by succeeding emperors; and in 1638, the last duke of Arensberg ceded to it also the county of Arensberg. The duchy is governed at present by a bailiff, under the archbishop, and is divided into the Hellwege, the Haarstrank, and the Surland; or otherwise into the Ruden, the Werl, the Bilstein, and the Brilon quarters.

WESTPHALIA, one of the circles of Germany, anciently the people inhabiting between the Weser and the Rhine, were called *Westphalians*; and hence that tract got the name of *Westphalia*: but the circle of that name is of a larger extent, being surrounded by the circle of Burgundy, or the Austrian Netherlands, the United Provinces, and the North Sea, with the circles of the Upper and Lower Rhine, and comprising a great many different states.

The summoning princes and directors of the circle of Westphalia, are the bishops of Munster, alternately with the electors of Brandenburg and Palatine, as dukes of Cleve and Juliers. The archives belonging to it were before the present war (1797) kept at Dusseldorp. Its quota of men and money is somewhat more than the ninth part of the whole sum granted by the empire. With respect to religion, it is partly Protestant and partly Catholic; but the Protestants predominate, and are, at least the greater part of them, Calvinists. The air of this country is not reckoned very wholesome, and towards the north is extremely cold in winter. The soil in general is marshy and barren; yet there is some good corn and pasture land: but the fruit is chiefly used to feed hogs; and hence it is that their bacon and hams are so much valued and admired.

WET COUCH, *coming heap*, a term used by the maltsters for one of the principal articles of malt making. See BREWING n° 4.

WETSTEIN (John James), a very learned German divine, born at Basil in 1693. On his admission to the ministry, he maintained a thesis *De variis Novi Testamenti Lectionibus*; in which he showed that the great variety of readings of the New Testament afford no argument against the authenticity of the text. He had made these various readings the object of his attention; and travelled into foreign countries to examine all the MSS. he could come at. In 1730, he published *Prolegomena ad Novi Testament. Græci editionem accuratissimam*, &c. Some divines, dreading his unsettling the present text, procured a decree of the senate of Basil against his undertaking, and even got him prohibited from officiating in the ministry; on which he went to Amsterdam, where the Remonstrants named him to succeed the famous Le Clerc, then superannuated, as professor of philosophy and history. At last he published his edition of the New Testament, in 2 vols folio, 1752; in which he left the text as he found it, placing the various readings, with a critical commentary, underneath; subjoining two epistles of Clemens Romanus, till then unknown to the learned, but discovered by him in a Syriac MS. of the New Testament. He also published some small works; and is said to have been not only an universal scholar, but to have abounded in good and amiable qualities. He died at Amsterdam in 1754.

WETTERAVIA, the southern division of the Landgravate of Hesse in Germany, lying along the northern bank of the river Maine, comprehending the counties of Hanau and Nassau.

WEXFORD, a county of Ireland, in the province of Munster, 38 miles in length, and 24 in breadth; bounded on the north by Wicklow, on the east by St George's Channel, on the south by the Atlantic Ocean, on the west by Waterford and Kilkenny, and on the north by Catherlough. It contains 109 parishes, and sends 18 members to parliament. It is a fruitful country in corn and grass; and the principal town is of the same name.

WEXFORD, a sea-port of Ireland, capital of a county of the same name. It was once reckoned the chief city in Ireland, being the first colony of the English, and is still a large handsome town, with a very commodious harbour at the mouth of the river Slana, on a bay of St George's Channel, 63 miles south of Dublin. W. Long. 6. 3. N. Lat. 52. 18.

WHALE, in ichthyology. See BALÆNA and PHYSETER.

WHALE, in astronomy, one of the constellations. See ASTRONOMY, n° 406.

WHALE-

Whale-Bone. See Balæna, n° 2.

Whale-Fishery. See Fishery.

WHARF, a ſpace on the banks of a haven, creek, or hithe, provided for the convenient loading and unloading of veſſels.

WHARTON (Philip duke of), a nobleman of the moſt brilliant parts, but of the moſt whimſical, extravagant, and inconſiſtent turn of mind, was educated by his father's expreſs order at home. He very early married a young lady, the daughter of major general Holmes, which diſappointed his father's views of diſpoſing of him in ſuch a marriage as would have been a conſiderable addition to the fortune and grandeur of his illuſtrious family; yet that amiable lady deſerved infinitely more felicity than ſhe met with by this alliance. This precipitate marriage is thought to have haſtened the death of his father; after which the duke, being free from paternal reſtraints, plunged into thoſe exceſſes which rendered him, as Pope expreſſes it,

"A tyrant to the wife his heart approv'd;
"A rebel to the very king he lov'd."

In the beginning of the year 1716, he began his travels; and as he was deſigned to be inſtructed in the ſtricteſt Whig principles, Geneva was thought a proper place for his reſidence. He firſt paſſed through Holland, and viſited ſeveral courts of Germany; and being arrived at Geneva, conceived ſuch a diſguſt againſt his governor, that he left him, and ſet out poſt for Lyons, where he wrote a letter to the chevalier de St George, who then reſided at Avignon, and preſented him a very fine ſtout horſe; which the chevalier no ſooner received than he ſent a man of quality to him, who took him privately to his court, where he was entertained with the greateſt marks of eſteem, and had the title of duke of Northumberland conferred upon him. He, however, remained there but one day, and then returned poſt to Lyons, whence he ſet out for Paris. He likewiſe paid a viſit to the conſort of James II. who then reſided at St Germains, to whom he alſo paid his court. During his ſtay at Paris, his winning addreſs and abilities gained him the eſteem and admiration of all the Britiſh ſubjects of rank of both parties.

About the latter end of December 1716, he arrived in England, whence he ſoon after ſet out for Ireland, where, though under age, he was allowed the honour to take his ſeat in the houſe of peers, and immediately diſtinguiſhed himſelf, notwithſtanding his former conduct, as a violent partizan for the miniſtry; in conſequence of which zeal the king created him a duke. He no ſooner came of age than he was introduced to the houſe of lords in England with the ſame blaze of reputation. In a little time he oppoſed the court, and appeared one of the moſt vigorous in defence of the biſhop of Rocheſter; and ſoon after printed his thoughts twice a-week, in a paper called the *True Briton*, ſeveral thouſands of which were diſperſed weekly.

The duke's boundleſs profuſion had by this time ſo burdened his eſtate, that by a decree of Chancery it was veſted in the hands of truſtees for the payment of his debts, allowing him a proviſion of L. 1200 *per annum* for his ſubſiſtence. This being not ſufficient to ſupport his title with ſuitable dignity, he went abroad and ſhone to great advantage, with reſpect to his perſonal character, at the imperial court. From thence he made a tour to Spain: the Engliſh miniſter was alarmed at his arrival, fearing that his grace was received in the character of an ambaſſador: upon which the duke received a ſummons under the privy-ſeal to return home; but inſtead of obeying it, he endeavoured to inflame the Spaniſh court againſt that of Great Britain, for exerciſing an act of power, as he calls it, within the juriſdiction of his Catholic majeſty. He then acted openly in the ſervice of the Pretender, and was received at his court with the greateſt marks of favour. Wharton.

While his grace was thus employed, his neglected ducheſs died in England on the 14th of April 1726, without iſſue. Soon after the duke fell violently in love with M. Oberne, one of the maids of honour to the queen of Spain, the daughter of an Iriſh colonel, whoſe fortune chiefly conſiſted in her perſonal accompliſhments. All his friends, and particularly the queen of Spain, oppoſed the match; but he falling into a lingering fever, occaſioned by his diſappointment, the queen gave her conſent, and they were ſoon after married. He then ſpent ſome time at Rome, where he accepted of a blue garter, aſſumed the title of duke of Northumberland, and for a while enjoyed the confidence of the exiled prince. But not always keeping within the bounds of Italian gravity, it became neceſſary for him to remove from hence; when, going by ſea to Barcelona, he wrote a letter to the king of Spain, acquainting him that he would aſſiſt at the ſiege of Gibraltar as a volunteer. Soon after he wrote to the chevalier de St George, expreſſing a deſire to viſit his court; but the chevalier adviſed him to draw near to England.

The duke ſeemed reſolved to follow his advice; and ſetting out with his ducheſs, arrived in Paris in May 1728, whence he ſoon after proceeded to Rouen, where he took up his reſidence; and was ſo far from making any conceſſion to the government of England, that he did not give himſelf the leaſt trouble about his eſtate, or any other concern there; though, on his arrival at Rouen, he had only about L. 600 in his poſſeſſion, and a bill of indictment was preferred againſt him in England for high treaſon. Soon after the chevalier ſent him L. 2000, which he ſquandered away in a courſe of extravagance; when, to ſave the charges of travelling by land, he went from Orleans to Nantz by water, and ſtaid there till he got a remittance from Paris, which was ſquandered almoſt as ſoon as received. At Nantz he was joined by his ragged ſervants, and from hence took ſhipping with them for Bilboa, when the queen of Spain took the ducheſs to attend her perſon. About the beginning of the year 1731, the duke, who commanded a regiment, was at Lerida, but declined ſo faſt that he could not move without aſſiſtance: yet when free from pain did not loſe his gaiety. He, however, received benefit from ſome mineral waters in Catalonia; but ſoon after relapſed at a ſmall village, where he was utterly deſtitute of all the neceſſaries of life, till ſome charitable fathers of a Bernardine convent removed him to their houſe, and gave him all the relief in their power. Under their hoſpitable roof he languiſhed a week, and then died, without one friend or acquaintance to cloſe his eyes; and his funeral was performed in the ſame manner in which the fathers inter thoſe of their own fraternity.

Thus died Philip duke of Wharton, "who, like Buckingham and Rocheſter (ſays Mr Walpole), comforted all the grave and dull, by throwing away the brighteſt profuſion of parts on witty fooleries, debaucheries, and ſcrapes, which mix graces with a great character, but never can compoſe one.

"With attachment to no party, though with talents to govern any party, this lively man changed the free air of Weſtminſter for the gloom of the Eſcurial, the proſpect of king George's garter for the Pretender's; and with indifference to all religion, the frolic lord who had writ the ballad on the archbiſhop of Canterbury, died in the habit of a capuchin. It is difficult to give an account of the works of a man whoſe library was a tavern, and women of pleaſure his muſes. A thouſand ſallies of his imagination may have been loſt. There are only two volumes in 8vo,

called

called *his Life and Writings*. These contain nothing of the latter, but 74 numbers of the True Briton, and his speech in defence of the bishop of Rochester. His other works are the ballads above mentioned; the Drinking Match at Eden-hall, in imitation of the Chevy Chace, printed in a miscellany called *Whartoniana*; and a parody of a song sung at the opera-house by Mrs Tofts. His lordship also began a play on the story of the queen of Scots."

WHEAT, in botany. See TRITICUM. For the culture of wheat, see AGRICULTURE, n° 122—136.

The three principal kinds of bad wheat are, the *blighted*, the *smutty*, and the *worm eaten*. Blighted wheat is that of which the stalk is a little twisted and rickety, the blade being of a bluish green and curled up, the grain also is green and tubercled: smutty wheat appears as if great part of the ear had been burnt, some small parts only being free, and, in particular, the stem that rises in the centre of the ear, round which the grain is ranged: worm eaten or rotten wheat is corrupted without losing much of its natural form, or external appearance; the husk is filled with a greasy, black powder, that is insufferably fetid. It appeared, from the experiments of M. Tillet, that there was a kind of infectious quality in all those kinds of wheat; so that if sound wheat was sprinkled with the flour of smutty or rotten wheat, the crop produced would be rotten or smutty. It appeared also, that among the grain which was produced from ground manured with the straw of distempered wheat, there was a much greater proportion of distempered wheat than in that produced from ground manured with the straw of good wheat: the great secret then was to destroy the principle of this contagion in the wheat that was put into the ground; and M. Tillet found, as the result of a great number of experiments, that if the grain, before it is sowed, be well moistened with a solution of sea-salt, or nitre, in common water, none of the ensuing crop will be smutty, or otherwise defective, either in kind or quality; not only supposing the grain that is sowed to be sound, and the soil to be good, but even supposing the grain to be strewed with the flour of smutty wheat, and the ground manured with bad straw.

Prize Dissertation by the Academy of Bourdeaux.

The following receipt for preventing smutty wheat was published in 1769 by order of the Society for the Encouragement of Arts: they received it from Mr John Reynolds of Adisham in Kent.

A tub is to be procured that has a hole at bottom, in which a staff and tap-hose is to be fixed over a whisp of straw, to prevent any small pieces of lime passing (as in the brewing way); this done, we put 70 gallons of water, then a corn bushel heap-full of stone-lime, unslaked, stirring it well till the whole is dissolved or mixed, letting it stand about 30 hours, and then run it off into another tub as clear as we can (as practised in beer): this generally produces a hogshead of good strong lime-water; then add three pecks of salt, 42 pounds, which, with a little stirring, will soon dissolve; thus we have a proper pickle for the purpose of brining and liming our seed-wheat without any manner of obstacle, which is more than can be said in doing it the common way, and greatly facilitates the drilling.

Herein we steep the wheat in a broad-bottomed basket of about 24 inches diameter, and 20 inches deep (for large sowing, made on purpose), running in the grain gradually in small quantities from 10 to 12 gallons up to 16 gallons, stirring the same. What floats, we skim off with a strainer, and is not to be sown: then draw up the basket, to drain over the pickle, for a few minutes; all which may be performed within half an hour, sufficiently pickled; and so proceed as before. This done, the wheat will be fit for sowing in 24 hours, if required; but if designed for drilling, two hours pickled will be found best; and if prepared four or five days before-hand, in either case it makes no difference at all; but should the seed be clammy, and stick to the notches in the drill-box, more lime must be added to the lime-water; here the master must use his discretion, as the case requires; for some lime has much more drying or astringent qualities in it than others. If sea-water can be obtained conveniently, much less salt will suffice, but some will be found necessary even then, otherwise the light grains will not float, a thing of more consequence than is generally imagined, and it ought to be skimmed off and thrown aside for poultry, &c.

WHEEL, in mechanics, a simple machine, consisting of a round piece of wood, metal, or other matter, which revolves on its axis. See MECHANICS.

Wheel-Carriages. See MECHANICS, Sect. iv.

Wheel-Animal. See ANIMALCULE, n° 16—23.

Wheel, Persian. See HYDROSTATICS.

Wheel, Potter's. See POTTERY.

WHEEL is also the name of a kind of punishment to which great criminals are put in divers countries. In some, assassins, parricides, and robbers on the highway, are said to be condemned to the wheel, when they are to have their bones first broken with an iron bar on a scaffold, and then to be exposed, and left to expire on the circumference of a wheel. In Germany they break their bones on the wheel itself.—Of this cruel punishment, it is not certain who was the inventor: it was first used in Germany, and was, indeed, but rarely practised anywhere else, till the time of Francis I. of France; who, by an edict of the year 1534, appointed it to be inflicted on robbers on the highway.

WHEELER (Sir George), a learned traveller and divine, was the son of colonel Wheeler of Charing in Kent, and was born in 1650 at Breda, where his parents as royalists were then in exile. He travelled through various parts of Greece and the East in company with Dr James Spon of Lyons; and taking orders on his return, was installed a prebend of Durham, made vicar of Basingstoke, and afterward rector of Houghton le Spring. He published an account of his Travels in 1682 in folio; and in 1689, his Observations on ancient edifices of Churches yet remaining in the East, compared with Eusebius: also the Protestant Monastery, or Christian Œconomics. He died in 1724.

WHEELINGS, in the military art, are different motions made both by horse and foot, either to the right and left, or to the right and left about.

General Rules for Wheeling.—The circle is divided into four equal points: thence, wheeling to the right or left, is only a quarter of the circle; wheeling to the right or left about is one half of the circle.

When you wheel to the right, you are to close to the right, so near as to touch your right-hand man, but without pressing him; and to look to the left, in order to bring the rank about even.

When you wheel to the left, you are to close to the left, and look to the right as above directed. This rule will serve for all the wheeling by ranks; as when a battalion is marching by subdivisions with their ranks open, then each rank wheels distinctly by itself, when it comes to the ground on which the ranks before it wheeled, but not before.

In wheeling, the men are to take particular care neither to open nor close their ranks, and to carry their arms well.

In wheeling, the motion of each man is quicker or slower, according to the distance he is from the right or the left: thus, when you wheel to the right, each man moves quicker than his right-hand man; and wheeling to the left, each man moves quicker than his left-hand man; the circle that every man wheels being larger, according to the distance he

is from the hand he wheels to; as may be seen by describing several circles within one another, at two feet distance from each, which is nearly the space every man is supposed to take up.

WHELK, in zoology. See BUCCINUM.

WHELP, the young of a dog, fox, lion, or any wild beast.

WHELPS, in a ship, the seaman's term for those brackets which are set up on the capstan close under the bars; they give the sweep to it, and are so contrived that the cable winding about them may not surge so much as it might otherwise do if the body of the capstan were quite round and smooth.

WHETSTONE, a stone which serves for the whetting of knives and other tools upon.

WHEY, the serum or watery part of milk.

WHIDAH, a kingdom of Africa, on the coast of Guinea, and to the west of the Gold Coast; extending about 10 miles along the sea. It is a populous country, well furnished with large villages, and these are so near to each other, that they are not above a musket-shot from each other.— The houses are small, round at the top, and encompassed with mud walls or hedges, together with a great number of all sorts of beautiful and lofty trees, which afford the most beautiful prospect in the world; insomuch that those that have been here represent it as a perfect paradise. The fields are always green, and they cultivate beans, potatoes, and fruits; nor will the negroes here let a foot of ground remain uncultivated. They sow again the very next day after they have reaped. The inhabitants are greatly civilized, very respectful to each other, especially to their superiors, and very industrious. The women brew the beer, dress the victuals, and sell all sorts of commodities at the market. Those that are rich employ their wives and slaves in tilling the land, and they carry on a considerable trade with the product, as well as in slaves; for some of them are able to deliver 1000 of the latter every month. The chief men have generally 40 or 50 wives, the principal captains 300 or 400, and the king 4000 or 5000. They are extremely jealous, and, on the least suspicion, will sell them to the Europeans for slaves. If any one happen to touch one of the king's wives accidentally, he is doomed to perpetual slavery. It is no wonder then that the women are not fond of being the king's wives; and some of them will prefer a speedy death to such a miserable life. They have no distinction of hours, days, weeks, months, or years. The rite of circumcision is used here, but they are not able to tell why they use it, nor whence it is derived. They are such great gamesters, that they will stake all they have at play, not excepting their wives and children. They have a vast number of idols; and they deify the most contemptible animal that they see first in a morning, and even stocks and stones. Their principal regard is for snakes, very high trees, and the sea. An English factor, just arrived, found a snake in the house belonging to the factory, and killed it without the least scruple; which so incensed the negroes, that they were for revenging the death of the snake, not only upon him that killed it, but upon the whole factory; but by dint of presents, and the interposition of the people of the other factories, this affair was made up, and the snake honourably interred. However, to prevent such accidents, they gave them warning not to do the like for the future. They have oxen, cows, goats, sheep, hogs, turkeys, ducks, and hens; which last are extremely plentiful. There are many elephants, buffaloes, tigers, several kinds of deer, and a sort of hares. The fruits are citrons, lemons, oranges, bananas, tamarinds, &c. and they have vast numbers of palm-trees, from which they obtain wine. Whidah was conquered by the king of Dahomy. Their trade consists in slaves, elephants teeth, wax, and honey. The English factory is 200 miles east of Cape Coast Castle, within land. Bows, arrows, [illegible], and clubs, are the principal weapons of the nation.

WHIDAW-BIRD. See EMBERIZA.

WHIG, a term in Britain, opposite to the Tories, from whom they differ chiefly in their political principles. See TORY.

WHIMBREL. See SCOLOPAX.

WHIN, in botany. See ULEX.

WHIN-CHAT. See MOTACILLA.

WHIP-STAFF, on board a ship, a piece of timber, in form of a strong staff, fastened into the helm, for the steersman to hold in his hand, in order to move the rudder and direct the ship.

WHIRLPOOL, an eddy, vortex, or gulf, where the water is continually turning round.

Those in rivers are very common, from various accidents, and are usually very trivial, and of little consequence. In the sea they are more rare, but more dangerous. Sibbald has related the effects of a very remarkable marine whirlpool among the Orcades, which would prove very dangerous to strangers, though it is of no consequence to the people who are used to it. This is not fixed to any particular place, but appears in various parts of the limits of the sea among these islands. Wherever it appears, it is very furious; and boats, &c. would inevitably be drawn in and perish with it; but the people who navigate them are prepared for it, and always carry an empty vessel, a log of wood, or large bundle of straw, or some such thing, in the boat with them; as soon as they perceive the whirlpool, they toss this within its vortex, keeping themselves out: this substance, whatever it be, is immediately received into the centre, and carried under water; and as soon as this is done, the surface of the place where the whirpool was becomes smooth, and they row over it with safety: and in about an hour they see the vortex begin again in some other place, usually at about a mile's distance from the first.

WHIRLWIND, a wind which moves in a spiral direction, as well as horizontally, which is exceedingly rapid and impetuous, but only of short duration.

Dr Franklin's opinion of the origin of whirlwinds has been already given in the article *WATER Spout*. If his theory be true, it will follow, that no hurricane ever can be so violent as to remove an obstacle of the size of only one cubic inch, provided that was supported by a power equivalent to 15 pounds; for this is the utmost force of the atmosphere when rushing into a perfect vacuum, which never could take place in the centre of a whirlwind or water-spout. Indeed, notwithstanding the dreadful effects sometimes observed from hurricanes and whirlwinds, we shall easily perceive, that the utmost of their power always falls very far short of this. The diminution of the specific gravity of the air by only 4th in the middle of the column, would produce such an afflux of air from all quarters, that an obstacle presenting a surface of one foot square, would require a force of 504 pounds to prevent it from being carried away; which the strongest walls that can be built by human art could scarce resist. Nay, even the tenth part of this, or the diminution of the gravity of the atmosphere by one 40th part, would produce a pressure of upwards of 50 pounds on every square foot of surface, which, it is to be doubted, whether any of our common houses could resist.

Some philosophers ascribe the vacuum in the atmosphere to which, according to Dr Franklin's theory, whirlwinds are owing, to a stream of electric matter rushing with violence into the atmosphere out of the earth. But they do not inform

Whirlwind. form us how this matter comes to be accumulated in that part of the earth; what induces it to pass out of the earth; how it passes invisibly through pure air; or what serves it for a conductor. It seems to be the fashion among certain philosophers to ascribe every phenomenon, with the cause of which we are unacquainted, to electricity. But this is merely substituting a new name, and serves rather to retard than advance our knowledge of nature.

Some kinds of whirlwinds move with a slow motion, and are injurious only by their vortex; while others seem to do mischief as well by their progressive as their whirling motion. Of this kind are those called *typhons;* which, by their frequently following the course of rivers, seem thus also to discover their electrical origin. Of the destructive effects of these, we have an instance in what happened at Charlestown in South Carolina, on the 1st of June 1761. It was first observed about noon, on land, upwards of 50 miles west by-south of Charlestown, and destroyed several houses, &c. as it passed along, in many places making wide avenues thro' the woods; from whence every tree and shrub was torn up, and great branches of trees were driven about in the column as it passed along. It directed its course to Ashley river, down which it came with surprising velocity; in its appearance resembling a column of smoke or vapour, whose motion was very irregular and tumultuous. Its momentum was so great, that Ashley river was ploughed to the bottom, and the channel laid bare. As it came down this river, it made a constant noise like thunder; its diameter being computed about 300 fathoms. It was met at White Point by another of the same kind which came down Cooper's river, but with inferior strength; however, on their meeting together, the agitation of the air was much greater, while the clouds, which were driving in all directions to the place, seemed to be precipitated, and whirled round with incredible velocity. It then fell upon the shipping in the road; entirely destroying some, and damaging others; being scarce three minutes in its passage, though the distance was near two leagues. In that short time it did damage to the amount of L. 20,000; and had not its direction been altered by that gust which came down Cooper's river, it must have totally destroyed Charlestown, as no obstacle whatever seemed capable of resisting its fury.

WHISKY, a term signifying *water*, and applied in Scotland and in Ireland to a distilled liquor drawn from barley, which is perhaps preferable to any English malt brandy: it is strong, but not pungent, and free from the empyreumatic taste or smell.

WHISPERING-PLACES. See ACCOUSTICS, n° 24.

WHIST, a well-known game at cards, which requires great attention and silence; hence the name.

This game is played by four persons, who cut for partners; the two highest and the two lowest are together, and the partners sit opposite to each other: the person who cuts the lowest card is to deal first, giving one at a time to each person, till he comes to the last card, which is turned up for the trump, and remains on the table till each person has played a card. The person on the left hand side of the dealer plays first, and whoever wins the trick is to play again, thus going on till the cards are played out. The ace, king, queen, and knave of trumps, are called *honours;* in case any three of these honours have been played between, or by either of the two partners, they reckon for two points towards the game; and if the four honours have been played between, or by either of the two partners, they reckon for four points towards the game, the game consisting of ten points. The honours are reckoned after the tricks; all above six tricks reckoning also towards the game.

General Rules for playing the Game of WHIST.—1. He who is to play first should lead from the strongest suit. If he has a sequence of king, queen, and knave, or queen, knave and ten, he may safely lead the highest of the sequence; but if he has five or six in number, he must begin with the lowest. He must always begin with the highest trump, by which he forces out the superior trumps, and can come in again, to make his strong suit.

2. He should never be afraid to play trumps when he has five in his hand, even of the smallest, although he may not have any good cards of any other suit.

3. With ace and king of any two suits, and only two or three small trumps, the aces and kings should be played out, in order to make as many tricks as possible; and having but two or three small trumps, he should never force his partner to trump, if he finds he cannot follow suit; but endeavour to throw the lead into his partner's hand.

4. He should in general return his partner's lead, unless he has some capital cards of his own.

5. As this game is played with the lurch, that is, to save half the stake, five points must be made before the game is out: he should not venture to play trumps when he is four of the game, unless he is very strong, having at least an honour and three trumps, or ace, king, and two small ones.

6. When the game is scored nine, at which stage the honours reckon for nothing, he should be still more cautious how he plays trumps, even if he is strong in hand, and give his partner an opportunity of trumping the adversaries suits, in case he is deficient in them.

7. If his adversaries are six or seven love of the game, he should play a forward or bold game, that he may have a chance, at the risk of a trick or two, to come up with them. If he has but three trumps and other good cards, he may play trumps, especially if he has a sequence, or queen, knave, and a small one.

8. He should always risk a trick or two when the game is much in his favour; because a new deal is of greater consequence to the adversary than one or two points are to him.

9. When the player finds there is a likelihood of either saving the game or his lurch, he should risk the odd trick; but if the game is five all, and he can make two tricks in his own hand, he should make them, in order to secure the difference of two points, which make the game near two to one in his favour.

10. A good player should begin with a small trump, when he has ace, king, and four small ones; for this reason, if his partner has a better trump than the last player, which is an equal wager but he has, he has a chance of fetching out all the trumps, by having three rounds of them.

11. The odds are always in his favour that his partner holds an honour; consequently if he has king, queen, and four small ones, he should begin with a small one.

12. When queen, knave, and four small trumps are dealt him, he should play a small one first, the odds being in his favour that his partner holds an honour; if he has knave, ten, and four small trumps, he should also begin with a small one, for the same reason.

13. If he has knave, ten, eight, and three small trumps, the knave should be played first, by which means the nine may be prevented from winning a trick, the odds being in his favour that three honours are played in two rounds.

14. If an honour is turned up against him on his left hand, and he has ten, nine, and eight, with two or three small trumps; when he is to play, he should play through the honours with the ten, which will force the dealer to play his honour to a disadvantage, if the dealer does not choose

choose to leave it to the option of his adversary whether he will pass it or not; but if he has six trumps of a lower denomination, and not ten, nine, or eight, and no honour turned up against him, he should begin with a small one.

15. In general, when he has two capital cards in trumps, and two or three small ones, he should begin with a small one, for the reason assigned in rule 12.

16. When he has ace, king, knave, and two small trumps, or even one small trump, by first playing the king, and putting the lead into his partner's hand, who will play a trump; judging him to have ace and knave, from his beginning with the king: in this case the knave should be finessed (A), nothing being against him but the queen.

17. If he has knave, ten, eight, and two small trumps, by playing the knave first, it is odds but in two rounds of trumps the nine falls, or he may finesse the eight when his partner returns trumps.

18. With five trumps of a lower denomination, he should begin with the smallest, unless he has a sequence of ten, nine, and eight; then he should begin with the ten.

19. When he has king, queen, ten, and one small trump, he must begin with the king, and wait for his partner's return of the trumps, in order to finesse the ten, by which means he may win the knave.

20. In order to prevent the ten from winning, when he has queen, knave, nine, and one small trump, he must begin with the queen. And in case he has knave, ten, eight, and one small trump, he should begin with the knave, that the nine may not win.

21. If he has ten, nine, eight, and one small trump, he should begin with the ten; thereby he strengthens his partner's hand, leaving it at his option to take it or not.

22. He should begin with a small one, when he has the ten and three small trumps.

23. If he has a good suit, and ace, king, and four small trumps, he must play three rounds of trumps, in order to secure his strong suit from being trumped.

24. When he has king, queen, ten, and three small trumps, he should begin with the king, because he has a chance of the knave's coming down in the second round: and to secure his strong suit, he should not wait to finesse the ten. If he should have queen, knave, and three small trumps, and some good suit to make, he must begin with a small one.

25. If he has knave, ten, eight, and two small trumps, with a strong suit, he should begin with the knave, in order to make the nine fall in the second round; but if he has knave, ten, and three small trumps, with a good suit, he should play a small one first.

26. With ten, nine, eight, and one small trump, provided he has a good suit, he should begin with the ten; by which means he may get the trumps out, and have a chance of making his strong suit.

The following observations will enable a player to know what his partner has no more of a suit which either of them has played. Suppose he leads from queen, ten, nine, and two small cards of any suit, the second hand puts on the knave, his partner plays the eight; in this case, he having queen, ten, and nine, it is a demonstration, if his partner plays well, that he can have no more of that suit. By that discovery, he may play his game accordingly, either by forcing his partner to trump that suit, if he is strong in trumps, or by playing another suit. If he has king, queen, and ten of a suit, and he leads his king, his partner plays the knave; this also demonstrates he has no more of that suit. If he has king, queen, and many more of a suit, and begins with the king, in some cases it is good play in a partner, when he has the ace and one small card in that suit only, to win the king with the ace; for suppose the partner to be very strong in trumps, by taking the king with the ace, he gets the lead and trumps out, and having cleared the board of trumps, his partner returns his lead; and the ace being out there is room for him to make that whole suit, which could not have been done if the partner had kept the ace. Suppose he has no other good card in his hand besides that suit, he loses nothing by the ace's taking his king; and if it should so happen that he has a good card to bring in that suit, he gains all the tricks which he makes in that suit by this method of play: as his partner has taken his king with the ace, and trumps out upon it, he has reason to imagine that his partner has one of that suit to return him; for which reason he should not throw away any of that suit, even to keep a king or queen guarded.

Method of playing when an honour is turned up on the right hand.—Suppose the knave is turned up on his right hand, and that he has king, queen, and ten; in order to win the knave, he must begin with the king; by which means, his partner may suppose him to have queen and ten remaining, especially if he has a second lead, and he does not proceed to play the queen.

Suppose the knave turned up as before, and he has ace, queen, and ten, by playing his queen, it answers the purpose of the former rule.

When the queen is turned up on his right hand, and he has ace, king, and knave, by playing his king, it answers the same purpose of the former rule.

In case an honour is turned up on his left hand, supposing he should hold no honour, he should play trumps through the honour as soon as he gets the lead; but if he should hold an honour (except the ace), he must be cautious how he plays trumps, because, in case his partner holds no honour, his adversary will play his own game upon him.

Method of playing sequences.—The highest in sequences of trumps should be played, unless he has ace, king, and queen; and then he should play the lowest, which informs his partner of the state of his game.

When he has king, queen, and knave, and two small ones, which are not trumps, he should begin with the knave, whether he is strong in trumps or not, as he makes way for the whole suit by getting the ace out.

If he is strong in trumps, and has a sequence of queen, knave, ten, and two small cards of a suit, he should play the highest of his sequence; for if either of the adversaries should trump that suit in the second round, being also strong in trumps, he will make the remainder of that suit, by fetching out their trumps. When he has knave, ten, and nine, and two small cards of a suit, he may play in the like manner.

If king, queen, and knave, and one small card of any suit, is the case, whether strong in trumps or not, he should play the king; and when there are only four in number, the same method of play should be observed by inferior sequences.

When weak in trumps, he should begin by the lowest of the sequence, provided he has five in number, because if his partner has the ace of that suit he will make it. If he has the ace and four small cards of a suit, and weak in trumps, leading from that suit, he should play the ace. When strong in trumps, the game may be played otherwise.

(A) *Finesse*, is to play a small card which may win, keeping the superior card or cards to lay over the right hand adversary.

Whiſt.

How to make a ſlam, or win every trick.—Suppoſe A and B partners againſt C and D, and C to deal, A to have the king, knave, nine, and ſeven of hearts, which are trumps, a quart-major in ſpades, a tierce major in diamonds, and the ace and king of clubs. Then ſuppoſe B to have nine ſpades, two clubs, and two diamonds. Alſo ſuppoſe D to have ace, queen, ten, and eight of trumps, with nine clubs, and C to have five trumps and eight diamonds. A leads a trump, which D wins, and D is to play a club, which his partner C is to trump; C leads a trump, which his partner D wins; D then will lead a club, which C will trump; and C will play a trump, which D will win; and D having the beſt trump will play it; after which D having ſeven clubs in his hand, makes them, ſo that he ſlams A and B.

How to play any hand of cards according to the neareſt calculations of his partner's holding certain winning cards:

1	That he has not one certain winning card, is	2 to	1
2	That he has not two certain winning cards, is	17 to	2
	But it is about 5 to 4 that he has one or both, or	32 to	25
3	That he has one card out of any three certain winning cards, is about	5 to	2
4	That he has not three certain winning cards, is about 31 to 1, or	681 to	22
5	That he has not two of them, is about 7 to 2, or	547 to	156
6	That he has not one of them, is about 7 to 6, or	378 to	325
7	That he holds one or two of them, is in his favour about 13 to 6, or	481 to	222
8	And about 5 to 2 that he holds 1, 2, or all three of them.		

The uſe of theſe calculations is for a whiſt-player to play his cards to the moſt advantage. For inſtance,

As the firſt calculation is two to one that his partner does not hold one certain winning card.—Suppoſe then a ſuit is led, of which the ſecond player has the king and a ſmall one only, he ſhould put on the king, becauſe the odds are in his favour that the third player cannot win it. For the ſame reaſon, when he is ſecond player, and to lead, he ſhould play a king in preference to a queen, becauſe it is two to one the ace does not take it; but it is five to four the queen will be taken by either ace or king, which may be in the third hand.

According to the ſecond calculation, of its being five to four that his partner holds one certain winning card out of any two: If he has two honours in any ſuit, he can play to an advantage, knowing it is five to four in favour of his partner's having one of the two honours; and by the ſame rule, if he is ſecond player, having a queen and one ſmall card, by playing the queen he plays five to four againſt himſelf.

It is obvious, from the third calculation, which proves it to be five to two that his partner has one card out of any three certain winning cards, that he who plays the knave ſecond hand, having but the knave and one ſmall card of the ſame ſuit, muſt play five to two againſt himſelf, and diſcovers his game to a great diſadvantage; for which reaſon, he ſhould play the loweſt of any ſequence which he may hold in his hand, as the knave, if he has king, queen, and knave; the ten, if he has queen, knave, and ten, &c. By ſo doing, his partner has an opportunity of judging what card to play in that ſuit, according to the odds for or againſt him.

From the above calculation, if he has ace, king, and two ſmall trumps, he is entitled to win four tricks out of ſix, provided he has four winning cards of any ſuit; or five tricks out of ſeven, if he has five winning cards of any ſuit: by playing two rounds of trumps, and taking out eight of them, it is five to two but his partner has a third trump; and if it ſhould be ſo, he makes the tricks intended.

WHISTON (William), an Engliſh divine of great parts, uncommon learning, and of a ſingular character, was born at Norton near Twycroſs in the county of Leiceſter, where his father was rector, in 1667. He was admitted of Clarehall, Cambridge, where he purſued his ſtudies, particularly in the mathematics, and commenced tutor; which his ill health at length forced him to decline. Having entered into orders, he, in 1694, became chaplain to Dr More biſhop of Norwich; and in this ſtation he publiſhed his firſt work, intitled, *A New Theory of the Earth*, &c. in which he undertook to prove the Moſaic doctrine of the earth perfectly agreeable to reaſon and philoſophy. This work brought no ſmall reputation to the author. In the beginning of this century he was made Sir Iſaac Newton's deputy, and afterwards his ſucceſſor, in the Lucaſian profeſſorſhip of mathematics; when he reſigned a living he had in Suffolk, and went to reſide at Cambridge. About this time he publiſhed ſeveral ſcientifical works, explanatory of the Newtonian philoſophy; and he had the honour of being one of the firſt, if not the very firſt, who rendered thoſe principles popular and intelligible to the generality of readers. About the year 1710, he was known to have adopted Arian principles, and was forming projects to ſupport and propagate them: among other things, he had tranſlated the Apoſtolical Conſtitutions into Engliſh, which favoured the Arian doctrine, and which he aſſerted to be genuine. The conſequence was, that he was deprived of his profeſſorſhip, and baniſhed the univerſity; he nevertheleſs purſued his ſcheme, by publiſhing the next year his Primitive Chriſtianity Revived, 4 vols, 8vo. for which the convocation fell upon him very vehemently. On his expulſion from Cambridge, Mr Whiſton ſettled in London; where, without ſuffering his zeal to be intimidated, he continued to write, and to propagate his Primitive Chriſtianity, with as much ardour as if he had been in the moſt flouriſhing circumſtances. In 1721, a ſubſcription was made for the ſupport of his family, which amounted to 470 l. For though he drew profits from reading aſtronomical and philoſophical lectures, and alſo from his publications, which were very numerous, yet theſe of themſelves would have been very inſufficient: nor, when joined with the benevolence and charity of thoſe who loved and eſteemed him for his learning, integrity, and piety, did they prevent his being frequently in great diſtreſs. He continued long a member of the church of England, and regularly frequented its ſervice, though he diſapproved of many things in it: but at laſt he went over to the Baptiſts, and attended Dr Forſter's meeting at Pinner's Hall, Broadſtreet. Among other performances not ſpecified above, he wrote Memoirs of his own life and writings, which contain ſome curious particulars.

He was remarkable for ſpeaking the plaineſt truths on every occaſion, and to perſons of every degree. During the year 1725, that he, with Dr Clarke, Dr Berkeley, and others, had the honour to attend Queen Caroline on a certain day of every week, to talk of the progreſs of ſcience, her Majeſty one evening took occaſion to pay him a juſt compliment on his truth and integrity, requeſting that he would, with his uſual plainneſs, point out to her any fault that he might have obſerved in her conduct. At firſt he begged to be excuſed, adding, that few perſons could bear to have their faults plainly told to them, and leaſt of all royal perſonages, who, from their elevation, are neceſſarily ſurrounded by flatterers, to whoſe lips truth is a ſtranger.

Her Majesty replied, that he was to consider her not as a queen, but as a philosopher; and that philosophy is of very little use, if it cannot enable its professors to bear without offence truths necessary to their own improvement. Upon this he told her, that the greatest fault which he had observed in her conduct, was her indecent behaviour in the house of God, which, he assured her, had made very unfavourable impressions on the minds of many persons, who, coming to town from distant parts of the country, had gone to the chapel to obtain a sight of her majesty, the king, and the royal family. The Queen made no reply; but in about six weeks afterwards renewed her request, that Mr Whiston would point out the most glaring improprieties in her conduct. To this he answered, that he had laid down a maxim from which he could not deviate, never to point out to any person more than one fault at a time, and never to give a second reproof till he had observed some good consequence to have arisen from the first (A). Much to the Queen's honour, she was pleased with this plain-dealing, and continued to think favourably of Mr Whiston. This honest, but whimsical and credulous man, died in 1762, at the advanced age of 95.

WHITBY (Dr Daniel), a very learned English writer, was born in 1638, and bred at Oxford; where, in 1664, he was elected perpetual fellow of his college. He afterward became chaplain to Dr Seth Ward, bishop of Salisbury; who collated him in 1668 to the prebend of Yatesbury in that church, and soon after to that of Husborn and Burbach. In 1672 he was admitted chanter of the said church, on the death of Mr John South, and then, or soon after, rector of St Edmund's church in Salisbury. He was made a prebendary of Taunton Regis in 1696, and died in 1726. He was ever strangely ignorant of worldly affairs, even to a degree that is scarcely to be conceived. His writings are numerous, and well known; particularly his Commentary on the New Testament.

WHITBY, a sea-port town in the North Riding of Yorkshire, seated on the river Esk, near the place where it falls into the sea. The houses are neat, strong, and convenient; the number of inhabitants about 9000. Ship-building is their principal manufacture. W. Long. 0. 24. N. Lat. 54. 30.

WHITE, one of the colours of natural bodies.

WHITE of the Eye, denotes the first tunic or coat of the eye, called *albuginea*. See ANATOMY, n° 142.

WHITE of an Egg. See ALBUMEN and EGG.

WHITE Friars, a name common to several orders of monks, from being clothed in a white habit.

WHITE Sea, is a bay of the Frozen Ocean, so called in the north part of Muscovy, lying between Russian Lapland and Samoieda; at the bottom of which stands the city of Archangel. This was the chief port the Russians had before their conquest of Livonia.

WHITE Colour for painting. See CHEMISTRY, n° 703.

WHITE Copper. See CHEMISTRY, n° 1157.

WHITE Drop, Ward's. See CHEMISTRY, n° 746.

WHITE Iron, or *Tin-plate*, iron-plates covered over with tin: for the method of making which, see LATTEN.

In 1681 tin plates were manufactured in England by one Andrew Yarranton, who had been sent to Bohemia to learn the method of making them. But the manufacture was soon afterwards discontinued. It was revived again in 1740, and is now arrived at as great, if not greater, perfection in this country than in any other.

WHITE Lead. See CHEMISTRY, n° 875.

WHITE Throat, in ornithology. See MOTACILLA.

Whitefield.

WHITEFIELD (George), the celebrated preacher among the people called *Methodists*, was born in the year 1714, at the Bell in the city of Gloucester, which was then kept by his mother. At about 12 years of age he was put to a grammar-school; but his mother entering into a second marriage, which proved a disadvantageous one, he, when about 15, put on a blue apron, and served her in the capacity of a drawer or waiter. After continuing about a year in this servile employment, she turned over the business to his brother; who marrying, and George not agreeing with his sister-in-law, he left the inn. Some time after, meeting with an old school-fellow, then a servitor in Pembroke college, Oxford, he was induced to attempt getting into the same college in a like capacity, and succeeded. Here Mr Whitefield, who from his own account appears to have always had a strong tincture of enthusiasm in his constitution from his very childhood, distinguished himself by the austerities of his devotion, and acquired considerable eminence in some religious assemblies in that city. At the age of 21, the fame of his piety recommended him so effectually to Dr Benson, then bishop of Gloucester, that he made him a voluntary offer of ordination. Immediately after this regular admission into the ministry, Mr Whitefield applied himself to the most extraordinary, the most indefatigable, duties of his character, preaching daily in prisons, fields, and open streets, wherever he thought there would be a likelihood of making proselytes. Having at length made himself universally known in England, he embarked for America, where the tenets of Methodism began to spread very fast under his friends the Wesleys; and first determined upon the institution of the orphan-house at Georgia, which he afterwards effected. After a long course of peregrination, his fortune increased as his fame extended among his followers, and he erected two very extensive buildings for public worship, under the name of *Tabernacles*; one in Tottenham-Court Road, and the other in Moorfields. Here, with the help of some assistants, he continued for several years, attended by very crowded congregations, and quitting the kingdom only occasionally. Besides the two tabernacles already mentioned, Mr Whitefield, by being chaplain to the countess dowager of Huntingdon, was connected with two other religious meetings, one at Bath, and the other at Tunbridge, chiefly erected under that lady's patronage. By a lively, fertile, and penetrating genius, by the most unwearied zeal, and by a forcible and persuasive delivery, he never failed of the desired effect upon his ever crowded and admiring audiences. America, however, which always engaged much of his attention, was destined to close his eyes; and he died at Newberry, about 40 miles from Boston in New England, in 1770.

Whitehaven.

WHITEHAVEN, a sea-port town of Cumberland, with a market on Thursday, and one fair on August 1st for merchandise and toys. It is seated on a creek of the sea, on the north end of a great heigh or hill, washed by the tide of flood on the west side, where there is a large rock or quarry of hard white stone, which gives name to the place, and which, with the help of a strong stone-wall, secures the harbour, into which small vessels may enter. It is lately much improved in its buildings, and is noted for its trade in pit-coal and salt, there being near it a prodigious coal-mine, which runs a considerable way under the sea. They have a custom-house here; and they carry on a good trade to Ireland, Scotland, Chester, Bristol, and other ports. It is 10 miles south-west of Cockermouth, and 279 north-west of London. W. Long. 3. 0. N. Lat. 54. 30.

(A) Bishop Berkeley was present at these conversations, and from his son we received the account which we have given of them. They are likewise mentioned, but not stated so accurately, by Bishop Newton in his own Life.

Whiteness || Whytt.

WHITENESS, the quality which denominates or constitutes a body white.

WHITES, or FLUOR *Albus*. See MEDICINE, n° 250.

WHITING, in ichthyology. See GADUS.

WHITLOW, or WHITLOE. See SURGERY.

WHITSUN-FARTHINGS, otherwise called *Smoke-farthings* or *Quadragesimae Pentecostales*, a composition for offerings which were anciently made in Whitsun-week by every man in England, who occupied a house with a chimney, to the cathedral church of the diocese in which he lived.

WHITSUNDAY, a solemn festival of the Christian church, observed on the fiftieth day after Easter, in memory of the descent of the Holy Ghost upon the apostles in the visible appearance of fiery cloven tongues, and of those miraculous powers which were then conferred upon them.

It is called *Whitsunday*, or *White-Sunday*; because this being one of the stated times for baptism in the ancient church, those who were baptised put on white garments, as types of that spiritual purity they received in baptism. As the descent of the Holy Ghost upon the apostles happened upon the day which the Jews called *Pentecost*, this festival retained the name of *Pentecost* among the Christians.

WHITSUNDAY Isle, one of the New Hebrides, which lies about four miles to the south, runs in the same direction, and is of the same length, having more sloping exposures than Aurora: it appears to be better inhabited, and to contain more plantations.

WHORTLEBERRY. See VACCINIUM.

WHYTT (Dr Robert), an eminent physician, born at Edinburgh on the 6th September 1714, was the son of Robert Whytt, Esq; of Bennochy, advocate. This gentleman died six months before the birth of our author, who had also the misfortune to be deprived of his mother before he had attained the seventh year of his age. After receiving the first rudiments of school-education, he was sent to the university of St Andrew's; and after the usual course of instruction there, in classical, philosophical, and mathematical learning, he came to Edinburgh, where he entered upon the study of medicine, under those eminent medical teachers, Monro, Rutherford, Sinclair, Plummer, Alston, and Innes. After learning what was to be acquired at this university, in the prosecution of his studies he visited foreign countries; and after attending the most eminent teachers at London, Paris, and Leyden, he had the degree of Doctor of Physic conferred upon him by the university of Rheims in 1736, being then in the 22d year of his age.

Upon his return to his native country, he had the same honour also conferred upon him by the university of St Andrew's; where he had before obtained, with applause, the degree of Master of Arts.

Not long afterwards in the year 1737, he was admitted a Licentiate of Medicine by the Royal College of Physicians of Edinburgh; and the year following he was raised to the rank of a Fellow of the College. From the time of his admission as a licentiate, he entered upon the practice of physic at Edinburgh; and the reputation which he acquired for medical learning, pointed him out as a fit successor for the first vacant chair in the university. Accordingly, when Dr Sinclair, whose eminent medical abilities, and persuasive powers of oratory, had contributed not a little to the rapid advancement of the medical school of Edinburgh, found that those conspicuous talents which he possessed could no longer be exerted in the manner which they once had been when he enjoyed bodily vigour unimpaired by age and powers of mind unclouded by disease, he resigned his academical appointments in favour of Dr Whytt.

This admission into the college took place on the 20th of June 1746; and he began his first course of the institutions of medicine at the commencement of the next winter-session. The abilities which he displayed from his academical chair, in no particular disappointed the expectations which had been formed of his lectures. The Latin tongue was the language of the university of Edinburgh; and he both spoke and wrote in Latin with singular propriety, elegance, and perspicuity. At that time the system and sentiments of Dr Boerhaave, which, notwithstanding their errors, must challenge the admiration of latest ages, were very generally received by the most intelligent physicians in Britain. Dr Whytt had no such idle ardour for novelties as to throw them entirely aside because he could not follow them in every particular. The institutions of Dr Boerhaave, therefore, furnished him with a text for his lectures; and he was no less successful in explaining, illustrating, and establishing the sentiments of the author, when he could freely adopt them, than in refuting them by clear, connected, and decisive arguments, when he had occasion to differ from him. The opinions which he himself proposed, were delivered and enforced with such acuteness of invention, such display of facts and force of argument, as could rarely fail to gain universal assent from his numerous auditors; but free from that self-sufficiency which is ever the offspring of ignorance and conceit, he delivered his conclusions with becoming modesty and diffidence.

From the time that he first entered upon an academical appointment, till the year 1756, his prelections were confined to the institutions of medicine alone. But at that period his learned colleague Dr Rutherford, who then filled the practical chair, who had already taught medicine at Edinburgh with universal applause for more than thirty years, and who had been the first to begin the institution of clinical lectures at the Royal Infirmary, found it necessary to retire from the fatiguing duties of an office to which the progress of age rendered him unequal. On this crisis Dr Whytt, Dr Monro, sen. and Dr Cullen, each agreed to take a share in an appointment in which their united exertions promised the highest advantages to the university. By this arrangement students, who had an opportunity of daily witnessing the practice of three such teachers, and of hearing the grounds of that practice explained, could not fail to derive the most solid advantages.

In these two departments, the institutions of medicine in the university, and the clinical lectures in the Royal Infirmary, Dr Whytt's academical labours were attended with the most beneficial consequences both to the students and to the university. But not long after the period we have last mentioned, his lectures on the former of these subjects underwent a very considerable change. About this time the illustrious Gaubius, who had succeeded to the chair of Boerhaave, favoured the world with his *Institutiones Pathologiæ*. This branch of medicine had indeed a place in the text which Dr Whytt formerly followed; but, without detracting from the character of Dr Boerhaave, it may justly be said, that the attention he had bestowed upon it was not equal to its importance. Dr Whytt was sensible of the improved state in which pathology now appeared in the writings of Boerhaave's successor; and he made no delay in availing himself of the advantages which were then afforded.

In the year 1762, his pathological lectures were entirely new-modelled. Following the publication of Gaubius as a text, he delivered a comment, which was read by every intelligent student with the most unfeigned satisfaction. In these lectures he collected and condensed the fruits of accurate observation and long experience. Enriched by all the

the opportunities of information which he had enjoyed, and by all the discernment which he was capable of exerting, they were justly considered as his most finished production.

For a period of more than twenty years, during which he was justly held in the highest esteem as a lecturer at Edinburgh, it may readily be supposed that the extent of his practice corresponded to his reputation. In fact, he received both the first emoluments, and the highest honours, which could here be obtained. With extensive practice in Edinburgh, he held numerous consultations from other places. His opinion on medical subjects was daily requested by his most eminent contemporaries in every part of Britain. Foreigners of the first distinction, and celebrated physicians, in the most remote parts of the British empire, courted an intercourse with him by letter. Besides private testimonies of esteem, many public marks of honour were conferred upon him both at home and abroad. In 1752, he was elected a fellow of the Royal Society of London; in 1761, he was appointed first physician to the king in Scotland; and in 1764, he was chosen president of the Royal College of Physicians at Edinburgh.

But the fame which Dr Whytt acquired as a practitioner and teacher of medicine, were not a little increased by the information which he communicated to the medical world in different publications. His celebrity as an author was still more extensive than his reputation as a practitioner.

His first publication, An Essay on the Vital and other Involuntary Motions of Animals, although it had been begun soon after he had finished his academical course of medical education, did not come from the press till 1751: a period of fifteen years from the time that he had finished his academical course, and obtained a degree in medicine: but the delay of this publication was fully compensated by the matter which it contained, and the improved form under which it appeared.

The next subject which employed the pen of Dr Whytt was one of a nature more immediately practical. His Essay on the Virtues of Lime-water and Soap in the Cure of the Stone, first made its appearance in a separate volume in 1752. Part of this second work had appeared several years before in the Edinburgh Medical Essays: but it was now presented to the world as a distinct publication with many improvements and additions.

His third work, intitled Physiological Essays, was first published in the year 1755. This treatise consisted of two parts; 1st, An Inquiry into the Causes which promote the Circulation of the Fluids in the very small Vessels of Animals; and 2dly, Observations on the Sensibility and Irritability of the Parts of Men and other Animals, occasioned by Dr Haller's treatise on that subject. The former of these may be considered as an extension and farther illustration of the sentiments which he had already delivered in his Essay on the Vital Motions, while the latter was on a subject of a controversial nature. In both he displayed that acuteness of genius and strength of judgment which appeared in his former writings.

From the time at which his Physiological Essays were published, several years were probably employed by our author in preparing for the press a larger and perhaps a more important work than any yet mentioned, his Observations on the Nature, Causes, and Cure of those Disorders which are commonly called *nervous*, *hypochondriac*, and *hysteric*. This elaborate and useful work was published in the year 1764.

The last of Dr Whytt's writings is intitled, Observations on the Dropsy in the Brain. This treatise did not appear till two years after his death; when all his other works were collected and published in one quarto volume, under the direction of his son and of his intimate friend the late Sir John Pringle.

Besides these five works, he wrote many other papers, which appeared in different periodical publications; particularly in the Philosophical Transactions, the Medical Essays, the Medical Observations, and the Physical and Literary Essays.

At an early period of life, soon after he had settled as a medical practitioner in Edinburgh, he entered into the married state. His first wife was Miss Robertson, sister to General Robertson governor of New York. By her he had two children; both of whom died in early infancy, and their mother did not long survive them. A few years after the death of his first wife, he married as a second wife Miss Balfour, sister to James Balfour, Esq; of Pilrig. By her he had fifteen children; but in these also he was in some respect unfortunate; for six of them only survived him, three sons and three daughters, and of the former two are since dead. Although the feeling heart of Dr Whytt, amidst the distresses of his family, must have often suffered that uneasiness and anxiety which in such circumstances is the unavoidable consequence of parental affection and conjugal love, yet he enjoyed a large share of matrimonial felicity. But his conjugal happiness was terminated by the death of his wife, which happened in the year 1764: and it is not improbable that this event had some share in hastening his own death; for in the beginning of the year 1765 his health was so far impaired, that he became unable for his former exertions. A tedious complication of chronical ailments, which chiefly appeared under the form of diabetes, was not to be removed by all the medical skill which Edinburgh could afford: and at length terminated in death, on the 15th of April 1766, in the 52d year of his age.

WIBURGH, a considerable town of Denmark, in North Jutland, with a bishop's see, remarkable for being the seat of the chief court of justice in the province. The hall where the council assemble has the archives of the country, and escaped the terrible fire that happened in the year 1726, and which burned the cathedral church, that of the Black Friars, the town-house, and the bishop's palace; but they have all been rebuilt more magnificent than before. It is seated on the lake Weter, in a peninsula, 25 miles north-west of Sleswick, and 110 north-by-west of Copenhagen. E. Long. 9. 50. N. Lat. 56. 20.

WICKER, signifies made of small twigs.

WICKET, a small door in the gate of a fortified place, &c. or a hole in a door through which to view what passes without.

WICKLIFF (John), the first divine in Europe who had resolution to attempt a reformation of religion, was born about the year 1324, in the parish of Wickliff, near Richmond, in Yorkshire. He was educated at Oxford, first in Queen's, and afterwards in Merton college, of which he was a probationer fellow. Having acquired the reputation of a man of great learning and abilities, in 1361 he was chosen master of Baliol-hall, and in 1365 constituted warden of Canterbury college, by the founder archbishop Simon de Islip; but was, in 1367, ejected by the regulars, together with three secular fellows. He thought their proceedings arbitrary, and therefore appealed to the pope; but instead of obtaining redress, in 1370 the ejectment was confirmed. This disappointment probably contributed somewhat towards his enmity to the see of Rome; at least it served to confirm that enmity; for he had long before written against the papal exactions and corruptions of religion. However, his credit in the university continued; for having taken the degree of doctor in divinity, he read public lectures

with

Wickliff, Wicklow.

with great applauſe; in which he frequently expoſed the impoſitions of the Mendicant friars. About this time he publiſhed a defence of his ſovereign Edward III. againſt the pope, who had infiſted on the homage to which his predeceſſor king John had agreed. This defence was the cauſe of Wickliff's introduction at court, and of his being ſent one of the ambaſſadors in 1374 to Bruges, where they met the pope's nuncios, in order to ſettle ſeveral eccleſiaſtical matters relative to the pope's authority. In the mean time Wickliff was preſented by the king to the rectory of Lutterworth in Leiceſterſhire, and in 1375 he obtained a prebend in the church of Weſtbury in Glouceſterſhire. Wickliff continued hitherto, without moleſtation, to oppoſe the papal authority; but in 1377 a bull was ſent over to the archbiſhop of Canterbury, and to Courtney biſhop of London, ordering them to ſecure this arch-heretic, and lay him in irons; at the ſame time the pope wrote to the king, requeſting him to favour the biſhops in the proſecution: he alſo ſent a bull to Oxford, commanding the univerſity to give him up. Before theſe bulls reached England Edward III. was dead, and Wickliff, protected by John duke of Lancaſter, uncle to Richard II. favoured by the queen-mother, and ſupported by the citizens of London, eluded the perſecution of pope Gregory IX. who died in 1378. In the following year this intrepid reformer preſented to parliament a ſevere paper againſt the tyranny of Rome, wrote againſt the papal ſupremacy and infallibility, and publiſhed a book *On the Truth of the Scriptures*, intended to prepare the way for an Engliſh tranſlation of them, in which he had made conſiderable progreſs. In 1381 he publiſh *Sixteen Concluſions*; in the firſt of which he ventured to expoſe the grand article of tranſubſtantiation. Theſe concluſions being condemned by the chancellor of Oxford, Wickliff appealed to the king and parliament; but being deſerted by his unſteady patron the duke of Lancaſter, he was obliged to make a confeſſion at Oxford; and by an order from the king was expelled the univerſity. He now retired to his living of Lutterworth, where he finiſhed his tranſlation of the bible. This verſion, of which there are ſeveral manuſcript copies in the libraries of the univerſities, Britiſh Muſeum, &c. is a very literal tranſlation from the Latin vulgate. In 1383 he was ſuddenly ſtruck with the palſy; a repetition of which put an end to his life in December 1384. He was buried in his own church, where his bones were ſuffered to reſt in peace till the year 1428, when, by an order from the pope, they were taken up and burnt. —Beſides a number of works that have been printed, he left a prodigious number of manuſcripts; an accurate liſt of which may be ſeen in biſhop Tanner's *Bib. Brit. Hil.* Some of them are in the Bodleian Library, others in the Britiſh Muſeum, &c.

Wickliff was doubtleſs a very extraordinary man, conſidering the times in which he lived. His natural ſagacity diſcovered the abſurdities and impoſitions of the church of Rome, and he had the honeſty and reſolution to promulgate his opinions, which a little more ſupport would probably have enabled him to eſtabliſh: they were evidently the foundation of the ſubſequent reformation.

WICKLOW, a county of Ireland, in the province of Leinſter; bounded on the north by the county of Dublin; on the eaſt by the Iriſh Sea; on the ſouth by Wexford; and on the weſt by Kildare and Catherlough. It is 33 miles in length, 20 in breadth, and indifferently fruitful. It contains 54 pariſhes, and ſends 10 members to parliament.

Wicklow, the capital of a county of the ſame name, in Ireland; ſeated on the ſea-ſide, with a narrow harbour, at the mouth of the river Leitrim, over which ſtands a rock, inſtead of a caſtle, ſurrounded by a ſtrong wall, 24 miles ſouth of Dublin. W. Long. 6. 7. N. Lat. 52. 55.

WIDGEON, in ornithology. See Anas.

WIDOW, a woman who has loſt her huſband.

WIFE, a married woman, or one joined with, and under the protection of, an huſband. See Husband.

Isle of WIGHT, an iſland lying on the ſouth coaſt of Hampſhire, from which it is ſeparated by a narrow channel. It is about 21 miles in length, and 13 in breadth. It is nearly divided into equal parts by the river Mede or Cowes, which riſing in the ſouthern angle, enters at the northern, into the channel, oppoſite the mouth of Southampton Bay. The ſouth coaſt is edged with very ſteep cliffs of chalk and freeſtone, hollowed into caverns in various parts. The weſt ſide is fenced with ridges of rocks, of which the moſt remarkable are thoſe called, from their ſharp extremities, the *Needles*. Between the iſland and the main are various ſandbanks, eſpecially off the eaſtern part, where is the ſafe road of St Helen's. Acroſs the iſland, from eaſt to weſt, runs a ridge of hills, forming a tract of fine downs, with a chalky or marly ſoil, which feed a great number of fine-fleeced ſheep. Rabbits are alſo very plentiful here. To the north of this ridge the land is chiefly paſture: to the ſouth of it is a rich arable country, producing great crops of corn. The variety of proſpects which this iſland affords, its mild air, and the neat manner in which the fields are laid out, render it a very delightful ſpot. It is devoted almoſt ſolely to huſbandry, and has no manufactory. It is one of the principal reſources of the London market for unmalted barley. Among its products are to be reckoned a pure white pipe-clay, and a fine white cryſtalline ſand; of the latter of which great quantities are exported for the uſe of the glaſs-works in various parts. Its principal town is the borough of Newport: it likewiſe contains the two ſmall boroughs of Newton and Yarmouth.

WILD-fire. See *Wild-Fire*.

WILDERNESS, in gardening, a kind of grove of large trees, in a ſpacious garden, in which the walks are commonly made, either to interſect each other in angles, or have the appearance of meanders and labyrinths.

Wilderneſſes (ſays Mr Miller) ſhould always be proportioned to the extent of the gardens in which they are made; for it is very ridiculous to ſee a large wilderneſs planted with tall trees in a ſmall ſpot of ground; and, on the other hand, nothing can be more abſurd than to ſee little paltry ſquares, or quarters of wilderneſs-work, in a magnificent large garden. As to the ſituation of wilderneſſes, they ſhould never be placed too near the habitation, nor ſo as to obſtruct any diſtant proſpect of the country, there being nothing ſo agreeable as an unconfined proſpect: but where, from the ſituation of the place, the ſight is confined within the limits of the garden, nothing can ſo agreeably terminate the proſpect as a beautiful ſcene of the various kinds of trees judiciouſly planted; and if it is ſo contrived that the termination is planted circularly, with the concave towards the ſight, it will have a much better effect than if it end in ſtraight lines or angles. The plants ſhould always be adapted to the ſize of the plantation; for it is very abſurd for tall trees to be planted in the ſmall ſquares of a little garden; and in large deſigns ſmall ſhrubs will have a mean appearance. It ſhould alſo be obſerved never to plant evergreens amongſt deciduous trees; but always to place the evergreens in a wilderneſs in a ſeparate part by themſelves, and that chiefly in ſight.

As to the walks, thoſe that have the appearance of meanders, where the eye cannot diſcover more than twenty or thirty yards in length, are generally preferable to all others,

others, and these should now and then lead into an open circular piece of grass; in the centre of which may be placed either an obelisk, statue, or fountain; and if in the middle of the wilderness there be contrived a large opening, in the centre of which may be erected a dome or banqueting house, surrounded with a green plot of grass, it will be a considerable addition to the beauty of the whole. From the sides of the walks and openings, the trees should rise gradually one above another to the middle of the quarters; where should always be planted the largest growing trees so that the heads of all the trees may appear to view, while their stems will be hid from the sight. Thus, in those parts which are planted with deciduous trees, roses, honeysuckles, spiræa frutex, and other kinds of low flowering shrubs may be planted next the walks and openings; and at their feet, near the sides of the walks, may be planted primroses, violets, daffodils, &c. not in a straight line, but so as to appear accidental, as in a natural wood. Behind the first row of shrubs should be planted syringas, althæa frutex, mezereons, and other flowering shrubs of a middle growth; and these may be backed with many other sorts of trees rising gradually to the middle of the quarters.

The part planted with evergreens may be disposed in the following manner, viz. in the first line next the great walks may be placed the laurustinus, boxes, spurge laurel, juniper, savin, and other dwarf evergreens. Behind these may be placed laurels, hollies, arbutuses, and other evergreens of a larger growth. Next to these may be planted alaternuses, phyllireas, yews, cypresses, Virginian cedars, and other trees of the same growth; behind these may be planted Norway and silver firs, the true pine, and other sorts of the fir growth; and in the middle should be planted Scotch pines, pinaster, and other sorts of the larger growing evergreens; which will afford a most delightful prospect if the different shades of the greens are curiously intermixed.

But beside the grand walks and openings (which should always be laid with turf, and kept well mowed), there should be some smaller serpentine walks through the middle of the quarters, where persons may retire for privacy; and by the sides of these private walks may also be scattered some wood-flowers and plants; which, if artfully planted, will have a very good effect.

In the general design for these wildernesses, there should not be a studied and stiff correspondency between the several parts; for the greater diversity there is in the distribution of these, the more pleasure they will afford.

WILKINS (Dr John), a most ingenious and learned English bishop, was the son of a goldsmith of Oxford, and was born in 1614. He adhered to the parliament during the civil wars, by whom he was made warden of Wadham college in 1648: he married afterwards the sister of Oliver Cromwell, and procured a dispensation to retain his wardenship notwithstanding. Richard Cromwell made him master of Trinity college, Cambridge, from which he was ejected on the Restoration. He then became preacher to Gray's-Inn, rector of St Lawrence Jewry, London, dean of Rippon, and in 1668 was promoted to the bishopric of Chester: he died in 1672. Bishop Wilkins thought it prudent to submit to the powers in being, he therefore subscribed to the solemn league and covenant while it was enforced, and was equally ready to swear allegiance to king Charles when he was restored: this, with his moderate spirit toward dissenters, rendered him not very agreeable to churchmen. His mathematical and philosophical works, which contain many ingenious and curious pieces, considering the time when they were written, have been collected in one vol. 8vo. He published also some theological tracts. He was the first president of the Royal Society.

WILL, that faculty of the mind by which it embraces or rejects any thing offered to it. See METAPHYSICS.

WILL, or *Last Will*, in law, signifies the declaration of a man's mind and intent relating to the disposition of his lands, goods, or other estate, or of what he would have done after his death. In the common law there is a distinction made between a will and a testament: that is called a will where lands or tenements are given; and when the disposition concerns goods and chattels alone, it is termed a *testament*. See TESTAMENT.

Will-with-a-wisp, or *Jack-with-a-lanthorn*, two popular names for the meteor called *ignis fatuus*. See LIGHT, n° ...

WILLIAM *of* MALMSBURY, an historian of considerable merit in the reign of king Stephen; but of whose life few particulars are known. According to Bale and Pits, he was surnamed *Somerset*, from the county in which he was born. From his own preface to his second book *De Gestis Anglorum*, it appears that he was addicted to learning from his youth; that he applied himself to the study of logic, physic, ethics, and particularly to history. He retired to the Benedictine convent at Malmsbury, became a monk, and was made precentor and librarian; a situation which much favoured his intention of writing the history of this kingdom. In this monastery he spent the remainder of his life, and died in the year 1142. He is one of our most ancient and most faithful historians. His capital work is that intitled *De Regibus Anglorum*, in five books; with an Appendix, which he styles *Historia Novella*, in two more. It is a judicious collection of whatever he found on record relative to England, from the invasion of the Saxons to his own times.

William of Newbury, so called from a monastery in Yorkshire, of which he was a member, wrote a history which begins at the conquest and ends at the year 1197. His Latin style is preferred to that of Matthew Paris; and he is intitled to particular praise, for his honest regard to truth, in treating the fables of Jeffery of Monmouth with the contempt they deserve; as well as for expressing his approbation of Henry II.'s design of reforming the clergy, by bringing them under the regulation of the secular power.

William of Wykeham, bishop of Winchester, was born at the village of Wykeham in the county of Southampton, in 1324. He had his education at Winchester and Oxford. Having continued near six years at the university, his patron Nicholas Wedal, governor of the province of Southampton, took him into his family, and appointed him his counsellor and secretary. He could not have made choice of a fitter person for that employment, no man in that age writing or speaking more politely than Wykeham. For this reason Edington, bishop of Winchester, lord high-treasurer of the kingdom, appointed him his secretary three years after, and also recommended him to king Edward III. who took him into his service. Being skilled in geometry and architecture, he was appointed surveyor of the royal buildings, and also chief justice in eyre: he it was who superintended the building of Windsor-castle. He was afterward chief secretary of state, a keeper of the privy-seal; and in 1367 succeeded Edington in the see of Winchester. A little after he was appointed lord high-chancellor and president of the privy-council. That he might well discharge the several functions of his employments, both ecclesiastical and civil, he endeavoured, on one hand, to regulate his own life according to the strictest maxims, and to promote such parish-priests only as were able to give due instructions to their parishioners, and at the same time led exemplary lives; on the other hand, he did all in his power to cause justice to be exactly administered. In 1371 he resigned his chancellorship,

Lufiíp, and fome time after the great feal. Edward being returned to England, after having carried on a very fuccefsful war in France, found his exchequer in great diforder. The duke of Lancafter, one of his fons, at the head of feveral lords, having brought complaints againft the clergy, who then enjoyed moft pofts in the kingdom, the king removed them from their employments. But the laymen, who were raifed to them, behaved fo ill, that the king was forced to reftore the ecclefiaftics. The duke of Lancafter fhowed ftrong animofity to the clergy, and fet every engine at work to ruin Wykeham. He impeached him of extortion, and of difguifing things, and obliged him to appear at the King's-bench. He got fuch judges appointed as condemned him; and not fatisfied with depriving him of all the temporalities of his bifhopric, he advifed Edward to banifh him: but this prince rejected the propofal, and afterward reftored to Wykeham all that he had been divefted of. Richard II. was but eleven years old when Edward died: whereby the duke of Lancafter had an eafy opportunity of reviving the accufations againft the bifhop of Winchefter: neverthelefs Wykeham cleared himfelf. Then he founded two noble colleges, the one in Oxford, the other in Winchefter. Whilft he was exerting his utmoft endeavours to improve thefe two fine foundations, he was recalled to court, and in a manner forced to accept of the office of lord high-chancellor in 1389.—Having excellently difcharged the duties of that employment for three years, he obtained leave to refign it, forefeeing the difturbances that were going to break out. Being returned to his church, he finifhed his college, and built there fo magnificent a cathedral, that it almoft equals that of St Paul's in London. He laid out feveral fums in things advantageous to the public and to the poor; notwithftanding which, in 1397 he was in great danger; for he and fome others were impeached of high-treafon in open parliament: however, he was again fully cleared. From that time till his death he kept quiet in his diocefe, and there employed himfelf in all the duties of a good prelate. He died in 1404, in the 81ft year of his age.

WILLIAM, the name of feveral kings of England. See ENGLAND, n° 87—92, and BRITAIN, n° 302.

Fort-WILLIAM, a fortrefs in the Highlands of Scotland, erected in king William's reign, as was alfo a fmall town adjoining, called *Maryburgh*, in honour of his queen. It is fituated in Invernefsfhire, on a narrow arm of the fea called *Loch Eil*, which might eafily, by a very fhort canal, be united to the Weftern fea. Fort-William is of a triangular form, having two baftions, and is capable of admitting a garrifon of 800 men; but could not be defended againft an attack, as it is commanded by feveral hills in the neighbourhood.

WILLIAM's Fort, is a factory of Afia belonging to the Eaft-India company, feated on one of the branches of the river Ganges, in the kingdom of Bengal. The fort was firft built in the fhape of an irregular tetragon of brick and mortar; and the town has nothing regular in it, becaufe every one built a houfe as he liked beft, and for his own conveniency. The governor's houfe is within the fort, and is the beft piece of architecture in thefe parts. Here there are alfo convenient lodgings for the factors and writers, with ftore-houfes for the company's goods, and magazines for ammunition. About 5 yards from the fort is the church, built by the charity of merchants refiding here. The town is called *Calcutta*, and has a pretty good hofpital for the fick, though few come out of it alive. It is governed by a mayor and aldermen, as moft of the company's factories in the Eaft Indies now are. In 1757 it was furprifed by the nabob of Bengal, who took it, and put moft of thofe that had made refiftance into a place called the *Black Hole*, where moft of them were fmothered. This nabob was afterwards killed, and another fet up in his room, more friendly to the Englifh; and the factory was re-eftablifhed. E. Long. 86. 0. N. Lat. 22. 27.

Sweet-WILLIAM. See DIANTHUS.

WILLIAMSBURG, a town of North America, in Virginia, and formerly capital of that ftate. It is fituated between two creeks; one falling into James, and the other into York River. The diftance of each landing place is about a mile from the town, which, with the difadvantage of not being able to bring up large veffels, and the want of enterprife in the inhabitants, has occafioned its decay. Here is a college, defigned for the education of the Indians, but which, on account of their averfion to learning, never anfwered the purpofe. It is 60 miles eaft of Richmond. W. Long. 76. 30. N. Lat. 37. 10.

WILLIAMSTADT, a fea-port town of Holland. It is a handfome ftrong place, and the harbour is well frequented. It was built by William prince of Orange in 1585; and in 1732 belonged to the ftadtholder of Friefland. The river near which it is built is called *Butterfliet* or *Holland Diep*; and is one of the bulwarks of the Dutch on the fide of Brabant, where they always keep a garrifon. This place made a gallant defence in 1793 againft the French, who were obliged to raife the fiege. It is 15 miles north-eaft of Bergen-op-Zoom, and 12 fouth-weft of Dort. E. Long. 4. 30. N. Lat. 51. 39.

WILLIS (Dr Thomas), a celebrated Englifh phyfician, was born at Great Bodwin, in Wiltfhire, in 1621, and ftudied at Chrift-church college, Oxford. When that city was garrifoned for the king, he, among other fcholars, bore arms for his Majefty, and devoted his leifure hours to the ftudy of phyfic. The garrifon of Oxford at length furrendering to the parliament, he applied himfelf to the practice of his profeffion; and foon rendered himfelf famous by his care and fkill. He appropriated a room as an oratory for divine fervice according to the church of England, whither moft of the loyalifts in Oxford daily reforted. In 1660, he became Sedleian profeffor of natural philofophy, and the fame year took the degree of doctor of phyfic. In 1664, he difcovered the famous medicinal fpring at Alftropp, near Brackley. He was one of the firft members of the Royal Society, and foon made his name illuftrious by his excellent writings. In 1666, after the fire of London, he removed to Weftminfter; and his practice became greater than that of any of the phyficians his contemporaries. Soon after his fettlement in London, his only fon Thomas falling into a confumption, he fent him to Montpelier in France for the recovery of his health; and it proved fuccefsful. His wife alfo labouring under the fame diforder, he offered to leave the town; but fhe, not fuffering him to neglect the means of providing for his family, died in 1670. He died at his houfe in St Martin's in 1675, and was buried near her in Weftminfter-abbey. Dr Willis was extremely modeft and unambitious, and refufed the honour of knighthood. He was remarkably pious: As he rofe early in the morning, that he might be prefent at divine fervice, which he conftantly frequented before he vifited his patients, he procured prayers to be read beyond the accuftomed times while he lived; and at his death fettled a ftipend of 20l. *per annum* to continue them. He was a liberal benefactor to the poor wherever he came, having from his early practice allotted part of his profits to charitable ufes. He was exact and regular in all his hours: and though his table was the refort of moft of the great men of London, yet he was remarkable

ry, able for his plainness, and his being a man of little discourse, complaisance, or society; but he was justly admired for his deep insight into natural and experimental philosophy, anatomy, and chemistry; for his successful practice; and for the elegance and purity of his Latin style. He wrote, 1. A treatise in English, intitled *A plain and easy Method for preserving those that are well from the Infection of the Plague, and for curing such as are infected.* 2. Several Latin works, which were collected and printed at Amsterdam, in 1682, in 2 vols 4to.

WILLUGHBY (Francis), a celebrated natural historian, was the only son of Sir Francis Willughby, knight. He was fond of study from his childhood, and held idleness in abhorrence; he being so great an economist with regard to his time, as not willingly to lose or misapply the least part of it, by which means he attained great skill in all branches of learning, and particularly in the mathematics. But observing that the history of animals was in a great measure neglected by his countrymen, he particularly applied himself to that province; and for this purpose carefully read over what had been written on that subject by others. He then travelled several times over his native country; and afterwards into France, Spain, Italy, Germany, and the Low Countries, attended by his ingenious friend Mr John Ray. It is remarkable, that, notwithstanding the advantages of birth, fortune, and parts, he was as humble as any man of the meanest fortune; was sober, temperate, and chaste; scrupulously just; so true to his word and promise, that a man might venture his estate and life upon it; so faithful and constant to his friend, as never to desert him when fortune frowned upon him; and remarkably pious, patient, and submissive to the divine will. This is the character given of him by Mr Ray, whose veracity none will doubt. This ingenious and learned gentleman died in 1672, at 37 years of age; having impaired his health by his application. He wrote, 1 *Ornithologiæ libri tres*, folio, which was afterwards translated into English, with an Appendix by Mr Ray, in folio. 2. *Historiæ Piscium libri quatuor*, folio. 3. Letters of Francis Willughby, Esq; added to Philosophical Letters between the learned Mr Ray and several of his correspondents, published, in 8vo, by William Derham. 4. Several ingenious papers in the Philosophical Transactions.

WILMOT (John), earl of Rochester, a great wit in the reign of Charles II. the son of Henry earl of Rochester, was born in 1648. He was taught grammar and classical learning at the free-school at Burford; where he obtained a quick relish of the beauties of the Latin tongue, and afterwards became well versed in the authors of the Augustine age. In 1659, he was admitted a nobleman of Wadham college, where he obtained the degree of master of arts. He afterwards travelled through France and Italy; and at his return was made one of the gentlemen of the bed-chamber to the king, and comptroller of Woodstock Park. In 1665, he went to sea, and was in the Revenge, commanded by Sir Thomas Tiddiman, when an attack was made on the port of Bergen in Norway; during the whole action he showed the greatest resolution, and gained a high reputation for courage; which he supported in a second expedition, but afterwards lost it in a private adventure with Lord Mulgrave.

Before the earl of Rochester travelled, he had given into the most disorderly and intemperate way of living; at his return, however, he seemed to have got the better of it entirely. But falling into the company of the courtiers, who continually practised these excesses, he became so sunk in debauchery, that he was for five years together so given up to drinking, that during all that time he was never cool enough to be master of himself. His violent love of pleasure, and his disposition to extravagant mirth, carried him to great excesses. The first involved him in sensuality, and the other led him into many adventures and ridiculous frolics. Once disguising himself so that he could not be known by his nearest friends, he set up in Tower-street for an Italian mountebank, and there practised his nostrums for some weeks. He often disguised himself as a porter, or as a beggar, sometimes to follow a mean amour; at other times, he would go about merely for diversion, in odd shapes; and acted his part so naturally, that he could not be known even by his friends. In short, by his constant indulgence in wine, women, and irregular frolics, he entirely wore out an excellent constitution before he was 30 years of age. In October 1679, when recovering from a violent disease, which ended in a consumption, he was visited by Dr Burnet, upon an intimation that such a visit would be agreeable to him. Dr Burnet published an account of his conferences with Lord Rochester; in which it appears, that though he had lived the life of a libertine and atheist, yet he died the death of a penitent Christian. His death happened in 1680; since which time his poems have been various times printed, both separately and together: but when once he obtained the character of a lewd and obscene writer, every thing in that strain was fathered upon him; and thus many pieces not of his writing have crept into the later editions of his works. The author of the Catalogue of Royal and Noble Authors says, he was "a man whom the Muses were fond to inspire, and ashamed to avow, and who practised without the least reserve that secret which can make verses more read for their defects than their merits. Lord Rochester's Poems have much more obscenity than wit, more wit than poetry, and more poetry than politeness." His writings, besides those already mentioned, are, A Satire against Mankind; Nothing, a poem; Valentinian, a tragedy; Fifty-four Letters to Henry Saville, and others; Seven more to his Wife and Son: a Letter on his deathbed to Dr Burnet. He also left behind him several other papers, and a History of the Intrigues of the Court of Charles II. but his mother, a very devout lady, ordered all his papers to be burned.

WILSON (Florence), known in the republic of letters by the name of *Florentius Volusinus*, was born at Elgin in the shire of Murray in Scotland, and educated in the university of Aberdeen. Travelling to England with an intention to improve his fortune, he had the felicity to be introduced to cardinal Wolsey, who appointed him tutor to one of his nephews. In that capacity he went to Paris, and continued there till the cardinal's death. During his residence in that city he became acquainted with the learned cardinal Bellai, archbishop of Paris, who allowed him a pension, and meant to have appointed him royal professor of the Greek and Latin languages in the university of Paris: but Bellai being disgraced, Wilson's prospects faded with the fortunes of his patron, whom nevertheless he attended on his journey to Rome. Wilson was taken ill at Avignon, and the cardinal proceeded without him. After his recovery, he paid a visit to the celebrated cardinal Sabolet, the Mecænas of his time, who was also bishop of Carpentras, where he then resided. The cardinal was so charmed with his erudition, that he appointed him professor of the learned languages, with a stipend of 100 pistoles *per annum*.

During his residence at Carpentras, he wrote his celebrated treatise *De Animi Tranquillitate*. Mackenzie says that he afterwards taught philosophy in Italy; and that, being at length desirous of returning to Scotland, he began his journey homeward, was taken ill at Vienne in Dauphiné, and died there in the year 1547. He was generally esteemed an accomplished linguist, an admirable philosopher, and an excellent Latin poet. He wrote, beside the above treatise, 1. *Poemata*. Lond. 1619, 4to. 2. *Commentatio quædam*

Wilson. *dam theologica in aphorismos dissecta, per Sebast. Gryph.* 3. *Philosophiæ Aristot. Synopsis*, lib. iv.

Wilson (Thomas), lord bishop of Sodor and Man, was born in 1663, at Burton, in the county of Chester. He received the rudiments of his education at the county town, and from thence was removed to the university of Dublin. His allowance at the university was 20 l. a-year; a sum, small as it may now appear, which was in those days sufficient for a sober youth in so cheap a country as Ireland.

His first intention was to have applied to the study of physic; but from this he was diverted by archdeacon Hewetson, by whose advice he dedicated himself to the church. He continued at college till the year 1686, when, on the 29th of June, he was ordained deacon.

The exact time of Mr Wilson's leaving Dublin is not known: but on account of the political and religious disputes of those days, it was sooner than he intended. On the 10th of December, in the same year, he was licensed to the curacy of New Church in Winwick, of which Dr Sherlock, his maternal uncle, was rector. His stipend was no more than 30 l. a-year; but being an excellent economist, and having the advantage of living with his uncle, this small income was not only sufficient to supply his own wants, but it enabled him to supply the wants of others; and for this purpose he set apart one-tenth of his income. In 1692 he was appointed domestic chaplain to William earl of Derby, and tutor to his son James Lord Strange, with a salary of 30 l. a-year. He was soon after elected master of the alms house at Latham, which brought him in 20 l. a-year more. Having now an income far beyond his expectations, or his wishes, except as it increased his ability to do good, he set apart one fifth of his income for pious uses, and particularly for the poor. In short, as his income increased, he increased the portion of it which was allotted to the purposes of charity. At first he set apart a tenth, then a fifth, afterwards a third, and lastly, when he became a bishop, he dedicated the full half of his revenues to pious and charitable uses.

He had not been long in the service of Lord Derby, before he was offered the valuable living of Baddelworth in Yorkshire; which he refused to accept, as being inconsistent with the resolves of his conscience against non-residence, Lord Derby choosing still to retain him as chaplain and tutor to his son. In 1697 he was promoted, not without some degree of compulsion on the part of his patron, to the bishopric of the Isle of Man; a preferment which he held 58 years. In 1698 he married Mary, daughter of Thomas Patten, Esq; of Warrington. By this lady, who survived her marriage about six years, he had four children; none of whom survived him except the late Dr Wilson, prebendary of Westminster.

"The annual receipts of the bishopric (says the author of his memoirs) did not exceed 300 l. in money. Some necessaries in his house, as spices, sugar, wine, books, &c. must be paid for with money; distressed or shipwrecked mariners, and some other poor objects, required to be relieved with money; but the poor of the island were fed and clothed, and the house in general supplied from his demesnes, by exchange, without money. The poor, who could weave or spin, found the best market at Bishop's-court, where they bartered the produce of their labour for corn. Taylors and shoemakers were kept in the house constantly employed, to make into garments or shoes that cloth or leather which his corn had purchased; and the aged and infirm were supplied according to their several wants. Mr Moore of Douglas informed the editor, that he was once witness to a pleasing and singular instance of the Bishop's attention to some aged poor of the island. As he was distributing spectacles to some whose eye-sight failed them, Mr Moore expressed his surprise, as he well knew not one of them could read a letter. 'No matter (said the Bishop with a smile), they will find use enough for them; these spectacles will help them to thread a needle, to mend their clothes, or, if need be, to keep themselves free from vermin."

So great was the bishop's attachment to his flock, that no temptation could seduce him from their service. He more than once refused the offer of an English bishopric. There is an anecdote of his lordship and cardinal Fleury, which does great credit to them both. The cardinal wanted much to see him, and sent over on purpose to inquire after his health, his age, and the date of his consecration, as they were the two oldest bishops, and he believed the poorest, in Europe; at the same time inviting him to France. The bishop sent the cardinal an answer, which gave him so high an opinion of him, that the cardinal obtained an order that no French privateer should ravage the Isle of Man.

This good prelate lived till the year 1755, dying at the advanced age of 93. His works have lately been published in 2 vols 4to.

Wilton. WILTON, a market town in Wiltshire, three miles west of Salisbury. It was once so considerable as to give title to the county. It formerly had 12 churches; and Odo, brother-in-law to William I. was bishop of Wilton: only one now remains. It sends members to parliament, and is the place where the knights of the shire are chosen. It has a great manufactory of carpets, which are brought to high perfection. Wilton is famous for lord Pembroke's seat, so well known through Europe for its containing a grand assemblage of the productions of the greatest and most ancient masters in painting and sculpture.—Two fairs are held here annually.

WILTSHIRE, a county of England, bounded on the west by Somersetshire, on the east by Berkshire and Hampshire, on the north by Gloucestershire, and on the south by Dorsetshire and part of Hampshire. The length amounts to 39 miles; its breadth to 30; and its circumference to 140. It contains 29 hundreds, 23 market-towns, 304 parishes, and about 876,000 souls. Besides two members for the shire, and two for the city of Salisbury, each of the following towns sends two members to parliament, *viz.* Wilton, Downton, Hindon, Heytesbury, Westbury, Calne, Devizes, Chippanham, Malmsbury, Cricklade, Great Bedwin, Ludgershall, Old Sarum, Wooton-Basset, Marlborough.

The air of this county is very healthy, not only in the more low and level parts, but also on the hills. The soil of the vales is very rich, and produces corn and grass in great plenty. The beautiful downs in the south yield the finest pasture for sheep, with which they are overspread. The greatest disadvantage the county labours under is want of fuel, as there are no coal-pits, and but little wood. This county is noted for great quantities of very fine cheese, and for its manufacture of broad cloth, to which it was invited by the great plenty and fineness of its wool. Besides a number of lesser streams, it is watered by the rivers Isis, Kennet, Upper and Lower Avon, Willy, Burne, and Nadder, which are well stored with fish.

WINCHELSEA, a town in Sussex, which has no market, but has one fair on May 14th for cattle and pedlars ware. It was an ancient place, at least the old town, which was swallowed up by the ocean in 1250. It is now dwindled to a mean place, though it retains its privileges, and sends two members to parliament. It is seated on a rocky cliff, on an inlet of the sea; and had a haven, now choked up. It had 18 parish-churches, now reduced to one. The market-house is in the midst of the town, from whence

whence run four paved ſtreets, at the end of which are four ways, which had formerly buildings on each ſide for a conſiderable diſtance. It is 2 miles ſouth-weſt of Rye, and 71 ſouth-eaſt of London. It is governed by a mayor and jurats, though it has but about 70 houſes. Three of the gates are ſtill ſtanding, but much decayed. E. Long. 0. 44. N. Lat. 50. 58.

WINCHELSEA (Anne counteſs of), a lady of excellent genius, eſpecially in poetry, was maid of honour to the ducheſs of York, ſecond wife to king James II. and was afterwards married to Heneage, ſecond ſon of the earl of Winchelſea. One of the moſt conſiderable of the counteſs of Winchelſea's poems was that on the Spleen. A collection of her poems was printed at London in 1713, containing a tragedy never acted, intitled *Ariſtomenes*. The counteſs died in 1720 without iſſue, as her huſband did in 1726.

WINCHESTER, the capital of the county of Hampſhire in England. It is a very ancient city, ſuppoſed to have been built ſeveral centuries before Chriſt. The Romans called it *Venta Belgarum*, the Britons *Caer Gwent*, and the Saxons *Wintan-ceaſter*; whence came the preſent name. It ſtands upon the river Itchin, in a bottom ſurrounded with chalky hills; and is generally allowed to have been a conſiderable place in the time of the Romans. Some of the firſt converts to Chriſtianity are ſuppoſed to have lived here. In the caſtle, near the weſt-gate, many of the Saxon kings anciently kept their court. The cathedral was founded by Kenegulſe, a king of the Mercians; but there were many Chriſtians, and places for their worſhip here, long before that period. It is a large pile, and has a venerable look, but is not very elegant. Beſides the tombs, there are many curious pieces of workmanſhip in it; the chief of which are, 1. The font, erected in the time of the Saxons. 2. Copper ſtatues of James I. and Charles I. 3. The biſhop's throne. 4. The ſtalls of the dean and prebendaries. 5. The aſcent to the choir and altar. 6. The pavement, inlaid with marble of diverſe colours, in various figures. 7. The altar-piece, reckoned the nobleſt in England. 8. The paintings in the windows, eſpecially the great eaſt window. At the hoſpital of the Holy Croſs, every traveller that knocks at the door may claim a manchet of white bread and a cup of beer; of which a great quantity is provided every day for that purpoſe. This hoſpital was intended for the maintenance of a maſter and 30 penſioners, but only 14 are now maintained in it; and the maſter enjoys a revenue of 800l. a-year. This city is about a mile and a half in compaſs, and almoſt ſurrounded with a wall of flint, has ſix gates, large ſuburbs, broad clean ſtreets; but the private houſes are in general but ordinary, many of them being very old. The city is interſperſed with a great many gardens, which contribute to its beauty and healthineſs. The corporation conſiſts of a mayor, high-ſteward, recorder, aldermen, two coroners, two bailiffs, 24 common-council-men, a town-clerk, four conſtables, and four ſerjeants at mace; and the city gives title of *marquis* to the duke of Bolton. A Roman highway leads from hence to Alton; and went formerly, as it is thought, from thence to London. The charming downs in the neighbourhood contribute greatly to the health and pleaſure of the inhabitants. The river Itchin is navigable for barges from hence to Southampton. W. Long. 1. 21. N. Lat. 51. 5.

WINCKLEMAN (Abbé John), was born at Stendall, in the old Marche of Brandenburgh, in 1718. His father was a ſhoemaker. This wonderful man, to all appearance deſtined by his birth to ſuperintend a little ſchool in an obſcure town of Germany, raiſed himſelf to the office of preſident of antiquities in the Vatican. After having been ſeven years profeſſor in the college of Seehauſen near Salſwedel, he went into Saxony, where he reſided ſeven years more, and was librarian to count Bunau at Nothenitz. When he left this place, 1754, he went to Dreſden, where he formed an acquaintance with the ableſt artiſts, and particularly with M. Oeſer, an excellent painter, and one of the beſt draughtſmen of the age. In that year he abjured Lutheraniſm, and embraced the Roman Catholic religion. In September 1755, he ſet out for Italy, and arrived at Rome in December following. His principal object was to ſee the Vatican library, and to examine the ruins of Herculaneum. Winckleman.

Mr Winckleman carried with him into Italy a ſenſe of beauty and art, which led him inſtantly to admire the maſter-pieces of the Vatican, and with which he began to ſtudy them. He ſoon increaſed his knowledge; and it was not till after he had thus purified his taſte and conceived an idea of ideal beauty, which led him into the greateſt ſecrets of art, that he began to think of the explanation of other monuments, in which his great learning could not fail to diſtinguiſh him. His erudition enabled him to fill up his principal plan of writing the "Hiſtory of Art." In 1756 he planned his "Reſtoration of Ancient Statues," and a larger work on the "Taſte of the Greek Artiſts;" and deſigned an account of the galleries of Rome and Italy, beginning with a volume on the Belvedere ſtatues, in the manner of Richardſon, who, he ſays, only ran over Rome. He alſo intended a hiſtory of the corruption of taſte in art, the reſtoration of ſtatues, and an illuſtration of the obſcure points of mythology. All theſe different eſſays led him to his "Hiſtory of Art," and his "Monumenti Inediti." It muſt, however, be confeſſed, that the firſt of theſe works has not all the clearneſs and preciſion that might be expected in its general plan and diviſion of its parts and objects; but it has enlarged and extended the ideas both of antiquaries and collectors. The deſcription of the gems and ſulphurs of the Stoſch cabinet contributed not a little to extend Mr Winckleman's knowledge. Few perſons have opportunities of contemplating ſuch vaſt collections. The engravings of Lippet and count Caylus are all that many can arrive at. Mr Winckleman's Monumenti Inediti, of which he had begun the third vol. 1767, ſeem to have ſecured him the eſteem of antiquaries. Had he lived, we ſhould have had a work long wiſhed for; a complete collection of the bas-reliefs diſcovered from the time of Bartoli to the preſent, the greater part of which are in the poſſeſſion of cardinal Albani.

When cardinal Albani ſucceeded to the place of librarian of the Vatican, he endeavoured to get a place for the Hebrew language for Winckleman, who refuſed a canonry, becauſe he would not take the tonſure. The elector of Saxony gave him, 1761, unſolicited, the place of counſellor Richter, the direction of the royal cabinet of medals and antiquities at Dreſden. Upon the death of the Abbé Venuti, 1762, he was appointed preſident of the antiquities of the apoſtolic chamber, with power over all diſcoveries and exportations of antiquities and pictures. This is a poſt of honour, with an income of 160 ſcudi *per annum*. He had a proſpect of the place of preſident of antiquities in the Vatican, going to be created at 16 ſcudi *per* month, and was named correſponding member of the Academy of Inſcriptions. The king of Pruſſia offered him by Col. Quintus Icilius the place of librarian and director of his cabinet of medals and antiquities, void by the death of M. Gautier de la Croze, with a handſome appointment. He made no ſcruple of accepting the offer; but when it came to the pope's ears, he added an appointment out of his own purſe, and kept him at Rome.

In April 1768, he left Rome, to go with M. Cavaceppi over Germany and Switzerland. When he came to Vienna, he

Winckleman, Wind.

he was so pleased with the reception he met with, that he made a longer stay there than he had intended. But, being suddenly seized with a secret uneasiness and extraordinary desire to return to Rome, he set out for Italy, putting off his visits to his friends in Germany to a future opportunity. As he passed through Trieste, he was assassinated, June 8. 1768, by a wretch named Arcangeli, a native of Campiglio, a town in the territory of Pistoia, with whom he had made an acquaintance on the road. This miscreant had been condemned for a robbery to work in fetters four years, and then to be banished the Austrian territories, on an oath never to return. He had obtained a mitigation of one of his sentences, and retired to Venice; but, changing his quarters backwards and forwards, he was so reduced in circumstances that he at length took up his lodgings at the inn to which the Abbé happened to come. Arcangeli paid such assiduous court to him, that he entirely gained his confidence; and having been favoured with a sight of the valuable presents which he had received at Vienna, formed a design to murder and rob him. He bought a new sharp knife on purpose; and as the Abbé (who had in the most friendly manner invited him to Rome) was sitting down in his chair, early in the morning, he threw a rope over his head, and before he could disengage himself, stabbed him in five different places. The Abbé had still strength to get down to the ground-floor, and call for help; and being laid on a bed in the midst of the most violent pain, he had composure sufficient to receive the last sacraments, and to make his will, in which he appointed cardinal Alexander Albani his residuary legatee, and expired in the afternoon. The murderer was soon after apprehended; and executed on the wheel opposite the inn, June 26.

Abbé Winckleman was a middle-sized man; he had a very low forehead, sharp nose, and little black hollow eyes, which gave him an aspect rather gloomy than otherwise. If he had any thing graceful in his physiognomy, it was his mouth. A fiery and impetuous disposition often threw him into extremes. Naturally enthusiastic, he often indulged an extravagant imagination; but as he possessed a strong and solid judgment, he knew how to give things a just and intrinsic value. In consequence of this turn of mind, as well as a neglected education, a cautious reserve was a quality he little knew. If he was bold in his decisions as an author, he was still more so in his conversation, and has often made his friends tremble for his temerity. If ever man knew what friendship was, that man was Mr Winckleman, who regularly practised all its duties; and for this reason he could boast of having friends among persons of every rank and condition.

WIND is a sensible agitation of the atmosphere, occasioned by a quantity of air flowing from one place to another.

As navigation depends in a great measure upon the direction and force of the winds, as the temperature of climates is greatly influenced by them, and as they are absolutely necessary to preserve the salubrity of the atmosphere, it is not surprising that they have very much engaged the attention of mankind. To be acquainted with the laws by which they are regulated, and to be able to calculate beforehand the consequences of these laws, has been in every age the eager wish of philosophers. But whether it has been owing to an improper method of studying this subject, or to its lying beyond the reach of the human faculties, philosophers have not made that progress in it which the sanguine imaginations of some individuals led them to expect. Many discoveries indeed have been made; and from the numbers and the genius of the philosophers at present engaged in this study, others equally important may be expected. But, notwithstanding this, many of the phenomena remain unexplained, and a rational and satisfactory theory seems still beyond our reach. It will not be expected, that where philosophers in general have failed, we shall succeed. If we can collect the facts hitherto ascertained, and explain such of them as the late discoveries have enabled us to understand, we trust we shall obtain the indulgence of the Public, though we cannot boast of throwing much new light on this difficult subject.

History of the Winds.

As the winds of the torrid zone differ in several important particulars from those which blow without the tropics, we shall first describe them, and afterwards those of the temperate zones.

Winds of the Torrid Zone.

I. In those parts of the Atlantic and Pacific oceans which lie nearest the equator, there is a regular wind during the whole year called the *trade-wind*. On the north side of the equator it blows from the north-east, varying frequently a point or two towards the north or east; and on the south side of it, from the south-east; changing sometimes in the same manner towards the south or east. The space included between the second and sixth degree of north latitude is the internal limit of these two winds. There the winds can neither be said to blow from the north nor the south; calms are frequent, and violent storms. This space varies a little in latitude as the sun approaches either of the tropics.—In the Atlantic ocean the trade-winds extend farther north on the American than on the African coast; and as we advance westward, they become gradually more easterly, and decrease in strength *. Their force diminishes likewise as we approach their utmost boundaries. It has been remarked also, that as the sun approaches the tropic of Cancer, the south-east winds become gradually more southerly, and the north-east winds more easterly: exactly the contrary takes place when the sun is approaching the tropic of Capricorn §.

The trade-wind.

* Dr Halley, Phil. Transf. vol. ii. 134.

§ Ibid.

The trade-wind blows constantly in the Indian ocean from the 10th degree of south latitude to near the 30th: But to the northward of this the winds change every six months, and blow directly opposite to their former course. These regular winds are called *monsoons*, from the Malay word *mossin*, which signifies "a season †." When they shift their direction, variable winds and violent storms succeed, which last for a month and frequently longer; and during that time it is dangerous for vessels to continue at sea.

Monsoons.

† Forrest's Voyage, 95.

The monsoons in the Indian ocean may be reduced to two; one on the north and another on the south side of the equator; which extend from Africa to the longitude of New Holland and the east coast of China, and which suffer partial changes in particular places from the situation and inflection of the neighbouring countries.

1. Between the 3d and 10th degrees of south latitude the south-east trade-wind continues from April to October; but during the rest of the year the wind blows from the north west ‡. Between Sumatra and New Holland this monsoon blows from the south during our summer months, approaching gradually to the south-east as we advance towards the coast of New Holland; it changes about the end of September, and continues in the opposite direction till April §. Between Africa and Madagascar its direction is influenced by the coast; for it blows from the north-east from October to April, and during the rest of the year from the south-west ¶.

‡ Dr Halley, Phil. Transf. vol. ii. 136.

§ Ibid.

¶ Bruce's Travels, i. p. 435

2. Over all the Indian ocean, to the northward of the 3d degree of south latitude, the north-east trade-wind blows from October to April, and a south-west wind from April to October ||. From Borneo, along the coast of Malacca and

|| Dr Halley, ibid

and as far as China, this monsoon in summer blows nearly from the south, and in winter from the north by east †. Near the coast of Africa, between Mozambique and Cape Guardefan, the winds are irregular during the whole year, owing to the different monsoons which blow round that particular place.—Monsoons are likewise regular in the Red Sea; between April and October they blow from the north-west, and during the other months from the south-east, keeping constantly parallel to the coast of Arabia *.

Monsoons are not altogether confined to the Indian Ocean; on the coast of Brazil, between Cape St Augustine and the island of St Catherine, the wind blows between September and April from the east or north-east, and between April and September from the south-west †.—The bay of Panama is the only place on the west side of a great continent where the wind shifts regularly at different seasons: there it is easterly between September and March; but between March and September it blows chiefly from the south and south west.

Such in general is the direction of the winds in the torrid zone all over the Atlantic, Pacific, and Indian Oceans; but they are subject to particular exceptions, which we shall now endeavour to enumerate.—On the coast of Africa, from Cape Bayador to Cape Verde, the winds are generally north-west; from hence to the island of St Thomas near the equator they blow almost perpendicular to the shore, bending gradually, as we advance southwards, first to the west and then to the south-west ‡. On the coast of New Spain likewise, from California to the Bay of Panama, the winds blow almost constantly from the west or south-west, except during May, June, and July, when land-winds prevail, called by the Spaniards *Pepagayos*. On the coast of Chili and Peru ¶, from 20° or 30° south latitude, to the equator, and on the parallel coast of Africa, the wind blows during the whole year from the south, varying according to the direction of the land towards which it inclines, and extending much farther out to sea on the American than the African coast. The trade winds are also interrupted sometimes by westerly winds in the Bay of Campeachy and the Bay of Honduras.

As to the countries between the tropics, we are too little acquainted with them to be able to give a satisfactory history of their winds.

In all maritime countries between the tropics of any extent, the wind blows during a certain number of hours every day *from* the sea, and during a certain number *towards* the sea from the land; these winds are called the *sea and land breezes*. The sea breeze generally sets in about ten in the forenoon, and blows till six in the evening; at seven the land-breeze begins, and continues till eight in the morning, when it dies away *. During summer the sea-breeze is very perceptible on all the coasts of the Mediterranean Sea ‡, and even sometimes as far north as Norway ||.

In the island of St Lewis on the coast of Africa, in 16° north latitude, and 16° west longitude, the wind during the rainy season, which lasts from the middle of July to the middle of October, is generally between the south and east; during the rest of the year it is for the most part east or north-east in the morning; but as the sun rises, the wind approaches gradually to the north, till about noon it gets to the west of north, and is called a *sea-breeze*. Sometimes it shifts to the east as the sun descends, and continues there during the whole night. In February, March, April, May, and June, it blows almost constantly between the north and west §. In the island of Balama, which lies likewise on the west coast of Africa, in the 11th degree of north latitude, the wind during nine months of the year blows from the south-west; but in November and December a very cold wind blows from the north-east *.

In the kingdom of Bornou, which lies between the 16th and 20th degree of north latitude, the warm season is introduced about the middle of April by fiery winds from the south-east, which bring along with them a deluge of rain †. In Fezzan, which is situated about the 25th degree of north latitude and the 15th degree of east longitude, the prevailing wind from May to August blows from the east, south-east, or south-west, and is intensely hot ‡.

In Abyssinia the winds generally blow from the west, north-west, north, and north-east. During the months of May, June, July, August, September, and October, the north and north-east winds blow almost constantly, especially in the morning and evening; and during the rest of the year they are much more frequent than any other winds *.

At Calcutta, in the province of Bengal, the wind blows during January and February from the south-west and south; in March, April, and May, from the south; in June, July, August, and September, from the south and south-east; in October, November, and December, from the north-west *.—At Madras the most frequent winds are the north and north-east.—At Tivoli in St Domingo, and at Iles de Vache, the wind blows oftenest from the south and south-east ‡.—From these facts it appears, that in most tropical countries with which we are acquainted, the wind generally blows *from* the nearest ocean, except during the coldest months, when it blows *towards* it.

II. Winds of the North Temperate Zone.

II. In the temperate zones the direction of the winds is by no means so regular as between the tropics. Even in the same degree of latitude, we find them often blowing in different directions at the same time; while their changes are frequently so sudden and so capricious, that to account for them has hitherto been found impossible. When winds are violent, and continue long, they generally extend over a large tract of country; and this is more certainly the case when they blow from the north or east than from any other points §. By the multiplication and comparison of Meteorological Tables, some regular connection between the changes of the atmosphere in different places may in time be observed, which will at last lead to a satisfactory theory of the winds. It is from such tables chiefly that the following facts have been collected.

11 Of America,

In Virginia, the prevailing winds are between the *south-west*, *west*, *north*, and *north-west*; the most frequent is the *south west*, which blows more constantly in June, July, and August, than at any other season. The *north west* winds blow most constantly in November, December, January, and February *.—At Ipswich in New England the prevailing winds are also between the *south-west*, *west*, *north*, and *north-east*; the most frequent is the *north west* †: But at Cambridge, in the same province, the most frequent wind is the *south-east* ‡.—The predominant winds at New York are the *north* and *west* §: And in Nova Scotia *north-west* winds blow for three-fourths of the year ||.—The same wind blows most frequently at Montreal in Canada; but at Quebec the wind generally follows the direction of the river St Lawrence, blowing either from the *north east* or *south-west* ¶.—At Hudson's Bay *westerly* winds blow for three-fourths of the year; the *north west* wind occasions the greatest cold, but the *north* and *north-east* are the vehicles of snow *.

It appears from these facts, that westerly winds are most frequent over the whole eastern coast of North America; that in the southern provinces south-west winds predominate; and that the north-west become gradually more frequent as we approach the frigid zone.

In Egypt, during part of May, and during June, July, August,

§ Derham's Physico-Theol.
* Jefferson's Virginia,
† Transact. Amer. Acad. vol. i. p. 336.
|| Cotte, Journ. de Phys. 1791.
§ Ibid.
|| Present State of Nova Scotia and Canada, p. 38.
¶ Cotte, ibid.
* Pennant's Suppl. to Arctic Zool. p. 41.

Wind.

12 Egypt,

August, and September, the wind blows almost constantly from the *north*, varying sometimes in June to the *west*, and in July to the *west* and the *east*; during part of September, and in October and November, the winds are variable, but blow more regularly from the *east* than any other quarter; in December, January, and February, they blow from the *north*, *north-west*, and *west*; towards the end of February they change to the *south*, in which quarter they continue till near the end of March; during the last days of March and in April they blow from the *south-east*, *south*, and *south-west*, and at last from the *east*; and in this direction they continue during a part of May ‡.

‡ Volney's Travels, vol. i. p. 58.

13 The Mediterranean,

In the Mediterranean the wind blows nearly three-fourths of the year from the *north*; about the equinoxes there is always an *easterly* wind in that sea, which is generally more constant in spring than in autumn †. These observations do not apply to the gut of Gibraltar, where there are seldom any winds except the *east* and the *west*.—At Bastia, in the island of Corsica, the prevailing wind is the *south-west* *.

† Ibid. p. 59 and 65.

* Cotte, ibid.

14 Syria and other parts of Asia,

In Syria the *north* wind blows from the autumnal equinox to November; during December, January, and February, the winds blow from the *west* and *south west*; in March they blow from the *south*, in May from the *east*, and in June from the *north*. From this month to the autumnal equinox the wind changes gradually as the sun approaches the equator; first to the *east*, then to the *south*, and lastly to the *west* †.—At Bagdad the most frequent winds are the *south-west* and *north-west*; at Pekin, the *north* and the *south* ‡; at Kamtschatka, on the north-east coast of Asia, the prevailing winds blow from the *west* §.

† Volney's Travels, i. p. 326.

‡ Cotte, ibid.

§ Pennant's Arctic Zool. p. cxxii.

15 Italy,

In Italy the prevailing winds differ considerably according to the situation of the places where the observations have been made: At Rome and Padua they are *northerly*, at Milan *easterly* †.—All that we have been able to learn concerning Spain and Portugal is, that on the west coast of these countries the *west* is by far the most common wind, particularly in summer; and that at Madrid the wind is *north-east* for the greatest part of the summer, blowing almost constantly from the Pyrenean mountains ‡.—At Berne in Switzerland the prevailing winds are the *north* and *west*; at St Gottard, the *north-east*; at Lausanne, the *north-west* and *south-west* §.

† Cotte, ibid.

16 Spain,

‡ Bohun's Hist. of Winds, p. 116.

17 Switzerland,

§ Cotte, ibid.

18 France,

Father Cotte has given us the result of observations made at 86 different places of France ‖; from which it appears, that along the whole south coast of that kingdom the wind blows most frequently from the *north*, *north-west*, and *north-east*; on the west coast, from the *west*, *south-west*, and *north-west*; and on the north coast, from the *south-west*. That in the interior parts of France the *south-west* wind blows most frequently in 18 places; the *west* wind in 14; the *north* in 13; the *south* in 6; the *north-east* in 4; the *south-east* in 2; the *east* and *north west* each of them in one. -On the west coast of the Netherlands, as far north as Rotterdam, the prevailing winds are probably the *south-west*, at least this is the case at Dunkirk and Rotterdam ‡. It is probable also that along the rest of this coast, from the Hague to Hamburgh, the prevailing winds are the *north-west*, at least these winds are most frequent at the Hague and at Franeker §.—The prevailing wind at Delft is the *south-east*; and at Breda the *north* and the *east* †.

‖ Ibid.

19 The Netherlands

‡ Ibid.

§ Ibid.

† Ibid.

20 Germany,

In Germany the *east* wind is most frequent at Gottingen, Munich, Weissemburg, Dusseldorf, Saganum, Erford, and at Buda in Hungary; the *south-east* at Prague and Wirtzburg; the *north-east* at Ratisbone; and the *west* at Manheim and Berlin ‡.

‡ Ibid.

21 Britain,

From an average of ten years of the register kept by order of the Royal Society, it appears, that at London the winds blow in the following order:

Winds.		Days.	Winds.		Days.
South-west	-	112	South-east	-	32
North-east	-	58	East	-	26
North-west	-	50	South	-	18
West	-	53	North	-	16

It appears, from the same register, that the *south-west* wind blows at an average more frequently than any other wind during every month of the year, and that it blows longest in July and August; that the *north east* blows most constantly during January, March, April, May, and June, and most seldom during February, July, September, and December; and that the *north-west* wind blows oftener from November to March, and more seldom during September and October than any other months. The *south-west* winds are also most frequent at Bristol, and next to them are the *north-east* §.

The following table of the winds at Lancaster has been drawn up from a register kept for seven years at that place ¶:

Winds.		Days.	Winds.		Days.
South-west	-	92	South-east	-	35
North-east	-	67	North	-	30
South	-	51	North-west	-	26
West	-	41	East	-	17

The following table is an abstract of nine years observations made at Dumfries by Mr Copland †.

Winds.		Days.	Winds.		Days.
South	-	82½	North	-	36½
West	-	69	North-west	-	25½
East	-	68	South-east	-	18½
South-west	-	50½	North-east	-	14½

The following table is an abstract of seven years observations made by Mr Meek at Cambuslang near Glasgow ‡:

Winds.		Days.	Winds.		Days.
South-west	-	174	North-east	-	104
North-west	-	140	South-east	-	47

It appears, from the register from which this table was extracted, that the *north-east* wind blows much more frequently in April. May, and June, and the *south-west* in July, August, and September, than at any other period. We learn from the Statistical Account of Scotland, that the *south-west* is by far the most frequent wind all over that kingdom, especially on the west coast. At Saltcoats in Airshire, for instance, it blows three-fourths of the year; and along the whole coast of Murray, on the *north-east* side of Scotland, it blows for two-thirds of the year. East winds are common over all Great Britain during April and May; but their influence is felt most severely on the eastern coast.

The following table exhibits a view of the number of days during which the westerly and easterly winds blow in a year at different parts of the island. Under the term *westerly* are included the north-west, west, south-west, and south; the term *easterly* is taken in the same latitude.

Years of Obser.	Places.		Wind Westerly.	Wind Easterly.
10	London	-	233	132
7	Lancaster	-	216	149
51	Liverpool ‡	-	170	175
9	Dumfries	-	227,5	137,5
10	Branxholm, 54 miles south-west of Berwick §,	-	232	133
7	Cambuslang	-	214	151
8	Hawkhill, near Edinburgh †,	-	229,5	135,5
		Mean	217,4	144,7

In

In Ireland the *south-west* and *west* are the grand trade-winds, blowing most in summer, autumn, and winter, and least in spring. The *north-west* blows most in spring, and nearly double to what it does in autumn and winter. The *south-east* and *north-east* are nearly equal, and are most frequent after the south-west and west ‡.

At Copenhagen the prevailing winds are the *east* and *south-east*; at Stockholm, the *west* and *north* §. In Russia, from an average of a register of 16 years, the winds blow from November to April in the following order:

	West.	N. W.	East.	S. W.	South.	N. E.	N.	S. E.
Days	45	29	23	22	20	19	14	12

And during the other six months,

	West.	N. W.	East.	S, W.	South.	N. E.	N.	S. E.
Days	27	27	19	24	22	15	32	18

The *west* wind blows during the whole year 72 days; the *north-west* 53; the *south-west* and *north* 46 days each. During summer it is calm for 41 days, and during winter for 21 *. In Norway the most frequent winds are the *south*, the *south-west*, and *south-east*. The wind at Bergen is seldom directly west, but generally south-west or south-east; a north-west, and especially a north-east wind, are but little known there †.

From the whole of these facts, it appears that the most frequent winds on the south coasts of Europe are the north, the north-east, and north-west; and on the western coast, the south-west: that in the interior parts which lie most contiguous to the Atlantic Ocean, south-west winds are also most frequent; but that easterly winds prevail in Germany. Westerly winds are also most frequent on the north-east coast of Asia.

It is probable that the winds are more constant in the south temperate zone, which is in a great measure covered with water, than in the north temperate zone, where their direction must be frequently interrupted and altered by mountains and other causes.

M. de la Caille, who was sent thither by the French king to make astronomical observations, informs us, that at the Cape of Good Hope the main winds are the *south-east* and *north-west*; that other winds seldom last longer than a few hours; and that the *east* and *north-east* winds blow very seldom. The *south-east* wind blows in most months of the year, but chiefly from October to April; the *north-west* prevails during the other six months, bringing along with it rain, and tempests, and hurricanes. Between the Cape of Good Hope and New Holland the winds are commonly westerly, and blow in the following order: *north-west*, *south-west*, *west*, *north* ‡.

In the great South Sea, from latitude 30° to 40° south, the *south-east* trade-wind blows most frequently, especially when the sun approaches the tropic of Capricorn; the wind next to it in frequency is the *north-west*, and next to that is the *south-west*. From south latitude 40° to 50° the prevailing wind is the *north-west*, and next the *south-west*. From 50° to 60° the most frequent wind is also the *north-west*, and next to it is the *west* *.

Thus it appears that the trade-winds sometimes extend farther into the south temperate zone than their usual limits, particularly during summer; that beyond their influence the winds are commonly westerly, and that they blow in the following order: *north-west*, *south-west*, *west*.

Thus have we finished the history of the direction of the winds. In the torrid zone they blow constantly from the north-east on the north side of the equator, and from the south-east on the south side of it. In the north temperate zone they blow most frequently from the south-west; in the south temperate zone from the north-west, changing, however, frequently to all points of the compass, and in the north temperate zone blowing particularly during spring from the north-east. Wind.

As to the velocity of the wind, its variations are almost infinite; from the gentlest breeze to the hurricane, which tears up trees and blows down houses. It has been remarked, that our most violent winds take place when neither the heat nor the cold is greatest; that violent winds generally extend over a great tract of country; and that they are accompanied with sudden and great falls in the mercury of the barometer. The wind is [illegible] very violent at a distance from the earth, while it is [illegible] at its surface. On one occasion Lunardi went at [illegible] 70 miles an hour in his balloon, though it was quite calm at Edinburgh when he ascended, and continued so during his whole voyage. See Pneumatics. 28 Velocity of wind.

For the instruments invented to measure the velocity of the wind, see Anemoscope and Anemometer.

Theory of the Winds.

The atmosphere is a fluid surrounding the earth, and extending to an unknown height. Now all fluids tend invariably to a level: if a quantity of water be taken out of any part of a vessel, the surrounding water will immediately flow in to supply its place, and the surface will become level as before; or if an additional quantity of water be poured into any part of the vessel, it will not remain there, but diffuse itself equally over the whole. Such exactly would be the case with the atmosphere. Whatever therefore destroys the equilibrium of this fluid, either by increasing or diminishing its bulk in any particular place, must at the same time occasion a wind. 29 The atmosphere a fluid.

30

Air, besides its qualities in common with other fluids, is also capable of being dilated and compressed. Suppose a vessel filled with air: if half the quantity which it contains be drawn out by means of an air-pump, the remainder will still fill the vessel completely; or if twice or three times the original quantity be forced in by a condenser, the vessel will still be capable of holding it. Capable of dilatation and expansion

Rarefied air is lighter, and condensed air heavier, than common air. When fluids of unequal specific gravities are mixed together, the heavier always descend, and the lighter ascend. Were quicksilver, water, and oil, thrown into the same vessel together, the quicksilver would uniformly occupy the bottom, the water the middle, and the oil the top. Were water to be thrown into a vessel of oil, it would immediately descend, because it is heavier than oil. Exactly the same thing takes place in the atmosphere. Were a quantity of air, for instance, to be suddenly condensed at a distance from the surface of the earth, being now heavier than before, it would descend till it came to air of its own density; or, were a portion of the atmosphere at the surface of the earth to be suddenly rarefied, being now lighter than the surrounding air, it would immediately ascend. 31

If a bladder half filled with air be exposed to the heat of a fire, the air within will soon expand, and distend the bladder; if it be now removed to a cold place, it will soon become flaccid as before. This shows that heat rarefies and that cold condenses air. The surface of the torrid zone is much more heated by the rays of the sun than the frozen or temperate zones, because the rays fall upon it much more perpendicularly. This heat is communicated to the air near the surface of the torrid zone, which being thereby rarefied, ascends; and its place is supplied by cooler air, which rushes in from the north and south. By heat and cold. 32

The diurnal motion of the earth is greatest at the equator, and diminishes gradually as we approach the poles, where it The heat of the sun.

Wind.

it ceaſes altogether. Every ſpot of the earth's ſurface at the equator moves at the rate of 15 geographical miles in a minute; at the 40° of latitude, it moves at about 11½ miles in a minute: and at the 30°, at nearly 13 miles. The atmoſphere, by moving continually round along with the earth, has acquired the ſame degree of motion; ſo that thoſe parts of it which are above the equator move faſter than thoſe which are at a diſtance. Were a portion of the atmoſphere to be tranſported in an inſtant from latitude 30° to the equator, it would not immediately acquire the velocity of the equator; the eminences of the earth therefore would ſtrike againſt it, and it would aſſume the appearance of an eaſt wind. This is the caſe in a ſmaller degree with the air that flows towards the equator, to ſupply the place of the rarefied air which is continually aſcending: and this, when combined with its real motion from the north and ſouth, muſt cauſe it to aſſume the appearance of a north eaſterly wind on this ſide the equator, and of a ſouth eaſterly beyond it.

33 The earth's diurnal motion,

The motion weſtwards occaſioned by this difference in celerity alone would not be great; but it is farther increaſed by another circumſtance. Since the rarefaction of the air in the torrid zone is owing to the heat derived from the contiguous earth, and ſince this heat is owing to the perpendicular rays of the ſun, thoſe parts muſt be hotteſt where the ſun is actually vertical, and conſequently the air over them muſt be moſt rarefied; the contiguous parts of the atmoſphere will therefore be drawn moſt forcibly to that particular ſpot. Now ſince the diurnal motion of the ſun is from eaſt to weſt, this hotteſt ſpot will be continually ſhifting weſtwards, and this will occaſion a current of the atmoſphere in that direction. That this cauſe really operates, appears from a circumſtance already mentioned: when the ſun approaches either of the tropics, the trade-wind on the ſame ſide of the equator aſſumes a more eaſterly direction, evidently from the cauſe here mentioned; while the oppoſite trade-wind, being deprived of this additional impulſe, blows in a direction more perpendicular to the equator.

34 And the action of the moon,

The weſterly direction of the trade-winds is ſtill farther increaſed by another cauſe. Since the attraction of the ſun and moon produces ſo remarkable an effect upon the ocean, we cannot but ſuppoſe that an effect equally great at leaſt is produced upon the atmoſphere. Indeed as the atmoſphere is nearer the moon than the ſea is, the effect produced by attraction upon it ought to be greater. When we add to this the elaſticity of the air, or that diſpoſition which it has to dilate itſelf when freed from any of its preſſure, we cannot but conclude that the tides in the atmoſphere are conſiderable. Now ſince the apparent diurnal motion of the moon is from eaſt to weſt, the tides muſt follow it in the ſame manner, and conſequently produce a conſtant motion in the atmoſphere from eaſt to weſt. This reaſoning is confirmed by the obſervations of ſeveral philoſophers, particularly of M. Caſſan §, that in the torrid zone the barometer is always two-thirds of a line higher twice every 24 hours than during the reſt of the day; and that the time of this riſe always correſponds with the tides of the ſea; a proof that it proceeds from the ſame cauſe.

§ *Journal de Phyſique, April* 1790.

35 Produce the *trade-winds*.

All theſe different cauſes probably combine in the production of the trade-winds; and from their being ſometimes united, and ſometimes diſtinct or oppoſite, ariſe all thoſe little irregularities which take place in the direction and force of the trade-winds.

Since the great cauſe of theſe winds is the rarefaction of the atmoſphere by the heat of the ſun, its aſcenſion, and the conſequent ruſhing in of colder air from the north and ſouth, the internal boundary of the trade-winds muſt be that parallel of the torrid zone which is hotteſt, becauſe there the aſcenſion of the rarefied air muſt take place. Now ſince the ſun does not remain ſtationary, but is conſtantly ſhifting from one tropic to the other, we ought naturally to expect that this boundary would vary together with its exciting cauſe; that therefore when the ſun is perpendicular to the tropic of Cancer, the north-eaſt trade-winds would extend no farther ſouth than north latitude 23,5°; that the ſouth-eaſt wind would extend as far north; and that when the ſun was in the tropic of Capricorn, the very contrary would take place. We have ſeen, however, that though this boundary be ſubject to conſiderable changes from this very cauſe, it may in general be conſidered as fixed between the ſecond and fifth degrees of north latitude.

Though the ſun be perpendicular to each of the tropics during part of the year, he is for one half of it at a conſiderable diſtance; ſo that the heat which they acquire while he is preſent is more than loſt during his abſence. But the ſun is perpendicular to the equator twice in a year, and never farther diſtant from it than 23½°; being therefore twice every year as much heated, and never ſo much cooled, as the tropics, its mean heat muſt be greater, and the atmoſphere in conſequence generally moſt rarefied at that place. Why then, it will be aſked, is not the equator the boundary of the two trade-winds? To ſpeak more accurately than we have hitherto done, the internal limit of theſe winds muſt be that parallel where the mean heat of the earth is greateſt. This would be the equator, were it not for a reaſon which ſhall now be explained. 37

It has been ſhown by aſtronomers, that the orbit of the earth is an ellipſis, and that the ſun is placed in one of the phoci. Were this orbit to be divided into two parts by a ſtraight line perpendicular to the tranſverſe axis, and paſſing through the centre of the ſun, one of theſe parts would be leſs than the other; and the earth, during its paſſage through this ſmaller part of its orbit, would conſtantly be nearer the ſun than while it moved through the other portion. The celerity of the earth's motion in any part of its orbit is always proportioned to its diſtance from the ſun; the nearer it is to the ſun, it moves the faſter; the farther diſtant, the ſlower. The earth paſſes over the ſmaller portion of its orbit during our winter; which muſt therefore be ſhorter than our ſummer, both on account of this part of the orbit being ſmaller than the other, and on account of the increaſed celerity of the earth's motion. The difference, according to Caſſini, is 7 days, 23 hours, and 53 minutes. While it is winter in the northern, it is ſummer in the ſouthern, hemiſphere; wherefore the ſummer in the ſouthern hemiſphere muſt be juſt as much ſhorter than the winter as our winter is ſhorter than our ſummer. The difference therefore between the length of the ſummer in the two hemiſpheres is almoſt 16 days. The ſummer in the northern hemiſphere conſiſts of 190¾ days, while in the ſouthern it conſiſts only of 174½. They are to one another nearly in the proportion of 14 to 12,8; and the heat of the two hemiſpheres may probably have nearly the ſame proportion to one another. The internal limit of the trade-winds ought to be that parallel where the mean heat of the globe is greateſt: this would be the equator, if both hemiſpheres were equally hot; but ſince the northern hemiſphere is the hotteſt, that parallel ought to be ſituated ſomewhere in it; and ſince the difference between the heat of two hemiſpheres is not great, the parallel ought not to be far diſtant from the equator (A). 38

The

(A) This parallel could be determined by calculation, provided the mean heat of both the ſegments into which it divides

The trade-wind would blow regularly round the whole globe if the torrid zone were all covered with water. If the Indian Ocean were not bounded by land on the north, it would blow there in the same manner as it does in the Atlantic and Pacific Oceans. The rays of light pass through a transparent body without communicating any, or at least but a small degree of heat. If a piece of wood be inclosed in a glass vessel, and the focus of a burning glass directed upon it, the wood will be burnt to ashes, while the glass through which all the rays passed is not even heated. When an opaque body is exposed to the sun's rays, it is heated in proportion to its opacity. If the bulb of a thermometer be exposed to the sun, the quicksilver will not rise so high as it would do if this bulb were painted black. Land is much more opaque than water; it becomes therefore much warmer when both are equally exposed to the influence of the sun. For this reason, when the sun approaches the tropic of Cancer, India, China, and the adjacent countries, become much hotter than the ocean which washes their southern coasts. The air over them becomes rarefied, and ascends, while colder air rushes in from the Indian Ocean to supply its place. As this current of air moves from the equator northward, it must, for a reason already explained, assume the appearance of a south-west wind; and this tendency eastward is increased by the situation of the countries to which it flows. This is the cause of the south-west monsoon, which blows during summer in the northern parts of the Indian Ocean. Between Borneo and the coast of China its direction is almost due north, because the country to which the current is directed lies rather to the west of north; a circumstance which counteracts its greater velocity.

In winter, when the sun is on the south side of the equator, these countries become cool, and the north-east trade-wind resumes its course, which, had it not been for the interference of these countries, would have continued the whole year.

As the sun approaches the tropic of Capricorn, it becomes almost perpendicular to New Holland: that continent is heated in its turn, the air over it is rarefied, and colder air rushes in from the north and west to supply its place. This is the cause of the north-west monsoon, which blows from October to April, from the third to the tenth degree of south latitude. Near Sumatra its direction is regulated by the coast: this is the case also between Africa and Madagascar.

The same cause which occasions the monsoons, gives rise to the winds which blow on the west coasts of Africa and America. The air above the land is hotter and rarer, and consequently lighter than the air above the sea; the sea air therefore flows in, and forces the lighter land atmosphere to ascend. Wind.

The same thing will account for the phenomena of the sea and land breezes. During the day, the cool air of the sea, loaded with vapours, flows in upon the land, and takes the place of the rarefied land air. As the sun declines, the rarefaction of the land air is diminished, thus an equilibrium is restored. As the sea is not so much heated during the day as the land, neither is it so much cooled during the night; because it is constantly exposing a new surface to the atmosphere. As the night approaches, therefore, the cooler and denser air of the hills (for where there are no hills there are no sea and land breezes) falls down upon the plains, and pressing upon the now comparatively lighter air of the sea, causes the land-breeze. 41 And of the sea and land breezes.

The rarefied air which ascends between the second and fifth degrees of north latitude, has been shown to be the principal cause of the trade winds. As this air ascends, it must become gradually colder, and consequently heavier; it would therefore descend again if it were not buoyed up by the constant ascent of new rarefied air. It must therefore spread itself to the north and south, and gradually mix in its passage with the lower air; and the greater part of it probably does not reach far beyond the 30°, which is the external limit of the trade-wind. Thus there is a constant circulation of the atmosphere in the torrid zone; it ascends near the equator, diffuses itself toward the north and south, descends gradually as it approaches the 30°, and returning again towards the equator, performs the same circuit. It has been the opinion of the greater part of those who have considered this subject, that the whole of the rarefied air which ascends near the equator, advances towards the poles and descends there. But if this were the case, a constant wind would blow from both poles towards the equator, the trade-winds would extend over the whole earth; for otherwise the ascent of air in the torrid zone would very soon cease. A little reflection must convince us that it cannot be true: rarefied air differs nothing from the common air except in containing a greater quantity of heat. As it ascends, it gradually loses this superfluous heat. What then should hinder it from descending, and mixing with the atmosphere below? That there is a constant current of superior air, however, towards the poles, cannot be doubted; but it consists principally of hydrogen gas. We shall immediately attempt to assign the reason why its accumulation at the pole is not always attended with a north wind. 42 Air circulates in the torrid zone,

If the attraction of the moon and the diurnal motion of the sun have any effect upon the atmosphere, and that they have some effect can hardly be disputed, there must be a real 43 And moves westward;

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vides the globe were known. Let the radius of this globe be $= 1$, the circumference of a great circle $= 6$, and consequently the arc of a great circle $= 3$, and the solid contents of a hemisphere $= 2$. Since the internal limit of the trade-winds is not far distant from the equator, we may consider that portion of the sphere intercepted between it and the equator as a cylinder, the base of which is the equator, and its height the arc intercepted between the equator and the internal limit of the trade-winds. Let this arc be x, and consequently the cylinder itself $= 3x$, equal to the excess of the southern segment into which this internal limit divides the globe above the northern. Let the heat of the northern segment be $= n$, and that of the southern $= s$. The southern segment is $= 2 + 3x$, the northern $= 2 - 3x$. Now let us supppose that the bulk of each segment is reciprocally as its heat, and we shall have this formula, $2 + 3x : 2 - 3x :: n : s$. Wherefore $x = \frac{2n - 2s}{3n + 3s}$. Now if we suppose $n = 14$, and $s = 12.8$, $\frac{2n - 2s}{3n + 3s}$ is $= \frac{2.4}{80.4}$. To reduce this value of x to degrees, we must multiply it by 60, since a great circle was made $= 6$: it gives $1° 48' 27''$ as the internal limit of the trade-wind. This is too small by $2° 11' 33''$. But the value which we have found is only that of the sine of the arc intercepted between the equator and the internal limit; the arc itself would be somewhat greater; besides, the proportion between the heat of the two segments is an assumed quantity, and may probably be greater than their difference in bulk: and one reason for this may be, the great proportion of land in the northern compared with the southern segment. See the *Journal de Physique*, *Mai* 1791.

Wind. real motion of the air weftwards within the limits of the trade-winds. When this body of air reaches America, its further paffage weftwards is ftopt by the mountains which extend from one extremity of that continent to the other. From the momentum of this air, when it ftrikes againft the fides of thefe mountains, and from its elafticity, it muft acquire from them a confiderable velocity, in a direction contrary to the firft, and would therefore return eaftwards again if this were not prevented by the trade-winds. It muft therefore rufh forwards in that direction where it meets with the leaft refiftance; that is, towards the north and fouth. As air is nearly a perfectly elaftic body, when it ftrikes againft the fides of the American mountains its velocity will not be perceptibly diminifhed, though its direction be changed. Continuing, therefore, to move with the velocity of the equator, when it arrives at the temperate zones it will affume the appearance of a north-eaft or fouth-eaft wind. To this is to be afcribed the frequency of fouth-weft winds over the Atlantic Ocean and weftern parts of Europe. Whether thefe winds are equally frequent in the Northern Pacific Ocean, we have not been able to afcertain; but it is probable that the mountains in Afia produce the fame effect as thofe in America.

44 And ftrikes againft the American mountains;

45 Which occafions our fouth-weft winds.

It is not impoffible that another circumftance may alfo contribute to the production of thefe winds. In the article Weather, we endeavoured to prove that the annual evaporation exceeds confiderably the quantity of rain which falls; and found reafon to conclude, therefore, that part of the evaporated water was decompounded in the atmofphere. In that cafe, the oxygen, which is rather heavier than common air, would mix with the atmofphere; but the hydrogen (a cubic foot of which weighs only 41.41 grains, while a cubic foot of oxygen weighs 593.32 grains) would afcend to the higher regions of the atmofphere.

46 Air generated in the torrid zone,

By what means this decompofition is accomplifhed (if it takes place at all) we cannot tell. There are probably a thoufand caufes in nature of which we are entirely ignorant. Whether heat and light, when long applied to vapours, may not be able to decompound them, by uniting with the hydrogen, which feems to have a greater attraction for heat than oxygen has; or whether the electrical fluid may not be capable of producing this effect—are queftions which future obfervations and experiments muft determine. Dr Franklin filled a glafs tube with water, and paffed an electrical fhock through it; the tube was broken in pieces, and the whole water difappeared. He repeated the experiment with ink inftead of water, and placed the tube upon white paper: the fame effects followed; and the ink, though it difappeared completely, left no ftain on the paper. Whether the water in thefe cafes was decompofed or not, it is impoffible to fay; but the fuppofition that it was, is not improbable. An experiment might eafily be contrived to determine the point.

This decompofition would account for the frequency of fouth-weft winds, particularly in fummer; for thus new air is furnifhed to fupply the place of that which is forced northwards by the caufes already explained. Perhaps it may be a confirmation of this conjecture, that the fouth-weft winds generally extend over a greater tract of country than moft other winds which blow in the temperate zones. What has been faid of fouth-weft winds, holds equally with regard to north-weft winds in the fouth temperate zone.

After fouth-weft winds have blown for fome time, a great quantity of air will be accumulated at the pole, at leaft if they extend over all the northern hemifphere: and it appears from comparing the tables kept by fome of our late navigators in the Northern Pacific Ocean with fimilar tables kept in this ifland, that this is fometimes the cafe fo far as relates to the Atlantic and Pacific Oceans. When this accumulation becomes great, it muft, from the nature of fluids, and from the elafticity of air, prefs with a confiderable and increafing force on the advancing air; fo that in time it becomes ftronger than the fouth-weft wind. This will occafion at firft a calm, and afterwards a north wind; which will become gradually eafterly as it advances fouthwards, from its not affuming immediately the velocity of the earth. The mafs of the atmofphere will be increafed in all thofe places over which this north-eaft wind blows: this is confirmed by the almoft conftant rife of the barometer during a north-eaft wind.

Whatever tends to increafe the bulk of the atmofphere near the pole, muft tend alfo to increafe the frequency of north-eaft winds; and if there be any feafon when this increafe takes place more particularly, that feafon will be moft liable to thefe winds. During winter the northern parts of Europe are covered with fnow, which is melted in the beginning of fummer, when the heat of the fun becomes more powerful. Great quantities of vapour are during that time raifed, which will augment both the bulk and weight of the atmofphere; efpecially if the conjecture about the converfion of vapour into air has any foundation. Hence north-eaft winds are moft prevalent during May and June (B).

But it will be faid, if this hypothefis were true, the fouth-weft and north-eaft winds ought to blow alternately, and continue each of them for a ftated time; whereas the fouth-weft wind blows fometimes longer and fometimes fhorter, neither is it always followed by a north-eaft wind.

If the conjecture about the decompofition of vapour in the torrid zone be true, the hydrogen which formed a part of it will afcend from its lightnefs, and form a ftratum above the atmofpherical air, and gradually extend itfelf, as additional hydrogen rifes, towards the north and fouth, till at laft it reaches the poles. The lightnefs of hydrogen is owing to the great quantity of heat which it contains: as it approaches the poles it muft lofe a great part of this heat, and may in confequence become heavy enough to mix with the atmofphere below. Oxygen makes a part of the atmofphere; and its proportion near the poles may fometimes be greater than ordinary, on account of the additional quantity brought thither from the torrid zone. Mr Cavendifh mixed oxygen and hydrogen together in a glafs jar; and upon making an electrical fpark pafs through them, they immediately combined, and formed water.

That there is electric matter at the poles, cannot be doubted. The Abbé Chappe informs us, that he faw thunder and lightning much more frequently at Tobolfki and other parts of Siberia than in any other part of the world. In the north of Europe the air, during very cold weather, is exceedingly electric: fparks can be drawn from a perfon's hands and face, by combing his hair, or even powdering

(B) The frequency of north-eaft winds during thefe months is the greateft defect in the climate of Scotland, and is felt indeed feverely over all Great Britain. In the united ftates of America, thefe winds keep pace with the clearing of the land. Some time ago, in Virginia, they did not reach farther than Williamfburgh; now they reach to Richmond, which is fituated confiderably farther weft, and are even beginning to be felt ftill farther within the country *. Might it not be poffible then to prevent the frequency of thefe winds in this country, by planting trees along the whole eaft coaft? It is a pity that the experiment were not tried; were it to fucceed, it would very materially improve the climate.

dering him with a puff. Æpinus was an eye-witness to this fact, and to still more astonishing proofs of the electricity of the atmosphere during great colds.

May not the appearance of the aurora borealis be owing to the union of oxygen and hydrogen by the intervention of the electric fluid? That it is an electrical phenomenon at least, can hardly be doubted. Artificial electricity is much strengthened during an aurora, as Mr Volta and Mr Canton have observed; and the magnetic needle moves with the same irregularity during an aurora that has been observed in other electrical phenomena. This fact we learn from Bergman and De la Lande. Many philosophers have attempted to demonstrate, that auroræ boreales are beyond the earth's atmosphere; but the very different results of their calculations evidently prove that they were not possessed of sufficient data.

If this conjecture be true, part of the atmosphere near the poles must at times be converted into water. This would account for the long continuance of south-west winds at particular times: when they do so, a decomposition of the atmosphere is going on at the pole. It would render this conjecture more probable, if the barometer fell always when a south-west wind continues long.

If this hypothesis be true, a south-west wind ought always to blow after auroræ boreales; and we are informed by Mr Winn *, that this is actually the case. This he found never to fail in 23 instances. He observed also, that when the aurora was bright, the gale came on within 24 hours, but did not last long; but if it was faint and dull, the gale was longer in beginning, and less violent, but it continued longer. This looks like a confirmation of our conjecture. Bright auroræ are probably nearer than those which are dull. Now, if the aurora borealis be attended with a decomposition of a quantity of air, that part of the atmosphere which is nearest must first rush in to supply the defect, and the motion will gradually extend itself to more distant parts. Just as if a hole were bored in the end of a long vessel filled with water, the water nearest the hole would flow out immediately, and it would be some time before the water at the other end of the vessel began to move. The nearer we are to the place of precipitation, the sooner will we feel the south-west wind. It ought therefore to begin sooner after a bright aurora, because it is nearer than a dull and faint one. Precipitations of the atmosphere at a distance from the pole cannot be so great as those which take place near it; because the cold will not be sufficient to condense so great a quantity of hydrogen; south-west winds, therefore, ought not to last so long after bright as after dull auroræ. Winds are more violent after bright auroræ, because they are nearer the place of precipitation; just as the water near the hole in the vessel runs swifter than that which is at a considerable distance.

Wind.

If these conjectures have any foundation in nature, there are two sources of south-west winds; the first has its origin in the trade-winds, the second in precipitations of the atmosphere near the pole (c). When they originate from the first cause, they will blow in countries farther south for some time before they are felt in those which are farther north; but the contrary will take place when they are owing to the second cause. In this last case, too, the barometer will sink considerably; and it actually does so constantly after auroræ, as we are informed by Mr [illegible] ‡, who paid particular attention to this subject. By keeping accurate meteorological tables in different latitudes, it might easily be discovered whether these consequences be true, and consequently whether the above conjectures be well or ill grounded.

‡ Philos. Trans. vol. ii. p. 142.

52 Another cause of north-east winds.

There are also two sources of north-east winds; the first is an accumulation of air at the pole (D), the second a precipitation of the atmosphere in the torrid zone. For the discovery of this last cause we are indebted to Dr Franklin. In 1740 he was prevented from observing an eclipse of the moon at Philadelphia by a north-east storm, which came on about seven o'clock in the evening. He was surprised to find afterwards that it had not come on at Boston till near 11 o'clock: and upon comparing all the accounts which he received from the several colonies of the beginning of this and other storms of the same kind, he found it to be always an hour later the farther north-east, for every 100 miles.

"From hence (says he) I formed an idea of the course of the storm, which I will explain by a familiar instance. I suppose a long canal of water stopped at the end by a gate. The water is at rest till the gate is opened; then it begins to move out through the gate, and the water next the gate is first in motion, and moves on towards the gate; and so on successively, till the water at the head of the canal is in motion, which it is last of all. In this case all the water moves indeed towards the gate; but the successive times of beginning the motion are in the contrary way, viz. from the gate back to the head of the canal. Thus, to produce a north-east storm, I suppose some great rarefaction of the air in or near the gulf of Mexico; the air rising thence has its place supplied by the next more northern, cooler, and therefore denser, and heavier air; a successive current is formed, to which our coast and inland mountains give a north-east direction †."

† Franklin's Philosophical Letters, p. [illegible]

53 Cause of north-west winds.

Currents of air from the poles naturally, as has been observed, assume a north-east direction as they advance southwards; because their diurnal motion becomes less than that of the earth. Various circumstances, however, may change this direction, and cause them to become north, or even north-west, winds. The south-west winds themselves may often prove sufficient for this; and violent rains, or great heat

(c) We are now rather doubtful whether the first cause here assigned be so general as we at first imagined. The almost constant sinking of the barometer when a south wind blows, seems to indicate, that it is generally occasioned by decompositions of the atmosphere. Nor are we certain that *mountains* are adequate to produce the effect assigned them.

(D) When the ice, which in Russia accumulates on the insides of the windows of the common people's houses, thaws, it lets loose a quantity of mephitic air, producing all the dangerous effects of charcoal (*Dr Guthrie of the Climate of Russia, Edin. Transf.* vol. ii. p. 220.). May not then a quantity of air be extricated from ice during its thawing? And may not this be another source of north-east winds? We are not ignorant of the experiment which Dr Garnet made to discover this (see *Manchester Transactions*, vol iv.); and that he found that ice in this country lets loose no air in the act of thawing. But Dr Guthrie has shown us, in the essay above referred to, that water, by being long exposed to intense cold, changes its nature, and acquires qualities which it had not before. Would it not be worth the while of the philosophers in Russia, and other cold countries, to investigate this a little farther? We would recommend it to the consideration of the ingenious Dr Guthrie himself; who, from his situation, has the best opportunities of investigating the matter completely. It is certainly of very great importance, and might lead to discoveries that would remove our present difficulties in meteorology, and enable us to give a satisfactory and useful theory of the weather.

Wind. heat, by leffening or rarefying the atmofphere in any country, will produce the fame effect in countries to the weftwards when north winds happen to be blowing.

54 Why they are fo frequent in North America. In North America, the north-weft winds become gradually more frequent as we advance northwards. The eaft coaft of this continent, where the obfervations were made from which this conclufion was drawn, is alone cultivated; the reft of the country is covered with wood. Now cultivated countries are well known to be warmer than thofe which are uncultivated; the earth in the latter is fhaded from the fun, and never heated by his rays. The air, therefore, in the interior parts of America, muft be conftantly colder than near the eaft coaft. This difference will hardly be perceptible in the fouthern parts, becaufe there the influence of the fun is very powerful; but it will become gradually greater as we advance northwards, becaufe the influence of the fun diminifhes, and the continent becomes broader. Hence north-weft winds ought to become more frequent upon the eaft coaft as we advance northwards; and they will probably ceafe to blow fo often as foon as the whole continent of North America becomes cultivated.

55 Caufes of eaft and weft winds. Thus have we attempted to explain the caufes which produce the more general winds that prevail in the torrid and temperate zones. The eaft and weft winds, when they are not partial and confined to a very fmall portion of the atmofphere, feem to be nothing elfe but currents of air brought from the north or fouth by the caufes already mentioned, and prevented from proceeding farther by contrary currents. If thefe currents have come from the north, they will affume the appearance of eaft winds; becaufe their diurnal motion will be lefs than that of the more fouthern latitudes over which they are forced to remain ftationary. The fouthern currents will become weft winds, for a contrary reafon. This will furnifh us with a reafon for the coldnefs of eaft winds, compared with weft winds. If this account be true, there ought very frequently to be a weft wind in a latitude to the fouth of thofe places where an eaft wind blows. This might eafily be determined by keeping accurate regifters of the winds in different latitudes, and as nearly as poffible under the fame meridian; and upon the refult of thefe obfervations the truth or falfehood of the above conjecture muft finally reft.

56 Partial winds. Befides thefe more general winds, there are others which extend only over a very fmall part of the earth. Thefe originate from many different caufes. The atmofphere is compofed of three different kinds of air, oxygen, azote, and carbonic acid; to which may be added water. Great quantities of each of thefe ingredients are conftantly changing their aerial form, and combining with various fubftances; or they are feparating from other bodies, affuming the form of air, and mixing with the atmofphere. Partial voids, therefore, and partial accumulations, muft be continually taking place in different parts of the atmofphere, which will occafion winds varying in direction, violence, and continuance, according to the fuddennefs and the quantity of air deftroyed or produced. Befides thefe there are many other ingredients conftantly mixing with the atmofphere, and many partial caufes of condenfation and rarefaction in particular places. To thefe, and other caufes probably hitherto unknown, are to be afcribed all thofe winds which blow in any place befides the general ones already explained; and which, as they depend on caufes hitherto at leaft reckoned contingent, will probably for ever prevent uniformity and regularity in the winds. All thefe caufes, however, may, and probably will, be difcovered: the circumftances in which they will take place, and the effects which they will produce, may be known; and whenever this is the cafe, the winds of any place may in fome meafure be reduced to calculation.

It is of importance, in the firft place, to know the general winds, and the caufes which produce them; they will blow ofteneft in every country, continue longeft, and in a great meafure ftamp the nature of the climate. To explain thefe has been the intention of this effay; and though we have probably failed of fuccefs, our attempt, we hope, will not be altogether ufelefs. The facts which are here collected will at leaft facilitate the labours of the future inquirer. Were accurate obfervations made over the whole globe of the direction and velocity of the winds, and efpecially of the time when they begin and ceafe to blow, fo much light would be thrown in a fhort time upon this important fubject, that a theory of the winds might be formed, capable of explaining all the phenomena, and really ufeful to the human race.

Hot Winds. See Samiel.

Wind-Flower. See Anemony.

Wind-Mill, a kind of mill, the internal parts of which are much the fame with thofe of a water-mill: from which, however, it differs, in being moved by the impulfe of the wind upon its fails or vanes, which are to be confidered as a wheel in axis. See Mechanics, n° 62.

Wind-Gage. See *Wind-Gage.*

Wind-Galls, in farriery. See there § xxxiii.

Wind-Gun. See *Air-Gun.*

Inftruments for meafuring the ftrength, velocity, &c. *of the Wind.* See *Wind-Gage*, Anemometer, and Anemoscope.

Wind-Hatch, in mining, a term ufed to exprefs the place at which the ore is taken out of the mines.

Wind-Shock, a name given by our farmers to a diftemper to which fruit-trees, and fometimes timber-trees, are fubject. It is a fort of bruife and fhiver throughout the whole fubftance of the tree; but the bark being often not affected by it, it is not feen on the outfide, while the infide is twifted round, and greatly injured. It is by fome fuppofed to be occafioned by high winds; but others attribute it to lightning. Thofe trees are moft ufually affected by it whofe boughs grow more out on one fide than on the other. The beft way of preventing this in valuable trees, is to take care in the plantation that they are fheltered well, and to cut them frequently in a regular manner while young.

Wind-Taught, in fea-language, denotes the fame as ftiff in the wind. Too much rigging, high mafts, or any thing catching or holding wind aloft, is faid to hold a fhip wind-taught; by which they mean, that fhe ftoops too much in her failing in a ftiff gale of wind. Again, when a fhip rides in a main ftrefs of wind and weather, they ftrike down her top-mafts, and bring her yards down, which elfe would hold too much wind, or be too much diftended and wind-taught.

Wind-Sails, a fort of wide tube or funnel of canvas, employed to convey a ftream of frefh air downward into the lower apartments of a fhip.

This machine is ufually extended by large hoops fituated in different parts of its height. It is let down perpendicularly through the hatches, being expanded at the lower end like the bafe of a cone; and having its upper fide open on the fide which is placed to windward, fo as to receive the full current of wind; which entering the cavity, fills the tube, and rufhes downwards into the lower regions of the fhip. There are generally three or four of thefe in our capital fhips of war, which, together with the ventilators, contribute greatly to preferve the health of the crew.

WINDAGE *of a Gun*, is the difference between the diameter of the bore and the diameter of the ball.

WINDLASS, a machine used for raising huge weights, as guns, ftones, anchors, &c.

It is very fimple, confifting only of an axis or roller, fupported horizontally at the two ends by two pieces of wood and a pulley; the two pieces of wood meet at top, being placed diagonally fo as to prop each other; the axis or roller goes through the two pieces, and turns in them. The pulley is faftened at top where the pieces join. Laftly, there are two ftaves or handfpikes which go through the roller, whereby it is turned, and the rope which comes over the pulley is wound off and on the fame.

WINDLASS, in a fhip, is an inftrument in fmall fhips, placed upon the deck, juft abaft the fore maft. It is made of a piece of timber fix or eight feet fquare, in form of an axletree, whofe length is placed horizontally upon two pieces of wood at the ends thereof, and upon which it is turned about by the help of handfpikes put into holes made for that purpofe. This inftrument ferves for weighing anchors, or hoifting of any weight in or out of the fhip, and will purchafe much more than any capftan, and that without any danger to thofe that heave; for if in heaving the windlafs about, any of the handfpikes fhould happen to break, the windlafs would pall of itfelf.

WINDOW, an aperture or open place in the wall of a houfe to let in the light. See ARCHITECTURE, n° 78.

The word is Welch, *uynt dor*, fignifying the paffage for the wind. Window is yet provincially denominated *windor* in Lancafhire; i. e. *wind-door*, or the paffage for air, as that for people was peculiarly called the *door*.

Before the ufe of glafs became general, which was not till towards the end of the 12th century, the windows in Britain feem generally to have been compofed of paper. Properly prepared with oil, this forms no contemptible defence againft the intrufions of the weather, and makes no incompetent opening for the admiffion of the light. It is ftill ufed by our architects for the temporary windows of unfinifhed houfes, and not unfrequently for the regular ones of our work-fhops. But fome of the principal buildings we may reafonably fuppofe to have been windowed in a fuperior manner. They could, however, be furnifhed merely with lattices of wood or fheets of linen, as thefe two remained the only furniture of our cathedrals nearly to the eighth century; and the lattices continued in fome of the meaner towns of Lancafhire to the 18th; and in many diftricts of Wales, and many of the adjoining parts of England, are in ufe even to the prefent moment. Thefe feem all to have been fixed in frames that were called *capfamenta*, and now therefore *cafements* in Wales and Lancafhire.

WINDSOR, a borough-town of Berkfhire, 22 miles weft of London, moft remarkable for the magnificent palace or caftle fituated there on an eminence, which commands the adjacent country for many miles, the river Thames running at the foot of the hill. The knights of the garter are inftalled in the royal chapel here. It fends two members to parliament. W. Long. 0. 36. N. Lat. 51. 30.

WINDWARD, in the fea-language, denotes any thing towards that point from whence the wind blows, in refpect of a fhip: thus windward-tide, is the tide which runs againft the wind.

WINE, an agreeable fpirituous liquor, produced by fermentation from thofe vegetable fubftances that contain faccharine matter. A very great number of vegetable fubftances may be made to afford wine, as grapes, currants, mulberries, elder, cherries, apples, pulfe, beans, peas, turneps, radifhes, and even grafs itfelf. Hence, under the clafs of wines or vinous liquors, come not only wines, abfolutely fo called, but alfo ale, cyder, &c. Wine.

Wine, however, is in a more particular manner appropriated to the liquor drawn from the fruit of the vine. The procefs of making wine is as follows: When the grapes are ripe, and the faccharine principle is developed, they are then preffed, and the juice which flows out is received in veffels of a proper capacity, in which the fermentation appears, and proceeds in the following manner: At the end of feveral days, and frequently after a few hours, according to the heat of the atmofphere, the nature of the grapes, the quantity of the liquid, and the temperature of the place in which the operation is performed, a movement is produced in the liquor, which continually increafes; the volume of the fluid increafes; it becomes turbid and oily; carbonic acid is difengaged, which fills all the unoccupied part of the veffel, and the temperature rifes to the 72,5th degree. At the end of feveral days thefe tumultuous motions fubfide, the mafs falls, the liquor becomes clearer, and is found to be lefs faccharine, more odorant, and of a red colour, from the reaction of the ardent fpirit upon the colouring matter of the pellicle of the grape. Chaptal's Chemistry, part iv. fect. v. chap. 6. 1 Method of making wine.

The wine is ufually taken out of the fermenting veffels at the period when all the phenomena of fermentation have fubfided. When the mafs is fettled, the colour of the liquor is well developed, when it has become clear, and its heat has difappeared; it is put into cafks, where, by a fecond infenfible fermentation, the wine is clarified, its principles combine more perfectly together, and its tafte and fmell become more and more developed. If this fermentation be ftopped or fuffocated, the gafeous principles are retained, and the wine is brifker, and more of the nature of muft.

It appears, from the interefting experiments of the Marquis de Bullion, that the vinous fermentation does not take place unlefs tartar be prefent.

The caufes of an imperfect fermentation are the following: 1. If the heat be too little, the fermentation languifhes, the faccharine and oily matters are not fufficiently elaborated, and the wine is unctuous and fweet. 2. If the faccharine body be not fufficiently abundant, as happens in rainy feafons, the wine is weak, and the mucilage which predominates caufes it to become four by its decompofition. 3. If the juice be too watery, concentrated and boiling muft is added. 4. If the faccharine principle be not fufficiently abundant, the defect may be remedied by the addition of fugar. Macquer has proved that excellent wine may be made of verjuice and fugar; and M. de Bullion has made wine at Bellejames with the verjuice of his vine rows and moift fugar. 2 Caufes of imperfect fermentation.

There have been many difputes to determine whether grapes fhould be preffed with the ftalks or without. This depends on the nature of the fruit. When they are highly charged with faccharine and mucilaginous matter, the ftalk corrects the infipidity of the wine by its bitter principle: but when, on the contrary, the juice is not too fweet, the ftalk renders it drier, and very rough.

The colouring principle of wine is of a refinous nature, and is contained in the pellicle of the grape; and the fluid is not coloured until the wine is formed; for until then there is nothing which can diffolve it: and hence it is that white wine may be made of red grapes, when the juice of the grape is expreffed, and the hufk thrown away. If wine be evaporated, the colouring principle remains in the refidue, and may be extracted by fpirit of wine. Old wines lofe their colour, a pellicle being precipitated, which is either depofited on the fides of the bottles, or falls to the bottom. If 3 Colouring matter of wine.

Wine

Wine.

wine be expofed to the heat of the fun during the fummer, the colouring matter is detached in a pellicle, which falls to the bottom: when the veffel is opened, the difcolouring is more fpeedy, and it is effected in two or three days during the fummer. The wine thus deprived of its colour is not perceptibly weakened.

4
Vinous fermentation explained.

The vinous fermentation has been examined with great accuracy by M. Lavoifier. According to him, the vegetable juice of which wine is to be made confifts of oxygen, hydrogen, and carbon, combined with one another in different proportions, fo as to form chiefly water and fugar. The fermentation produces a feparation of the elements, and a new combination of them; a quantity of the oxygen and carbon combine and fly off in the ftate of carbonic acid; part of the carbon, oxygen, and hydrogen, combine firft with each other, and then all together, to form alcohol; another part forms acetous acid; the water ftill remains, and a refiduum falls to the bottom compofed of the three elements combined in other proportions.

5
Ingredients in different wines.

The different kinds of wines produced in Europe and other parts of the world are many; the principal of them and their qualities are well known: a catalogue of them would ferve no purpofe here. We fhall, however, fubjoin a table of the quantities of the ingredients of the principal kinds from Neumann's Chemiftry.

A quart of	Highly rectified Spirit.			Thick, oily unctuous, refinous matter.			Gummy and tartareous matter.			Water.			
	oz.	dr.	gr.	oz.	dr.	gr.	oz.	dr.	gr.	lb.	oz.	dr.	gr.
Aland	1	6	00	3	2	00	1	5	00	2	5	3	00
Alicant	3	6	00	6	0	20	0	1	40	2	2	6	00
Burgundy	2	2	00	0	4	00	0	1	40	2	9	0	20
Carcaffone	2	6	00	0	4	10	0	1	20	2	8	4	30
Champagne	2	5	20	0	6	40	0	1	00	2	8	3	00
French	3	0	00	0	6	40	0	1	00	2	8	0	20
Frontignac	3	0	00	3	4	00	0	5	20	2	4	6	30
Vin Grave	2	0	00	0	6	00	0	2	00	2	9	0	00
Hermitage	2	7	00	1	2	00	0	1	40	2	7	5	20
Madera	2	3	00	3	2	00	2	0	00	2	4	3	00
Malmfey	4	0	00	4	3	00	2	3	00	2	1	2	00
Vino de Monte Pulciano	2	6	00	0	3	00	0	2	40	2	8	0	20
Mofelle	2	2	00	0	4	20	0	1	30	2	9	0	10
Mufcadine	3	0	00	2	4	00	1	0	00	2	5	4	00
Neufschatel	3	2	00	4	0	00	1	7	00	2	2	7	00
Palm Sec	2	3	00	2	4	00	4	4	00	2	2	5	00
Pontac	2	0	00	0	5	20	0	2	00	2	9	0	40
Old Rhenifh	2	0	00	1	0	00	0	2	20	2	8	5	40
Rhenifh	2	2	00	0	3	20	0	1	34	2	9	1	06
Salamanca	3	0	00	3	4	00	2	0	00	2	3	4	00
Sherry	3	0	00	6	0	00	2	2	00	2	0	6	00
Spanifh	1	2	00	2	4	00	9	4	00	1	10	6	00
Vino Tinto	3	0	00	6	4	00	1	6	00	2	0	6	00
Tokay	2	2	00	4	3	00	5	0	00	2	0	3	00
Tyrolred wine	1	4	00	1	2	00	0	4	00	2	8	6	00
Red wine	1	6	00	0	4	40	0	2	00	2	9	3	20
White	2	0	00	0	7	00	0	3	00	2	7	0	00

The colour of wine is frequently artificial; a deep red is almoft always the effect of artificial additions, as of the red-woods, elder-berries, bilberries, &c. In France no fecret is made of thefe practices, the colouring matters being publicly thrown out after they have been ufed.

It is well known to be a common practice among wine-coopers, innkeepers, and other dealers in wines, to adulterate bad wine in order to conceal its defects: if, for inftance, the wine be four, they throw into it a quantity of fugar of lead, which entirely takes away the four tafte. For fimilar purpofes alum is often mixed with wine. Such fubftances, however, are well known to be extremely pernicious to the human conftitution; it becomes of importance therefore to be able to detect them whenever they happen to be contained in wine. Several chemifts who have turned their attention to this fubject, have furnifhed us with tefts for this purpofe.

6
Adulteration of wine.

To detect lead in wine. Wall's Chem. Effays vol. i. p. 3.

To difcover lead diffolved in wine, boil together in a pint of water an ounce of quicklime and half an ounce of flour of brimftone; and when the liquor, which will be of a yellow colour, is cold, pour it into a bottle, and cork it up for ufe. A few drops of this liquor being dropt into a glafs of wine or cyder containing *lead*, will change the whole into a colour more or lefs *brown*, according to the quantity of lead which it contains. If the wine be wholly free from lead, it will be rendered turbid by the liquor, but the colour will be rather a dirty white than a black brown.

By this teft, however, iron is alfo precipitated when diffolved in wine, and is apt to be taken for lead; a miftake which has ruined feveral honeft merchants. The following teft is therefore preferable, as not liable to the fame inconvenience.

8
Another method.

Take equal parts of calcined oyfter-fhells and crude fulphur in fine powder, and put them in a crucible, which put into a fire, and raife the heat fuddenly till it has been expofed to a white heat for 15 minutes. Then take it out, let it cool, beat the ingredients to powder, and put them into a well corked bottle. To prepare the teft-liquor, put 20 grains of this powder, together with 120 grains of cream of tartar, and put them into a ftrong bottle, fill it up with water, boil it for an hour, and let it cool. Cork the bottle immediately, and fhake it from time to time. After fome hours repofe, decant off the clear liquor into an ounce vial, having firft put 22 drops of muriatic acid into each vial. Cork thefe vials accurately with a little wax mixed up with a little turpentine. One part of this liquor, mixed with three parts of fufpected wine, will difcover the prefence of the fmalleft quantity of lead or copper, by a very fenfible black precipitate, and of arfenic by an orange precipitate; but will have no effect on iron, if there be any: the prefence of which, however, may be afcertained by adding a little potafh, which will turn the liquor black if there be any iron. Pure wine remains limpid after the addition of this liquor ‡.

9
State of lead in wine.

As this fubject is of importance, we fhall add M. Fourcroy's obfervations on the ftate in which lead exifts in wine, and on the methods of difcovering its prefence: "Of the different principles which compofe wine, there was no doubt (fays he) but that acids were the only ones which were capable of diffolving oxyd (*calx*) of lead. But was it the tartareous acid always contained in larger or fmaller quantity in wine, or the acetous acid developed in thofe which have become fharp, and which there is a greater temptation to fweeten? Experience had proved to me that the acidulous tartrite of potafh, or the cream of tartar, takes oxyd of lead from the acetous acid, and a precipitate of tartrite of lead is formed; the pure tartareous acid prepared in Scheele's method produces the fame effect. In order to underftand how the fharp wine which contains thefe two acids can hold the oxyd of lead in folution, I made the experiments which gave me the following refults: 1. The acidulous tartrite (*crem. tart.*) has no fenfible action upon the oxyds of lead; 2. The pure tartareous acid has a flight action upon the oxyds, and forms on their furface a little tartrite of lead (*tartarifed lead*), in a

‡ *Jour. de Phyfique* Octobr 1791.

a white powder; 3. Wine which only contains the tartareous acidule, would not have any action upon the ſemi-vitrous oxyd of lead or litharge; 4. Sharp wine which we attempt to ſweeten by this oxyd of lead, acts firſt upon it by the acetous acid it contains; 5. When this acetite of lead is formed, the tartareous acid precipitates it in the form of tartrite of lead: this is proved by the precipitate which the ſolution of the acetite of lead or ſugar of lead forms in the wine; 6. But the acetous acid, if it be in large enough quantity, rediſſolves the tartrite of lead in the wine juſt as diſtilled water would. Bergman has pointed out this ſolution of tartrite of lead in acetous acid for diſtinguiſhing the tartareous ſalt from the ſulfat of lead (*vitriol of lead*); 7. As this ſolution of tartrite of lead in the acetous acid is much quicker, and more eaſy in ſharp wines than in diſtilled water and vinegar, it is probable that the cauſe of this difference depends upon the citric and malic acids which I have found in wine, and which I ſhall take notice of again on another occaſion; 8. Litharged wine then, or wine ſweetened with lead, contains tartrite diſſolved in the acetous acid, and perhaps at the ſame time in the malic and citric acids.

"It was neceſſary afterwards to know the properties of this combination. What experience has taught me is as follows: I particularly examined the tartrite of lead and its ſolution in acetous acid. The tartrite of lead is ſcarcely at all ſoluble in water; it is in the form of powder, or of ſmall white grains which have no ſenſible taſte; when it is diſſolved in vinegar, the vinegar is ſoftened, its ſharpneſs is diminiſhed remarkably, and the ſolution takes a ſlight ſweetiſh taſte, much leſs ſtrong than that of the pure acetite of lead. This taſte proves that the union of the tartrite of lead with vinegar is not only a ſolution like that of ſalt in water, by which the properties of the ſalt are not changed, but a combination which gives occaſion to new properties. It is a kind of a triple ſalt, different from thoſe we have hitherto known, formed of two acids and of one baſe; whereas the other triple ſalts deſcribed hitherto are compoſed of one acid and two baſes. I name this new triple ſalt *aceto-tartrite of lead*. The acetous acid adheres to it more than water in a common ſolution: what is remarkable in this combination is, that the two acids appear to adhere to the baſe with an equal force, although they have a different attraction for it: nothing is neceſſary to produce this equilibrium, but to unite firſt the oxyd of lead with the acid to which it adheres the moſt ſtrongly, and afterwards to put this firſt compound in contact with the weaker acid.

"It was neceſſary, in order to diſcover eaſy and certain methods of aſcertaining the preſence of lead in wine, to examine with care the properties and phenomena of the decompoſitions of the aceto-tartrite of lead. Fixed alkalis and ammoniac (*volatile alkali*) precipitate from this ſalt an oxyd of lead, which is of a greyiſh white colour; but as they occaſion a precipitate in pure wine, they cannot be of any uſe. The ſulphuric (*vitriolic*) acid decompoſes the aceto-tartrite of lead, and forms with it inſtantly ſulfat of lead; which being very little ſoluble, and very heavy, is precipitated. The oxalic, or pure ſaccharine acid, and the acidulous oxalat, or the ſalt of ſorrel of the ſhops, likewiſe decompoſe this ſalt, and take from it the lead. The oxalat of lead is precipitated in great abundance: theſe two acids, the ſulphuric and oxalic acids, not producing any precipitate in pure wine, are very proper to ſhow the preſence of lead in wine. The ſulfat and oxalat of lead, when they are precipitated from wine, are coloured, whereas they are very white when they are formed in diſtilled water; but their red or brown colour does not prevent us from diſcovering them by a very ſimple method. If the precipitates be collected with care, and are cautiouſly heated upon a coal with a blow-pipe, they ſmoke, become white, exhale vapours, paſs ſucceſſively thro' the ſtates of the red and yellow oxyds of lead, and at length are reduced into metallic globules at the inſtant they are perceived to be agitated by a very evident efferveſcence: if we ceaſe to blow at this inſtant, we obtain globules upon the charcoal. In order to this, it is neceſſary, however, that the charcoal be ſolid, and be not cracked, and that we ſhould not have blowed too ſtrongly; otherwiſe the globules would be abſorbed, and would diſappear. The ſulfat of lead requires a longer time to be reduced than the oxalat of the ſame metal, and there is a greater hazard of loſing the metallic particles, which, beſide, are in ſmall quantity.

"To theſe two firſt proceſſes, already ſufficiently certain of themſelves, I wiſhed to be able to add one which might be capable of pointing out inſtantly the preſence of lead, by an appearance belonging excluſively to this metal, and which might unite to this advantage that of manifeſting very ſmall quantities of it. Diſtilled water impregnated with ſulphurated hydrogenous gas, or hepatic gas, extricated from ſolid alkaline ſulphurets (*livers of ſulphur*) by acids, preſented me with theſe properties. This ſolution blackens very deeply that of the aceto-tartrite of lead, and renders $\frac{1}{10000}$th of this ſalt in water or in wine very ſenſible. The ſenſibility of this reactive is ſuch, that we may dilute litharged wine with a ſufficient quantity of water to take away almoſt entirely the colour of the wine, and this reactive will ſtill produce a very manifeſt alteration. The ſulphurated water has, beſides, the advantage not to occaſion any change in the wines which do not contain a metallic ſubſtance, and it is not precipitated by the acids of wine, like the ſolutions of alkaline ſulphurets. In order to procure this reactive pure, it is neceſſary to prepare it at the inſtant of the experiment, by receiving in a vial full of diſtilled water, and inverted upon a ſhelf of a ſmall hydro-pneumatice apparatus, filled with diſtilled water, the ſulphurated hydrogenous gas, ſeparated from the ſolid ſulphuret of potaſh by the ſulphuric or muriatic acid, and firſt filtered through water in another vial; when the ſecond vial contains the third of its volume of the ſulphurated hydrogenous gas, the gas is ſhaken ſtrongly with the water, which fills the two-thirds of the vial; and when the abſorption is over, the teſt liquor is prepared. This reactive changes very quickly in the air: it is neceſſary to make it the moment it is to be employed, and to keep it in a veſſel quite full and well corked. If there were any fear that the black colour and the precipitation by the gaſeous ſulphurated water ſhould not be ſufficient to prove the preſence of lead in ſpirituous liquors, I would obſerve, that this fear would be diminiſhed by employing the three reactives mentioned in this memoir, and by depending only on the correſpondent effects of theſe three reactives: but all ſuſpicion would be removed, by reducing the three precipitates by the blow-pipe, and obtaining globules of lead from each of them." 12

Method of detecting alum diſſolved in wine.

Some years ago, the Academy of Lyons propoſed the following prize-queſtion, What is the beſt method of aſcertaining the preſence and the quantity of *alum* diſſolved in wine, eſpecially in very deep coloured red wine? The prize was gained by M. J. S. Beraud. From his experiments, it appears that a mixture of lime-water and wine in any proportion whatever, will at the end of 12 or 15 hours furniſh a quantity of cryſtals, which may be ſeparated by filtration, and that theſe cryſtals will be eaſieſt diſcovered when the quantities of wine and lime-water are equal; but that wine containing alum diſſolved in it, will not form cryſtals when mixed with lime-water, but merely depoſits a muddy ſediment. To know therefore whether any wine contains alum or

or not, we have only to mix a ſmall quantity of it with lime-water: if cryſtals are formed, it contains no alum; if not, it does. Again, if wine contains alum, the reſiduum that remains after filtration will, as it dries, ſplit into quadrilateral ſegments, which will detach themſelves from the paper which contains them; but if the wine contains no alum, the reſiduum, after it is dry, will remain united and attached to the paper. If one meaſure of wine and two thirds of a meaſure of lime-water depoſit cryſtals, we are certain that if the wine contains alum, the proportion of that alum to the wine will be leſs than 1 to 1152; if, when equal parts of wine and lime-water are mixed, no cryſtals be depoſited, we may be ſure that more than $\frac{1}{400}$th part of the maſs of wine conſiſts of alum.

A great proportion of the wine conſumed in this country is brought from Spain and Portugal; government has always diſcouraged the importation of French wines by heavy taxes. We are not ſure how far ſuch conduct is founded on good policy, as the French wines are confeſſedly the beſt, and might be the cheapeſt; but ſuch is the jealouſy and enmity that has always ſubſiſted between Britain and France, that both nations have been contented to injure themſelves provided they could do a greater injury to their neighbours. Beſides, the advantages which Britain derives from the Portugal trade are very great, and it would not be eaſy perhaps to ſecure them on any other terms.

13
Directions for the treatment of imported wines.

It may be worth while to inſert here a few directions about the treatment of wines after they have been imported into this country.—On landing, the leſs they are expoſed the better; for they are affected by the ſeaſons, and more or leſs by climate. March and April are the proper times for ſhipping wines from France, and they will be landed in England and Ireland in the ſame degree of temperature. The great art in keeping wines is to prevent their fretting, which is done by keeping them in the ſame degree of heat. In ſpring and fall, the wines in Bourdeaux are ſubject to changes that may be dangerous, if not prevented by neceſſary rackings: theſe changes are ſolely the effect of the ſeaſons. If wines are chilled, and of courſe turn foul, from being ſhipped and landed in cold weather, they will ſoon recover by putting them in a warm vault, well covered with ſaw-duſt. As ſoon as they are in the vault, they ought to be covered up. But if ſhipped and landed in ſummer, if the ſmalleſt degree of fermentation be found on them, it will be requiſite to dip the bung clothes in brandy, and leave the bungs looſe for ſome days, to give it time to cool; and if in a fortnight or three weeks the fermentation do not ceaſe, and the wine become bright, it will be proper to rack it (matching the hogſheads well with brimſtone), and force it with the whites of eight eggs. If it then becomes fine, bung it tight, and let it remain ſo until it is bottled. If wines new landed are wanted ſoon for the bottle, it will be neceſſary to force them immediately, and let them remain bunged cloſe for at leaſt a month, to recover from the forcing, or if two months the better; for wines bottled in high order come much ſooner into drinking than if bottled when flat, which all wines are after forcing. Wine muſt never be bottled the leaſt foul, which produces a tendency to fret; and if bottled in this ſtate, will never come in order, but may poſſibly be loſt: for this there is no remedy but repeated rackings; and care muſt be taken (after rinſing the hogſheads well and drawing them) to burn a good piece of match in them. This cools the wine, and there is no danger of hurting the colour, for it recovers it in a little time: but if it did, it is abſolutely neceſſary; for if wine is ſuffered to continue on the fret, it will wear itſelf to nothing. Wines bottled in good order may be fit to drink in ſix months; but they are not in perfection before twelve: from that to two years they may continue ſo; but it would be improper to keep them longer, for wines in general have not the body they had formerly, from the vines being too much forced.

It ſometimes happens that wines ſcuddy and ſtubborn will not fall with one or even two forcings. It will then be proper to give them five or ſix gallons of good ſtrong wine, and force them with the whites of a dozen eggs, with a tea-ſpoonful of ſand produced from ſawing-marble, or a ſmall ſpoonful of fine ſalt. Bottled wine in winter ſhould be well covered with ſaw-duſt, and if the vaults are cold and damp, ſtrew it deep on the floor; if ſaw-duſt is thrown upon the hogſheads, and their ſides are bedded ſome inches thick, it will keep them from the fret.

The ſame treatment is to be regarded with white wines, except that they require to be higher matched, particularly Muſcat wines; ſuch as Frontignac, Beziers, &c. which being often ſweetened with honey, are very ſubject to fret; and theſe only frequent rackings, with a great deal of brimſtone, can cool. Hermitage, from not being ſufficiently dried, and poſſeſſing more richneſs than claret, is alſo very liable to come on the fret, and will require much the ſame treatment as the Muſcat wines. Attention ſhould be had to bottle in fine weather, when the wind is north; but to avoid cold or froſty weather. The months of April and October are favourable. The beſt time to bottle port wine is four years after the vintage, and to keep them two years in bottle before you begin to uſe them. When wines are racked, and the lees immediately paſſed thro' flannel bags into cloſe-necked jars, and directly bottled, there will be very little loſt by rackings, as the wine when fine may ſerve for filling up.

When wines are deſtined for warm climates, it may be proper to rinſe the hogſheads with brandy; and in bottling many rinſe the bottles and corks with it. Wines that have remained a certain time (three or four months) in a vault, and made leſs or more lee, ought never to be ſent into the country without firſt racking them, otherwiſe they may be liable to fret; and if bottled in that ſtate, may riſk being loſt.

Wines which may be ordered for immediate drinking will be forced on the ſhipping, and in a few weeks after they are landed will be fit for the bottle. The forcings proper for claret are the whites of a dozen eggs, beat up with a tea-ſpoonful of fine ſalt, and well worked with a forcing rod. Take care to uſe no bad egg. This is for one hogſhead.

The forcing for white wine is iſinglas diſſolved in wine. One ounce is ſufficient for two hogſheads. No ſalt is to be uſed in forcing the white wines. See *Croft on Wines*, 8vo, 1788.

14
Receipt for making *raiſin-wine*.

We ſhall inſert here the following receipt for making *raiſin-wine*.—To a 20 gallon veſſel take 100 pounds of raiſins; pick off the ſtalks, chop them groſsly, and put them into an open tub more wide than deep. Add two parts in three of the water to them, and let them ſtand 15 days, ſtirring them well every day. Then ſtrain and preſs them, putting aſide the liquor that runs from them. Add the remainder of the water to the raiſins that have thus been preſſed, and let it ſtand upon them one week, frequently ſtirring them as before. Then preſs off the liquor, and add it to what you firſt collected; putting both runnings together into your veſſel, together with one quart of brandy. To colour it, burn three-fourths of a pound of ſugar into a ſmall quantity of the liquor, and add this to the wine. When the liquor in the barrel has done ſinging, ſtop the veſſel cloſe, and let it ſtand till fit to be bottled. The greater the quantity which the veſſel holds, and the longer it is kept in the wood, the better will it be.

WINE-Preſs, a machine contrived to ſqueeze the juice out of

WINTERA Aromatica. Plate DX.

A. Bell Pr. Wal. Sculptor fecit.

of grapes, and consisting of several pieces of timber, variously disposed, which compose three bodies of timber-work, closely united to the axis, which serves as a swing whereby it may be moved by the vice. Of these there are different sizes as well as different constructions; for an account of which, illustrated by figures, see Miller's Gardener's Dictionary, article *Wine-Press*.

Spirit of Wine, or *alcohol*, a name given by chemists to every ardent spirit produced by distillation. See Chemistry-*Index*.

WING, that part of a bird, insect, &c. whereby it is enabled to fly. See Bird and Ornithology.

Wings, in military affairs, are the two flanks or extremes of an army, ranged in form of a battle; being the right and left sides thereof.

WINTER, one of the four seasons or quarters of the year. See Season, &c.

Winter commences on the day when the sun's distance from the zenith of the place is greatest, and ends on the day when its distance is at a mean between the greatest and least.

Under the equator, the winter as well as other seasons return twice every year; but all other places have only one winter in the year; which in the northern hemisphere begins when the sun is in the tropic of Capricorn, and in the southern hemisphere when in the tropic of Cancer; so that all places in the same hemisphere have their winter at the same time.

Winter-Berry. See Physalis.

WINTERA, in botany: A genus of plants of the class of *polyandria*, and order of *pentagynia*; and in the natural system arranged under the 12th order, *Holoraceæ*. The calyx is three-lobed; there are six or twelve petals; there is no style; the fruit is a berry, which is club-shaped as well as the germen. There are two species; the aromatica and granadensis.

Wintera aromatica, is one of the largest forest-trees upon Terra del Fuego; it often rises to the height of 50 feet. Its outward bark is on the trunk grey and very little wrinkled, on the branches quite smooth and green. The branches do not spread horizontally, but are bent upwards, and form an elegant head of an oval shape. The leaves come out, without order, of an oval elliptic shape, quite entire, obtuse, flat, smooth, shining, of a thick leathery substance, evergreen, on the upper side of a lively deep green colour, and of a pale bluish colour underneath, without any nerves, and their veins scarcely visible; they are somewhat narrower near the footstalks, and there their margins are bent downwards. In general, the leaves are from three to four inches long, and between one and two broad; they have very short footstalks, seldom half an inch long, which are smooth, concave on the upper side, and convex underneath. From the scars of the old footstalks the branches are often tuberculated.

The peduncles, or footstalks for the flowers, come out of the *axillæ foliorum*, near the extremity of the branches; they are flat, of a pale colour, twice or three times shorter than the leaves; now and then they support only one flower, but are oftener near the top divided into three short branches, each with one flower. The bracteæ are oblong, pointed, concave, entire, thick, whitish, and situated one at the basis of each peduncle.

There is no calyx; but in its place the flower is surrounded with a spathaceous gem, of a thick leathery substance, green, but reddish on the side which has faced the sun: before this gem bursts, it is of a round form, and its size is that of a small pea. It bursts commonly so, that one side is higher than the other, and the segments are pointed. The corolla consists always of seven petals, which are oval, obtuse, concave, erect, white, have small veins, and are of an unequal size, the largest scarcely four lines long; they very soon fade, and drop off almost as soon as the gem bursts. The filaments are from 15 to 30, and are placed on the flat end side of the receptacle; they are much shorter than the petals, and gradually decrease in length towards the sides. The antheræ are large, oval, longitudinally divided into two, or as if each was made up of two oblong antheræ. The germina are from three to six, placed above the receptacle, turbinated, or of the shape of an inverted fig; flat on the inside, and somewhat higher than the stamina; they have no styles, but terminate in a stigma, which is divided into two or three small lobes.

Dr Solander, to whom the world is indebted for the description, never saw the fruit in its perfectly ripe state; but could conclude from the unripe fruit which he saw in abundance, that each germen becomes a separate seed-vessel, of a thick fleshy substance, and unilocular; and in each the rudiments of three, four, or five seeds were plainly discernible. See Plate DXL. where no 1. represents the spathaceous gem, after it is burst open. 2. The same. 3. The same (*a*) with the corolla (*b*) remaining within it. 4. One of the petals spread out. 5. The stamina (*a*) and the pistilla (*b*) after the gem and the corolla are taken away. 6. The outside of an anthera (*a*) with its filament (*b*). 7. The inside of the same. 8. The germina (*a*) situated on the centre of the receptacle, after the stamina have been removed; the lobated stigma (*b*). 9. The convex or outermost side of a germen (*a*) with its stigma (*b*). 10. The inside of the same. 11. A germen cut open longitudinally, so as to show the rudiments of the seeds. 12. A germen cut through transversely.

The weather is much more severe in the climate where these trees are natives than in Britain; here, therefore, it is thought they would thrive very well.

The bark of the wintera, or winter's cinnamon, brought over by the Dolphin, in respect to figure, exactly resembles that which was delineated by Clusius. The pieces are about three or four inches square, of different degrees of thickness, from a quarter to three quarters of an inch. It is of a dark brown cinnamon colour; an aromatic smell, if rubbed; and of a pungent hot spicy taste, which is lasting on the palate, though imparted slowly. It has the name of *winter's cinnamon*, from a faint resemblance in colour and flavour to that grateful aromatic, though differing from it greatly in every other respect. This bark is only brought to us from the Straits of Magellan, and is the produce of the tree above described; much celebrated as an antiscorbutic by the first discoverers, but unknown in the practice of physic, no quantity, except as a curiosity, having been brought to Europe till the return of the ships sent out on the expeditions to the South Seas. The bark which was substituted in the room of this is the canella alba of the shops. See Canella.

From several experiments made by Dr Morris, the cortex magellanicus appears to be an astringent of a particular kind, and therefore likely to be of use in several manufactures. Water is the proper solvent of this bark; though the saline, gummy, and resinous parts are so blended in it, as in saffron and some other vegetables, that it parts with them readily in proof and rectified spirits of wine, though not in so great a quantity.

The infusion and decoction of this bark were of so grateful an aromatic bitter taste, that it seems likely to be a pleasant vehicle for some of the nauseous drugs. With this view, on substituting the powder of this bark for the cardamom seeds in making the infusion of senna, as directed in the London Dispensatory, the nauseous smell and taste of

that excellent purgative was ſo effectually covered, as to be ſcarcely diſtinguiſhed by the niceſt palate. Tincture of rhubarb alſo prepared with this bark inſtead of cardamoms ſeemed far leſs diſagreeable.

WIRE, a piece of metal drawn through the hole of an iron into a thread of a fineneſs anſwerable to the hole it paſſed through.

Wires are frequently drawn ſo fine as to be wrought along with other threads of ſilk, wool, flax, &c.

The metals moſt commonly drawn into wire are gold, ſilver, copper, and iron. Gold-wire is made of cylindrical ingots of ſilver, covered over with a ſkin of gold, and thus drawn ſucceſſively through a vaſt number of holes, each ſmaller and ſmaller, till at laſt it is brought to a fineneſs exceeding that of a hair. That admirable ductility which makes one of the diſtinguiſhing characters of gold, is nowhere more conſpicuous than in this gilt wire. A cylinder of 48 ounces of ſilver, covered with a coat of gold, only weighing one ounce, as Dr Halley informs us, is uſually drawn into a wire, two yards of which weigh no more than one grain; whence 98 yards of the wire weigh no more than 49 grains, and one ſingle grain of gold covers the 98 yards; ſo that the ten thouſandth part of a grain is above one-eighth of an inch long.

Wire of Lapland. The inhabitants of Lapland have a ſort of ſhining ſlender ſubſtance in uſe among them on ſeveral occaſions, which is much of the thickneſs and appearance of our ſilver-wire, and is therefore called, by thoſe who do not examine its ſtructure or ſubſtance, *Lapland wire.* It is made of the ſinews of the rein deer, which being carefully ſeparated in the eating, are, by the women, after ſoaking in water and beating, ſpun into a ſort of thread, of admirable fineneſs and ſtrength, when wrought to the ſmalleſt filaments; but when larger, is very ſtrong, and fit for the purpoſes of ſtrength and force. Their wire, as it is called, is made of the fineſt of theſe threads covered with tin. The women do this buſineſs; and the way they take is to melt a piece of tin, and placing at the edge of it a horn, with a hole through it, they draw theſe ſinewy threads, covered with the tin, through the hole, which prevents their coming out too thick covered. This drawing is performed with their teeth; and there is a ſmall piece of bone placed at the top of the hole, where the wire is made flat; ſo that we always find it rounded on all ſides but one, where it is flat.

This wire they uſe in embroidering their clothes as we do gold and ſilver; they often ſell it to ſtrangers, under the notion of its having certain magical virtues.

WISDOM, uſually denotes a higher and more refined notion of things immediately preſented to the mind, as it were, by intuition, without the aſſiſtance of ratiocination.

Sometimes the word is more immediately uſed, in a moral ſenſe, for what we call *prudence,* or *diſcretion,* which conſiſts in the ſoundneſs of the judgment, and a conduct anſwerable thereto.

Wisdom of Solomon, one of the books of the Apocrypha. It abounds with Platonic language, and was probably written after the Chaballiſtic philoſophy was introduced among the Jews.

WIT, is a quality of certain thoughts and expreſſions, much eaſier perceived than defined. According to Mr Locke, wit lies in the aſſemblage of ideas, and putting thoſe together with quickneſs and variety, wherein can be found any reſemblance or congruity, thereby to make up pleaſant pictures and agreeable viſions to the fancy. Mr Addiſon limited this definition conſiderably, by obſerving, that every reſemblance of ideas does not conſtitute wit, but thoſe only which produce delight and ſurpriſe. Mr Pope defined wit to be a quick conception and an eaſy delivery: while, according to a late writer, it conſiſts in an aſſimilation of diſtant ideas.

The word *wit* originally ſignified *wiſdom.* A *witte* was anciently a *wiſe man:* the *wittenagemot,* or Saxon parliament, an aſſemblage of wiſe men. So late as the reign of Elizabeth, a man of pregnant *wit,* of great *wit,* was a man of vaſt *judgment.* We ſtill ſay, *in his wits, out of his wits,* for in or out of ſound mind. The word, however, is now applied in a more limited ſenſe.

Without attempting to expoſe the inaccuracy of the definitions above mentioned, or hazarding a definition of our own where ſo many eminent men have failed, we ſhall endeavour to ſhow in what true wit conſiſts.

It is evident that wit excites in the mind an agreeable ſurpriſe, and that this is owing entirely to the ſtrange aſſemblage of related ideas preſented to the mind. This end is effected, 1. By debaſing things pompous or *ſeemingly* grave; 2. By aggrandiſing things little or frivolous; 3. By ſetting ordinary objects in a particular and uncommon point of view, by means not only remote but apparently contrary. Of ſo much conſequence are ſurpriſe and novelty, that nothing is more taſteleſs, and ſometimes diſguſting, than a joke that has become ſtale by frequent repetition. For the ſame reaſon, even a pun or happy alluſion will appear excellent when thrown out extempore in converſation, which would be deemed execrable in print. In like manner, a witty repartee is infinitely more pleaſing than a witty attack: for though, in both caſes, the thing may be equally new to the reader or hearer, the effect on him is greatly injured, when there is acceſs to ſuppoſe that it may be the ſlow production of ſtudy and premeditation. This, however, holds moſt with regard to the inferior tribes of witticiſms, of which their readineſs is the beſt recommendation.

Campb. Philoſ. of Rhet. vol. i.

We ſhall illuſtrate theſe obſervations by ſubjoining a ſpecimen or two of each of theſe ſorts of wit:

Of the firſt ſort, which conſiſts in the debaſement of things great and eminent, Butler, amongſt a thouſand other inſtances, hath given us thoſe which follow:

> And now had Phœbus in the lap
> Of Thetis taken out his nap:
> And, like a lobſter boil'd, the morn
> From black to red began to turn.
>
> *Hudibras, part* ii. *canto* 2.

Here the low allegorical ſtyle of the firſt couplet, and the ſimile uſed in the ſecond, afford us a juſt notion of this loweſt ſpecies, which is diſtinguiſhed by the name of the *ludicrous.* Another ſpecimen from the ſame author you have in theſe lines:

> Great on the bench, great in the ſaddle,
> That could as well bind o'er as ſwaddle,
> Mighty he was at both of theſe,
> And ſtyl'd of *war,* as well as *peace:*
> So ſome rats of amphibious nature,
> Are either for the *land* or *water.*
>
> *Ibid. part* i. *canto* 1.

In this coarſe kind of drollery, thoſe laughable tranſlations or paraphraſes of heroic and other ſerious poems, wherein the authors are ſaid to be traveſtied, chiefly abound.

The ſecond kind, conſiſting in the aggrandiſement of little things, which is by far the moſt ſplendid, and diſplays a ſoaring imagination, theſe lines of Pope will ſerve to illuſtrate:

> As Berecynthia, while her offspring vie
> In homage to the mother of the ſky,
> Surveys around her in the bleſt abode,
> An hundred ſons, and every ſon a god:
> Not with leſs glory mighty dulneſs crown'd,
> Shall take thro' Grubſtreet her triumphant round;

And

And her Parnassus glancing o'er at once,
Behold a hundred sons, and each a dunce.

This whole similitude is spirited. The parent of the celestials is contrasted by the daughter of night and chaos; heaven by Grubstreet; gods by dunces. Besides, the parody it contains on a beautiful passage in Virgil adds a particular lustre to it. This species we may term the *thrasonical*, or *the mock-majestic*. It affects the most pompous language, and sonorous phraseology, as much as the other affects the reverse, the vilest and most grovelling dialect.

To this class also we must refer the application of grave reflections to mere trifles. For that *great* and *serious* are naturally associated by the mind, and likewise little and trifling, is sufficiently evinced by the common modes of expression on these subjects used in every tongue. An apposite instance of such an application we have from Philips:

My galligaskins, that have long withstood
The winter's fury and encroaching frosts,
By time subdued, (*What will not time subdue!*)
An horrid chasm disclose. *Splendid Shilling.*

Of the third species of wit, which is by far the most multifarious, and which results from what may be called the queerness or singularity of the imagery, we shall give a few specimens that will serve to mark some of its principal varieties. To illustrate all would be impossible. The first shall be where there is an apparent contrariety in the things she exhibits as connected. This kind of contrast we have in these lines of Garth:

Then Hydrops next appears amongst the throng;
Bloated and big she slowly sails along:
But like a miser in excess she's poor,
And pines for thirst amidst her watery store.
Dispensary.

A second sort is, where the things compared are what with dialecticians would come under the denomination of *disparates*, being such as can be ranked under no common genus. Of this we shall subjoin an example from Young:

Health chiefly keeps an Atheist in the dark;
A fever argues better than a *Clarke*:
Let but the logic in his pulse decay,
The Grecian he'll renounce, and learn to pray.
Universal Passion.

A third variety in this species springs from confounding artfully the proper and the metaphorical sense of an expression. In this way, one will assign as a motive what is discovered to be perfectly absurd, when but ever so little attended to; and yet, from the ordinary meaning of the words, hath a specious appearance on a single glance. Of this kind we have an instance in the subsequent lines:

While thus the lady talk'd, the knight
Turn'd th' outside of his eyes to white,
As men of inward light are wont
To turn their optics in upon't.
Hudibras, part iii. *canto* 1.

For whither can they turn their eyes more properly than to the light?

A fourth variety, much resembling the former, is when the argument or comparison (for all argument is a kind of comparison) is founded on the supposal of corporeal or personal attributes in what is strictly not susceptible of them; as in this,

But Hudibras gave him a twitch
As quick as lightning in the breech,
Just in the place where honour's lodg'd,
As wise philosophers have judg'd:
Because a kick in that place more
Hurts honour than deep wounds before.
Ibid. part ii *canto* 3.

The fifth, and only other variety which we shall mention, is that which arises from a relation, not in the things signified, but in the signs of all relations, no doubt the slightest. Identity here gives rise to puns and clinches; resemblance to quibbles, cranks, and rhimes: Of these it is quite unnecessary to exhibit specimens.

WIT (John de), a celebrated pensioner of Holland, and one of the greatest politicians of his time, was the son of Jacob de Wit, burgomaster of Dort, and was born in 1625. He became well skilled in civil law, politics, mathematics, and other sciences; and wrote a treatise on the Elements of Curved Lines, published by Francis Schooten. Having taken his degree of doctor of law, he travelled into foreign courts, where he became esteemed for his genius and prudence. At his return to his native county in 1650, he became pensionary of Dort, then counsellor-pensionary of Holland and West Friesland, intendant and register of the fiefs, and keeper of the great seal. He was thus at the head of affairs in Holland; but his opposition to the re-establishment of the office of stadtholder, which he thought a violation of the freedom and independence of the republic, cost him his life, when the prince of Orange's party prevailed. He and his brother Cornelius were assassinated by the populace at the Hague in 1674, aged 47.

WITCH, a person guilty of witchcraft.

WITCHCRAFT, a supernatural power which persons were formerly supposed to obtain the possession of by entering into a compact with the devil. They gave themselves up to him body and soul; and he engaged, that they should want for nothing, and that he would avenge them upon all their enemies. As soon as the bargain was concluded, the devil delivered to the witch an imp, or familiar spirit, to be ready at a call, and do whatever it was directed. By the assistance of this imp and the devil together, the witch, who was almost always an old woman, was enabled to transport herself in the air on a broom-stick or a spit to distant places to attend the meetings of the witches. At these meetings the devil always presided. They were enabled also to transform themselves into various shapes, particularly to assume the forms of cats and hares, in which they most delighted; to inflict diseases on whomsoever they thought proper; and to punish their enemies in a variety of ways.

The belief that certain persons were endowed with supernatural power, and that they were assisted by invisible spirits, is very ancient. The *sagae* of the Romans seem rather to have been sorcerers than witches; indeed the idea of a witch, as above described, could not have been prevalent till after the propagation of Christianity, as the heathens had no knowledge of the Christian *devil*.

Witchcraft was universally believed in Europe till the 16th century, and even maintained its ground with tolerable firmness till the middle of the seventeenth. Vast numbers of reputed witches were convicted and condemned to be burnt every year. The methods of discovering them were various. One was, to weigh the supposed criminal against the church bible, which, if she was guilty, would preponderate: another, by making her attempt to say the Lord's Prayer; this no witch was able to repeat entirely, but would omit some part or sentence thereof. It is remarkable, that all witches did not hesitate at the same place; some leaving out one part, and some another. Teats, through which the imps sucked, were indubitable marks of a witch: these were always raw, and also insensible; and, if squeezed, sometimes yielded a drop of blood. A witch could not weep more than three tears, and that only out of the left eye. This want of tears *Provincial Glossary.*

 was,

Witchcraft

was, by the witch-finders, and even by some judges, considered as a very substantial proof of guilt. Swimming a witch was another kind of popular ordeal generally practised: for this she was stripped naked, and cross-bound, the right thumb to the left toe, and the left thumb to the right toe. Thus prepared, she was thrown into a pond or river, in which, if guilty, she could not sink; for having, by her compact with the devil, renounced the benefit of the water of baptism, that element, in its turn, renounced her, and refused to receive her into its bosom. Sir Robert Filmer mentions two others by fire: the first, by burning the thatch of the house of the suspected witch; the other, burning any animal supposed to be bewitched by her, as a hog or ox. These, it was held, would force a witch to confess.

The trial by the stool was another method used for the discovery of witches. It was thus managed: Having taken the suspected witch, she was placed in the middle of a room upon a stool or table, cross-legged, or in some other uneasy posture; to which if she submitted not, she was then bound with cords: there she was watched, and kept without meat or sleep for the space of 24 hours (for, they said, within that time they should see her imp come and suck). A little hole was likewise made in the door for imps to come in at; and lest it should come in some less discernible shape, they that watched were taught to be ever and anon sweeping the room, and, if they saw any spiders or flies, to kill them; if they could not kill them, then they might be sure they were imps. If witches, under examination or torture, would not confess, all their apparel was changed, and every hair of their body shaven off with a sharp razor, lest they should secrete magical charms to prevent their confessing. Witches were most apt to confess on Fridays.

By such trials as these, and by the accusation of children, old women, and fools, were thousands of unhappy women condemned for witchcraft, and burnt at the stake. In the 18th volume of the Statistical Account of Scotland there is the trial of two witches, William Coke and Alison Dick, in Kirkaldy, in 1636. The evidence on which they were condemned is absolutely ridiculous: they were, however, burnt for witchcraft. The expences which the town and kirk-session were put to on this occasion were as follows:

In primis.—To Mr James Miller, when he went to Prestowne for a man to try them, 47 s.	L. 2	7
Item.—To the man of Culross, (the executioner), when he went away the first time, 12 s.	0	12
Item.—For coals for the witches, 24 s.	1	4
Item.—In purchasing the commission,	9	3
Item.—For one to go to Finmouth for the laird to sit upon their assize as judge,	0	6
Item.—For harden to be jumps to them,	3	10
Item.—For making of them,	0	8
Summa for the kirk's part	L. 17	10 Scots.

The Town's part of expences debursed extraordinarily upon William Coke and Alison Dick.

In primis.—For ten loads of coals to burn them, 5 merks,	L. 3	6	8
Item.—For a tar barrel, 14 s.	0	14	0
Item.—For towes,	0	6	0
Item.—To him that brought the executioner,	2	18	0
Item.—To the executioner for his pains,	8	14	0
Item.—For his expences here,	0	16	4
Carry over	L. 16	15	0
Brought over	L. 16	15	0
Item.—For one to go to Finmouth for the laird,	0	6	0
Summa town part,	L. 17	1	Scots
Both,	L. 34	11	
Or	L. 2	17	7 Ster.

For a considerable time after the inquisition was erected, the trials of witches (as heretics) were confined to that tribunal; but the goods of those who were condemned being confiscated to the holy office, its ministers were so active in discovering sorcerers, that the different governments found it necessary to deprive them of the cognisance of this crime. On the continent, commissioners were then appointed for the discovery and conviction of witches, who, though less active than the inquisitors, were but too zealous in prosecuting their function. In 1494, Sprenger and Institor, two persons employed in this commission, published a collection of trials, most of which had come before themselves, under the title of *Malleus Maleficarum*: this served as a kind of institute for their successors.

Dr H... cr, v... chester Tran... vol.

The first writers against witchcraft were stigmatized as Atheists, though they only endeavoured to prove the imbecility of the persons accused, and the infatuation or the knavery of their accusers. Such were the epithets bestowed by Dr Henry More, and even by Cudworth himself. Wierus, the disciple of the celebrated Agrippa, gave rise to the first great controversy on this subject. His master had taught him humanity; and he endeavoured, but with too feeble a hand, to stop the bloody proceedings of the judges. Wierus appears to have been a well-disposed, weak man, with extensive reading on his subject, but too narrow-minded to comprehend it thoroughly. He involved himself in unspeakable difficulties, by admitting the action of supernatural powers in certain diseases, and in possessions, while he denied that witches had any concurrence in them. These appearances (said he) are illusions of the devil, who persuades simple and melancholy persons that the mischief he himself performs, is done by them, and at their pleasure. He was weak enough to attempt the explanation of every story alleged by his antagonists, without questioning the truth of the facts.

Bodinus, a French lawyer of eminence, who had assisted at several trials of witches, wrote against Wierus, in his *Demonomania*. He urged the concurrent testimonies of sufficient witnesses, and the confessions of the witches themselves, to establish the existence of sorcery. Wierus owned that the unhappy persons believed themselves to be guilty of the crimes alleged against them, but that they were deceived by the devil. But what do you make of the witches meetings, cried Bodinus? The witches (replied his antagonist) are atrabilious. This explanation was so unsatisfactory that Wierus passed for a magician, whom the devil had furnished with specious arguments to save others from punishment. Lerchemer, Godelmann, Ewichius, Ewaldus, and some others, followed him, notwithstanding this stigma; but they were opposed by men of more acuteness and consistency than themselves; by Remigius, who had condemned several hundreds of sorcerers to the flames; Delrio, whose book is a complete Corpus Magiæ; Cujas, Erastus, Scribonius, Camerarius, and a croud of others.

In this country, while the belief in witchcraft was supported by royal authority (for James I. is universally known to have written on demonology) countenanced by Bacon, and generally adopted among the people, only one writer was hardy enough to oppose it. This was Reginald Scott, who published a collection of impostures detected, under the title of Discoveries of Witchcraft. James ordered the book to

to be burnt by the common executioner, and the judges continued to burn witches as usual. During the civil wars, upwards of eighty were hanged in Suffolk, on the accusations of Hopkins the witch-finder. Webster was the next writer against witchcraft; but he had a different fate from that of Scott, for most of his arguments were refuted by Glanville. This very acute writer was induced to publish his Philosophical Considerations about Witchcraft, by the apprehension, that the increasing disbelief of witches and apparitions tended to affect the evidences of religion, and even of a Deity. In respect of argument, he was certainly superior to his adversaries; his reasoning is perspicuous, though sometimes subtle, rested on the most specious foundations of evidence, and arranged with great skill.

On the continent, this controversy seemed almost forgotten, till Bekker published his *Monde Enchantée*, in which he denied the existence of witches on the Cartesian principle, that the Deity is the source of all action, consequently actions so opposite to his nature and attributes cannot be supposed to exist. He was answered by Frederick Hoffman, the father of the modern theory and practice of medicine, in his dissertation *De Diaboli Potentia in Corpora*.

The latest witchcraft frenzy was in New England, about 1692, when the execution of witches became a calamity more dreadful than the sword or the pestilence. The accusers became so daring, that neither civil nor religious authority would have proved a security against their attacks, if all the prosecutions had not been suddenly dropped, and the prisoners set at liberty. So far did those wretches proceed in absurdity, that a dog was accused of throwing persons into fits by looking at them. As soon as the prosecutions were stopped, all reports of witchcraft ceased.

It would be ridiculous to attempt a serious refutation of the existence of witches; and at present, luckily, the task is unnecessary. In this country, at least, the discouragement long given to all suspicion of witchcraft, and the repeal of the statutes against that crime, have very much weakened, though perhaps they have not entirely eradicated, the persuasion. On the continent, too, it is evidently on the decline; and notwithstanding the exertions of Dr De Haen, and of the celebrated Lavater, we have little doubt but that in a short time posterity will wonder at the credulity of their ancestors. That there ever were witches, is an opinion that cannot for a moment be believed by a thinking man. The actions imputed to them were either absurd or impossible; the witnesses by whose evidence they were condemned, either weak enthusiasts or downright villains; and the confessions ascribed to the witches themselves, the effects of a disordered imagination produced by cruel treatment and excessive watchings. As to the nightly meetings, demonologists themselves have been obliged to confess, that they were nothing else but uneasy dreams, often produced by soporific compositions. The facts which have been brought forward by the advocates for witchcraft bear in their front the most evident marks of trick and imposture; and this has constantly been found out whenever these facts have been properly examined. See Sorcery.

WITENA MOT, or WITENA *Gemot*, among the Anglo-Saxons, was a term which literally signified the assembly of the wise men; and was applied to the great council of the nation of latter days called the *parliament*.

WITHERS *of a* HORSE, the juncture of the shoulder-bones at the bottom of the neck and mane, towards the upper part of the shoulder.

WITNESS, in law, a person who gives evidence in any cause, and is sworn to speak the truth, the whole truth, and nothing but the truth.

Trial by WITNESSES, a species of trial without the intervention of a jury. This is the only method of trial known to the civil law, in which the judge is left to form in his own breast his sentence upon the credit of the witnesses examined: but it is very rarely used in the English law, which prefers the trial by jury before it in almost every instance. Save only that when a widow brings a writ of dower, and the tenant pleads that the husband is not dead; this being looked upon as a dilatory plea, is in favour of the widow, and for greater expedition allowed to be tried by witnesses examined before the judges: and so, saith Finch, shall no other case in our law. But Sir Edward Coke mentions some others; as, to try whether the tenant in a real action was duly summoned, or the validity of a challenge to a juror: so that Finch's observation must be confined to the trial of direct and not collateral issues. And in every case Sir Edward Coke lays it down, that the affirmative must be proved by two witnesses at the least.

WITSIUS (Herman), a learned and eminent divine of North Holland, born at Enckhuisen in 1626. He was professor of divinity successively at Franeker, Utrecht, and Leyden; and applied himself successfully to oriental learning, of which his capital work *Ægyptiaca* affords sufficient proof. His Œconomy of the Covenants between God and Men, is warmly recommended by Mr Hervey in his Theron and Aspasio. He died in 1708.

WITTENBERG, a city of Germany, capital of the circle of Upper Saxony, 50 miles north of Dresden. It is under immediate vassalage, and the seat of an aulic judicatory, a general superintendency, an inspection and consistory. The town is not large; but is well fortified, and contains a famous university, in which Melancthon was a professor. In this place Martin Luther first began to preach against the pope's indulgences; and in the cathedral of All Saints he is said to have been buried. In the old citadel of this town the ancient Saxon electors used to reside. Besides the university, there is a Latin school in the town, with six masters. The library belonging to the university is said to be very valuable. In 1756 the Prussians being masters of the town, destroyed a part of its fortifications. E. Long. 12. 47. N. Lat. 51. 49.

WOAD, in botany. See Isatis.

The preparation of woad for dying, as practised in France, is minutely described by Astruc, in his Memoirs for a Natural History of Languedoc. The plant puts forth at first five or six upright leaves, about a foot long and six inches broad: when these hang downwards, and turn yellow, they are fit for gathering: five crops are gathered in one year. The leaves are carried directly to a mill, much resembling the oil or tan mills, and ground into a smooth paste. If this process was deferred for some time, they would putrefy, and send forth an insupportable stench. The paste is laid in heaps, pressed close and smooth, and the blackish crust, which forms on the outside, reunited if it happens to crack: if this was neglected, little worms would be produced in the cracks, and the woad would lose a part of its strength. After lying for fifteen days, the heaps are opened, the crust rubbed and mixed with the inside, and the matter formed into oval balls, which are pressed close and solid in wooden moulds. These are dried upon hurdles: in the sun, they turn black on the outside; in a close place, yellowish, especially if the weather be rainy. The dealers in this commodity prefer the first, though it is said the workmen find no considerable difference betwixt the two. The good balls are distinguished by their being weighty, of an agreeable smell, and when rubbed, of a violet colour within. For the use of the dyer, these balls require a farther preparation: they are beat with wooden mallets, on a brick or stone floor, into a gross powder; which is heaped up in the

the middle of the room to the height of four feet, a ſpace being left for paſſing round the ſides. The powder, moiſtened with water, ferments, grows hot, and throws out a thick fetid fume. It is ſhovelled backwards and forwards, and moiſtened every day for twelve days; after which it is ſtirred leſs frequently, without watering, and at length made into a heap for the dyer.

Woad not only affords a laſting and ſubſtantial blue, which, according to the ſcale of the dyers, may be reduced into many different ſhades, but is alſo of great uſe in dyeing and fixing many other colours. But notwithſtanding this, and its being a commodity of our own, the uſe of it has very much declined ſince the introduction of indigo; for the purchaſe of which large ſums go annually out of the nation. The reaſon of this is, that indigo affords a more lively and pleaſing colour, is managed with more eaſe by the dyers, and does their buſineſs more expeditiouſly. Yet with all theſe advantages, it is univerſally acknowledged, that the colour which indigo affords is inferior to that of woad in many reſpects, and particularly in permanency; for which reaſon, they are frequently uſed in conjunction; woad to give ſolidity and ſubſtance, and indigo to give brightneſs and colour. But the worſt conſequence that has attended the uſe of indigo is, not barely leſſening the conſumption, but abating the price and depreciating the intrinſic value of woad; ſo that leſs care is taken in the management of it; to which in a great meaſure the inferiority of its colour, at leaſt in ſome places, is at preſent owing. The declenſion in its conſumption is not the caſe here only, but alſo in other countries; for it was once the great ſtaple of Languedoc, and was cultivated alſo in Normandy, and in other provinces of France; as it alſo is in Spain, Portugal, the Azores, and Canary iſlands, Switzerland, in the neighbourhood of Geneva, in different parts of Germany, and in Sweden.

An idea has been entertained, that by an alteration in the manner of curing of it, the inconveniencies that are ſuppoſed to attend the uſe of it might be removed, and that woad might be brought to anſwer all the purpoſes of indigo; which, if it could be accompliſhed, would be moſt certainly a great advantage, and an advantage which every true lover of his country would wiſh ſhould take place here rather than any where elſe. The author of the Natural Hiſtory of Languedoc ſuggeſts, that woad, if cured in the ſame manner as indigo, might produce as lively a colour; and adds, that from ſome experiments made by himſelf, he is convinced the method would effectually anſwer. The celebrated M. Du Hamel du Monçeau informs us, that having propoſed to Mr Fontenelle, a phyſician in Louiſiana, the cultivating the paſtel there in the manner of indigo, that gentleman acquainted him, that by treating indigo after the manner of paſtel, he had obtained a very beautiful green: which indeed is always the caſe when the indigo is only allowed to abſorb a ſmall quantity of oxygen; for it is now well known that its blue colour is owing to the abſorption of that gas.

WOAHOO, one of the Sandwich Iſlands, lying to the north-weſt of Morotoi, at the diſtance of ſeven leagues. From the appearance of the north-eaſt and north-weſt parts, it is the fineſt iſland of the group. Nothing can exceed the verdure of the hills, the variety of wood and lawn, and rich cultivated valleys, which the whole face of the country diſplays. A bay is formed by the north and weſt extremities, into which a fine river empties itſelf, through a deep valley; but as the water is brackiſh for 200 yards from the entrance, watering in it is not convenient. It contains about 60,000 inhabitants. Lieutenant Hergeſt, commander of the Dædalus ſtoreſhip, who had been ſent from England, in 1791, to New South Wales, and thence to the Southern Pacific Ocean, with a ſupply of proviſions for the Diſcovery ſloop, Captain Vancouver, then on a voyage of diſcovery, was here ſurpriſed and murdered by the natives, together with Mr Gooch, the aſtronomer. W. Long. 157. 51. N. Lat. 21. 43.

WODEN. See Odin, and Mythology, nº 40.

WODEVILE (Anthony), earl of Rivers, brother to the queen of Edward IV. was born in the end of 1442, or in the beginning of 1443. Though one of the moſt accompliſhed men of his age, very little is known of his private hiſtory. He was early and conſtantly employed either in the tumults of thoſe turbulent times, or in diſcharging the duties of ſome of the higheſt offices of the ſtate, with which he was inveſted. Yet he found leiſure to cultivate letters, and to be the author of works which, though of little value now, made ſome noiſe in that age, when learning was at a low ebb in England. Theſe conſiſted chiefly of tranſlations from the French; and his Lordſhip, with his printer Caxton, were the firſt Engliſh writers who had the pleaſure to ſee their works publiſhed from the preſs. This accompliſhed, brave, and amiable nobleman was treacherouſly impriſoned by Richard III. in Pomfret caſtle, where, during his confinement, he compoſed a ſhort poem, which has been preſerved by John Rous of Warwick, and breathes, ſays Dr Henry, a noble ſpirit of pious reſignation to his approaching fate. He was beheaded on the 23d of June 1483, in the 41ſt year of his age.

WOLAW, a town in Germany, in Sileſia, and capital of a duchy of the ſame name. It is ſurrounded with ſtrong walls and a moraſs, and one part of the houſes are built with ſtone. The caſtle is alſo encompaſſed with deep ditches, and the greateſt part of the inhabitants are employed in a woollen manufactory. In 1709 a Proteſtant church was allowed to be built here. It is ſeated on the river Oder, 20 miles north-weſt of Breſlau, and 32 ſouth-eaſt of Glogau. E. Long. 16. 54. N. Lat. 51. 18.

WOLD, Weld, or *Dyers Weed*. See Reseda.

WOLF, in zoology. See Canis.

Wolf-Fiſh, or *Sea-Wolf*. See Anarchicas.

Wolf or *Woolf Poiſon*. See Poison.

WOLFE (Major-general James), was born at Weſterham in the county of Kent, about the beginning of the year 1726. His father was Lieutenant-general Edward Wolfe. He went into the army when very young; and applying himſelf with unwearied aſſiduity to the ſtudy of his profeſſion, ſoon became remarkable for his knowledge and his genius. He diſtinguiſhed himſelf at the battle of Lafelt when little more than 20, and received the higheſt encomiums from the commander in chief. After the peace he ſtill continued to cultivate the art of war. He contrived to introduce the greateſt regularity and the exacteſt diſcipline into his corps, and at the ſame time to preſerve the affection of every ſoldier. In 1758 he was preſent as a brigadier-general at the ſiege of Louiſbourg. He landed firſt on the iſland at the head of his diviſion; and in ſpite of the violence of the ſurf, and the force and well directed fire of the enemy, drove them from their poſt with great precipitation. The ſurrender of the town, which happened ſoon after, was in a great meaſure owing to his activity, bravery, and ſkill. The fame which he acquired during this ſiege pointed him out to Mr Pitt, who was then miniſter, as the propereſt perſon to command the army deſtined to attack Quebec. This was the moſt difficult and the moſt arduous undertaking of the whole war. Quebec was the capital of the French dominions in North America; it was well fortified, ſituated in the midſt of an hoſtile country, and defended by an army of 20,000 men, regulars and militia, beſides a conſiderable

derable number of Indian allies. The troops destined for his expedition consisted of ten battalions, making up altogether about 8000 men. Such was the army destined to oppose three times their own number, defended by fortifications, in a country altogether unknown, and in a late season in that climate for military operations. But this little army, says an officer who was present at that expedition, and who has been so obliging as to communicate all the information we desired, was always sanguine of success; for they were commanded by General Wolfe, who, by a very uncommon magnanimity and noblenefs of behaviour, had attached the troops so much to his person, and inspired them with such resolution and steadinefs in the execution of their duty, that nothing seemed too difficult for them to accomplish. The admirable skill with which his measures were planned, and the prudence and vigour with which they were executed, is well known. He landed his army on the northern shore of the river St Lawrence in spite of the enemy, and forced them to a battle, in which they were completely defeated. The consequence of this battle was the reduction of Quebec, and the conquest of Canada. In the beginning of the battle General Wolfe was wounded in the wrist by a musket-ball: he wrapt his handkerchief round it, continued to give his orders with his usual calmnefs and perspicuity, and informed the soldiers that the advanced parties on the front had his orders to retire, and that they needed not be surprised when it happened. Towards the end of the battle he received a new wound in the breast; he immediately retired behind the rear-rank supported by a grenadier, and laid himself down on the ground. Soon after a shout was heard; and one of the officers who stood by him exclaimed, "See how they run!" The dying hero asked with some emotion, "Who run?" "The enemy (replied the officer); they give way every where." The general then said, "Pray, do one of you run to Colonel Burton, and tell him to march Webb's regiment with all speed down to Charles river, to cut off the retreat of the fugitives from the bridge. Now, God be praised, I shall die happy!" He then turned on his side, closed his eyes, and expired.

The death of General Wolfe was a national loss universally lamented. He inherited from nature an animating fervour of sentiment, an intuitive perception, an extensive capacity, and a passion for glory, which stimulated him to acquire every species of military knowledge that study could comprehend, that actual service could illustrate and confirm. This noble warmth of disposition seldom fails to call forth and unfold all the liberal virtues of the soul. Brave above all estimation of danger; generous gentle, complacent, and humane; the pattern of the officer, the darling of the soldier. There was a sublimity in his genius which soared above the pitch of ordinary minds; and had his faculties been exercised to their full extent by opportunity and action, had his judgment been fully matured by age and experience, he would, without doubt, have rivalled in reputation the most celebrated captains of antiquity. His body was brought to England, and buried with military honours in Westminster abbey, where a magnificent monument is erected to his memory.

Wolfe (Christian), a celebrated German philosopher, was born at Breslau in 1679. After having been well instructed in the rudiments of learning and science in his own country, Wolfe prosecuted his studies successively in the universities of Jena, Hamburgh, and Leipsic. At the age of 26 he had acquired so much distinction, that he was appointed professor of mathematics, and soon afterwards of philosophy in general, in the university of Hall. After Leibnitz had published his *Theodicea*, Wolfe, struck with the novelty of the edifice which that philosopher had raised, assiduously laboured in the investigation of new metaphysical truths. He also digested the Elements of Mathematics in a new method, and attempted an improvement of the art of reasoning in a treatise On the Powers of the Human Understanding. Upon the foundation of Leibnitz's doctrine of Monads, he formed a new system of Cosmology and Pneumatology, digested and demonstrated in a mathematical method. This work, entitled Thoughts on God, the World, and the Human Soul, was published in the year 1719; to which were added, in a subsequent edition, Heads of Ethics and Policy.

Wolfe was now rising towards the summit of philosophical reputation, when the opinion which he entertained on the doctrine of necessity being censured by his colleagues as inimical to religion, and an oration which he delivered in praise of the morality of the Chinese having given much offence, an accusation of heresy was publicly brought against him; and, though he attempted to justify himself in a treatise which he wrote on the subject of fatality, a royal mandate was issued in November 1723, requiring him to leave the Prussian dominions. Having been formerly invited by the landgrave of Hesse-Cassel to fill a professor's chair in the university of Cassel, Wolfe now put himself under the patronage of that prince, who had the liberality to afford him a secure asylum, and appointed him professor of mathematics and philosophy. The question concerning the grounds of the censure which had been passed upon Wolfe was now every where freely canvassed; almost every German university was inflamed with disputes on the subject of liberty and necessity; and the names of Wolfians and Anti-Wolfians were every where heard. After an interval of nine years, the king of Prussia reversed his sentence of exile, and appointed him vice-chancellor of the university of Hall; where his return was welcomed with every expression of triumph. From this time he was employed in completing his Institutes of Philosophy, which he lived to accomplish in every branch except policy. In 1745 he was created a baron by the elector of Bavaria, and succeeded Ludowig in the office of chancellor of the university. He continued to enjoy these honours till the year 1754, when he expired. He possessed a clear and methodical understanding; which by long exercise in mathematical investigations was particularly fitted for the employment of digesting the several branches of knowledge into regular systems; and his fertile powers of invention enabled him to enrich almost every field of science in which he laboured, with some valuable additions. The lucid order which appears in all his writings enables his reader to follow his conceptions with ease and certainty, through the longest trains of reasoning.

WOLFEMBUTTLE, a considerable town of Germany, in the circle of Lower Saxony, and duchy of Brunswick, with a castle where the duke of Brunswick Wolfembuttle resides. It is one of the strongest places in Germany, though the fortifications want repairing in several places. There is an excellent library, kept in a building lately erected for that purpose, consisting of 116,000 printed books, and 2000 uncommon books, with a cabinet of curiosities, relating to natural history. It is seated on the river Ocker, five miles south of Brunswick, and 30 west of Halberstadt. E. Long. 10. 42. N. Lat. 52. 18.

WOLFRAM, or Tungsten. See Tungsten.

Wolfram, in natural history and chemistry, the name of a peculiar mineral, lately ranged among the [illegible] metals. See Mineralogy, p. 184, col. 2.

This mineral, which the Germans have called [illegible], *wolfrath*, a name translated into Latin [illegible], or rather [illegible] *lupus Jovis*, has been met with hitherto only in [illegible]; for, though many authors would make it more common, [illegible]

Wolfram. is an error owing to their confounding fome gloffy iron-ores with the true wolfram, as appears by the fpecimens which are frequently found in cabinets under this name. It has been, on account of the bad effects produced by this mineral in the fmelting of tin-ores, from which it is very difficult to feparate it by wafhing, becaufe of its great fpecific weight, that the names of *fpuma lupi*, *lupus Jovis*, and *wolfram*, have been given to it by the miners and fmelters.

This is really a metallic ore, and contains the very femi-metal lately difcovered in the tungften; both being mineralized, or rather formed by the fame tungftenic acid.

1. It is of a black or brown fhining colour, of a radiated or foliated texture, of a moderate hardnefs, and fometimes fo brittle as to be eafily broken between the fingers; but it is very weighty, its fpecific gravity being $= 7{,}119$.

2. When fcratched it fhows a red trace, and this diftinguifhes it from the tungften, MINERALOGY, part ii. p. 73. col. 1. which is a variety of the ore of the fame femi-metal.

3. It is found in fcattered maffes, cryftallized into hexaedral flat prifms, coming to a point, with four fides, and thefe points terminated obliquely.

4. Internally it is fhining, with the luftre almoft of a metal.

5. When it is broken, its texture appears leafy; and the leaves are flat, but fomewhat confufed.

6. On fome fides they are unequal, and very feldom ftriated.

7. It is always opaque; and when fcraped, it yields a powder of a dark reddifh grey.

8. The wolfram will not melt by itfelf with the blow-pipe, the angles being only rounded; but,

9. Internally it preferves its ftructure and colour without change.

10. With microcofmic falt *(phofphate of ammoniac)* it fufes with effervefcence; and forms a glafs of a pale red in the exterior flame, and much darker in the interior.

11. With borax it likewife effervefces, and forms by the interior flame a glafs of a greenifh yellow, which by the exterior turns reddifh.

12. Being expofed in a crucible to a ftrong fire for one hour, it fwelled, became fpongy, and of a brownifh colour; entered into a femi-vitrification; and was attracted by the magnet.

13. Equal parts of nitre and wolfram being put in a red-hot crucible, they detonated, or rather boiled up with a blue flame round the edges, and a nitrous vapour arofe; the matter, when cold, on being put into water, partly diffolved; and a few drops of acid produced a white precipitation.

14. Pounded wolfram, digefted in a fand heat with a fufficient quantity of marine acid, to the depth of the thicknefs of a finger above the matter, after one hour's boiling, the powder turned yellow; which is the fame phenomenon as happens with the tungftenic acid. See CHEMISTRY-*Index*.

15. It appears by the chemical analyfis of wolfram made by Meff. John and Fauft de Luyart, that its contents confift of 22 parts of manganefe in the ftate of black oxyd; 13,5 of iron, 65 of a yellow wolfranic oxyd, and of quartz and tin.

16. A good quantity of this yellow oxyd being collected, it was obferved that it was entirely infipid, and that its fpecific gravity was $= 6{,}120$. It effervefces with microcofmic falt; produces a tranfparent blue colour without any fhade of red; and effervefces alfo with borax and with mineral alkali. This fame matter does not diffolve in water; but when triturated with it, forms a kind of emulfion; to which the acetous acid gives a blue colour, but does not diffolve it. This matter, however, diffolves completely in cauftic vegetable alkali, both by the dry and moift way; and the liquor acquires a great bitternefs. By pouring on it fome nitrous acid a precipitate enfues, which leaves on the filtre a white falt; and this being well edulcorated, has a tafte at firft fweet, afterwards fharp and bitter, producing a very difagreeable fenfation on the throat. It is in fact a true acid combined with a portion of the alkali and precipitating acid.

17. This acid melts, if alone, by the flame urged with the blow-pipe.

18. This white falt is a true metallic triple falt, as appears by putting 100 grains in a crucible with powdered charcoal; for after one hour and a half of a ftrong fire, when cooled a button was found, which fell to powder between the fingers. Its colour was brown; and, on examining it with a magnifier, there was a congeries of metallic globules, of the bignefs of pins heads; which, when broken, exhibit the metallic appearance of a fteel colour in the fracture; and their fpecific gravity was $= 17{,}600$.

19. Thefe metallic globules, melted with other metals, gold and platina excepted, afford ductile alloys with filver or copper; and hard ones with caft iron, tin, antimony, bifmuth, and manganefe.

It has been fuppofed that this is a new metal before unknown: That this was evinced, 1. by its fpecific gravity, equal to 17,600; 2. by the tinges it gives to different glaffes; 3. by its great difficulty to fufe, which is greater than that of manganefe; 4. by the yellow colour of its calx; 5. its alloys with other metals; 6. its infolubility, at leaft by a direct method, with mineral acids; 7. its eafy folution in alkalis; 8. the emulfion it gives with water; 9. and by the blue colour it gives to acetous acid. We are not certain, however, how far this opinion has been corroborated by later experiments.

WOLFSPERG, a town of Germany, in Lower Carinthia, with a caftle, on which the diftrict about it depends, which is 20 miles in length, and 10 in breadth. It is feated on the river Lavand, at the foot of a mountain covered with wood, and full of wolves, from whence the town took its name. It is 36 miles eaft of Clagenfurt. E. Long. 15. 0. N. Lat. 46. 56.

WOLGAST, a pretty confiderable town of Germany, in the circle of Upper Saxony, and in Pomerania, capital of a territory of the fame name, with a caftle, and one of the beft and largeft harbours on the Baltic Sea. It is a well-built place, fubject to Sweden, and feated on the river Pfin. E. Long. 14. 4. N. Lat. 54. 1.

WOLLASTON (William), defcended of an ancient family in Staffordfhire, was born in 1659. He was in 1674 admitted a penfioner in Sidney college, Cambridge, where, notwithftanding feveral difadvantages, he acquired a great degree of reputation. In 1682, feeing no profpect of preferment, he became affiftant to the head mafter of Birmingham fchool. Some time after, he got a fmall lecture about two miles diftant, but did the duty the whole Sunday; which, together with the bufinefs of a great free-fchool for about four years, began to break his conftitution. During this fpace he likewife underwent a great deal of trouble and uneafinefs, in order to extricate two of his brothers from fome inconveniences, to which their own imprudence had fubjected them. In 1688 affairs took a new turn. He found himfelf by a coufin's will intitled to a very ample eftate; and came to London that fame year, where he fettled; choofing a private, retired, and ftudious life. Not long before his death, he publifhed his treatife, intitled The Religion of Nature Delineated; a work for which fo great a demand was made, that more than 10,000 were fold in a very few years. He had fcarcely completed the publication

cation of it, when he unfortunately broke an arm; and this adding ftrength to diftempers that had been growing upon him for fome time, accelerated his death; which happened upon the 29th of October 1724. He was a tender, humane, and in all refpects worthy man; but is reprefented to have had fomething of the irafcible in his conftitution and temperament. His Religion of Nature Delineated expofed him to fome cenfure, as if he had put a flight upon Chriftianity by laying fo much ftrefs, as he does in this work, upon the obligations of truth, reafon, and virtue; and by making no mention of revealed religion. But this cenfure muft have been the offspring of ignorance or envy, fince it appears from the introduction to his work, that he intended to treat of revealed religion in a fecond part, which he lived not to finifh.

WOLSEY (Thomas), a famous cardinal and archbifhop of York, is faid to have been the fon of a butcher at Ipfwich. He ftudied at Magdalen college, Oxford, where he became acquainted with the learned Erafmus; and in the year 1500 became rector of Lymington in Somerfetfhire: he was afterwards made chaplain to king Henry VIII. and obtained feveral preferments. Having gradually acquired an entire afcendency over the mind of Henry VIII. he fucceffively obtained feveral bifhoprics, and at length was made archbifhop of York, lord high-chancellor of England, and prime minifter; and was for feveral years the arbiter of Europe. Pope Leo X. created him cardinal in 1515, and made him *legate à latere*; and the emperor Charles V. and the French king Francis I. loaded him with favours, in order to gain him over to their intereft: but after having firft fided with the emperor, he deferted him to efpoufe the intereft of France. As his revenues were immenfe, his pride and oftentation were carried to the greateft height. He had 500 fervants; among whom were 9 or 10 lords, 15 knights, and 40 efquires. His ambition to be pope, his pride, his exactions, and his political delay of Henry's divorce, occafioned his difgrace. In the earlier part of his life he feems to have been licentious in his manners; for there goes a ftory, that foon after his preferment to the living of Lymington in Somerfetfhire, he was put into the ftocks by Sir Amias Paulet, a neighbouring juftice of the peace, for getting drunk and making a riot at a fair. This treatment Wolfey did not forget when he arrived at the high ftation of lord-chancellor of England; but fummoned his corrector up to London, and, after a fevere reprimand, enjoined him fix years clofe confinement in the Temple. Whatever may have been his faults, there can be no doubt of their having been aggravated both by the zealous reformers and by the creatures of Henry VIII. who was himfelf neither Papift nor Proteftant; for there is every reafon to believe that the cardinal was fincere in his religion; and fincerity, or at leaft confiftency, was then a crime. Wolfey was the patron of learned men; a judge and munificent encourager of the polite arts; and ought to be confidered as the founder of Chrift-church college, Oxford; where, as well as in other places, many remains of his magnificent ideas in architecture ftill exift. He died in 1530.

WOLVERENE, in zoology. See Ursus.

WOLVES-teeth, of a horfe. See Farriery, § xxxv.

WOMAN, the female of the human fpecies. See Homo.

WOMB, or Uterus. See Anatomy, n° 108.

WOOD (Anthony), an eminent biographer and antiquarian, was the fon of Thomas Wood, bachelor of arts and of the civil law, and was born at Oxford in 1632. He ftudied at Merton college, and in 1655 took the degree of mafter of arts. He wrote, 1. The Hiftory and Antiquities of the Univerfity of Oxford; which was afterwards tranflated into Latin by Mr Wafe and Mr Peers, under the title of *Hiftoria & Antiquitates Univerfitatis Oxonienfis*, 2 vols folio. 2. *Athenæ Oxonienfes*; or an exact Account of all the Writers and Bifhops who have had their Education in the Univerfity of Oxford, from the Year 1500 to 1690, 2 vols folio; which was greatly enlarged in a fecond edition publifhed in 1721 by bifhop Tanner. Upon the firft publication of this work the author was attacked by the univerfity, in defence of Edward earl of Clarendon, lord high-chancellor of England, and chancellor of the univerfity, and was likewife animadverted upon by bifhop Burnet; upon which he publifhed a Vindication of the Hiftoriographer of the Univerfity of Oxford. He died at Oxford of a retention of urine in 1695.

Wood

WOOD, a fubftance whereof the trunks and branches of trees confift. It is compofed of a number of concentric circles or zones, one of which is formed every year; confequently their number correfponds to the age of the tree. Thefe zones vary in thicknefs according to the degree of vegetation that took place the year of their formation. They are alfo of different degrees of thicknefs in different parts, that part of the tree which is moft expofed to the fun and beft fheltered growing falteft; hence in this country that part of the zone which looked towards the fouth while the tree was growing is generally thickeft. The innermoft circle or zone is the one which was firft formed, the outermoft was formed the year before the tree was cut down. Thefe zones are at firft very foft and tender, and harden by degrees as the tree becomes older: this is the reafon that the middle of a tree is fo often much better wood than the outfide of it.

The proper ligneous part of the wood confifts of longitudinal fibres, difpofed in fafciculi, and poffeffed of confiderable hardnefs. It is this longitudinal direction of the fibres that renders it fo much eafier to cleave wood lengthwife than acrofs the tree or in any other direction. See Plant.

Chemifts have attempted to afcertain the ingredients which enter into the compofition of wood. The tafk, however, is fo difficult, that they have by no means made the fame progrefs that they have done in analyfing the various mineral productions of nature. When wood is diftilled, water comes over firft; foon after it begins to be impregnated with oil, then an empyreumatic oil comes over, then carbonic acid gas, then hydrogen gas, and laftly carbonated hydrogen gas: a coal remains behind, which is compofed of charcoal, fixed alkali, various earths, and fometimes alfo of feveral neutral falts and metallic fubftances. This was once looked upon by chemifts as a perfect analyfis, and it was fuppofed that all the various fubftances above-mentioned exifted in plants in their proper form. But this is now known to be a miftake: the action of the fire produces new combinations in the ultimate ingredients of the plant, and thus produces new fubftances; and it is only thefe that are obtained by the above procefs. It is fufficient however to fhow, that wood is compofed in a great meafure of carbon, oxygen, and hydrogen, combined varioufly and in unknown proportions with one another; as moft of the products of the diftillation can be refolved into thefe fubftances.

There are many varieties of wood poffeffed of diftinguifhing properties, as cedar, box, ebony, &c. See thefe articles.

For the *Method of Staining or Dyeing Wood*, fee Turning.

For more complete information concerning wood, fee alfo Plant, Tree, Strength *of Materials*.

Foffil Wood. Foffil wood, or whole trees, or parts of them, are very frequently found buried in the earth, and that in different ftrata; fometimes in ftone, but more ufually in

Wood. in earth; and sometimes in small pieces loose among gravel. These, according to the time they have lain in the earth, or the matter they have lain among, are found differently altered from their original state; some of them having suffered very little change; and others being so highly impregnated with crystalline, sparry, pyritical, or other extraneous matter, as to appear mere masses of stone, or lumps of the common matter of the pyrites, &c. of the dimensions, and, more or less, of the internal figure of the vegetable bodies into the pores of which they have made their way.

The fossil woods which we find at this day are, according to these differences, arranged by Dr Hill into three kinds; 1. The less altered: 2. The pyritical: and, 3. The petrified.

Of the trees, or parts of them, less altered from their original state, the greatest store is found in digging to small depths in bogs, and among what is called *peat* or *turf earth*, a substance used in many parts of the kingdom for fuel. In digging among this, usually very near the surface, immense quantities of vegetable matter of various kinds are found buried; in some places there are whole trees scarce altered, except in colour; the oaks in particular being usually turned to a jetty black; the pines and firs, which are also very frequent, are less altered, and are as inflammable as ever, and often contain between the bark and wood a black resin. Large parts of trees have also been not unfrequently met with unaltered in beds of another kind, and at much greater depths, as in the strata of clay and loam, among gravel, and sometimes even in solid stone.

Beside these harder parts of trees, there are frequently found also in the peat earth vast quantities of the leaves and fruit and catkins of the hazel and similar trees: these are usually mixed with sedge and roots of grass, and are scarce at all altered from their usual texture. The most common of these are hazel nuts; but there are frequently found also the twigs and leaves of the white poplar; and a little deeper usually there lies a cracked and shattered wood, the crevices of which are full of a bituminous black matter: and among this the stones of plums and other stone-fruits are sometimes found, but more rarely.

In this state the fruits and larger parts of trees are usually found: what we find of them more altered, are sometimes large and long, sometimes smaller and shorter branches of trees, sometimes small fragments of branches, and more frequently small shapeless pieces of wood. The larger and longer branches are usually found bedded in the strata of stone, and are more or less altered into the nature of the stratum they lie in. The shorter and smaller branches are found in vast variety in the strata of blue clay used for making tiles in the neighbourhood of London. These are prodigiously plentiful in all the clay-pits of this kind, and usually carry the whole external resemblance of what they once were, but nothing of the inner structure; their pores being wholly filled, and undistinguishably closed, by the matter of the common pyrites, so as to appear mere simple masses of that matter. These fall to pieces on being long exposed to moisture; and are so impregnated with vitriol that they are what is principally used for making the green vitriol or copperas at Deptford and other places.

The irregular masses or fragments of petrified wood are principally of oak, and are most usually found among gravel; though sometimes in other strata. These are variously altered by the insinuation of crystalline and stony particles; and make a very beautiful figure when cut and polished, as they usually keep the regular grain of the wood, and show exactly the several circles which mark the different years growth. These, according to the different matter which has filled their pores, assume various colours, and the appearance of the various fossils that have impregnated them; some are perfectly white, and but moderately hard; others of a brownish black, or perfectly black, and much harder; others of a reddish black, others yellowish, and others greyish, and some of a ferruginous colour. They are of different weights also and hardnesses, according to the nature and quantity of the stony particles they contain: of these some pieces have been found with every pore filled with pure pellucid crystal; and others in large masses, part of which is wholly petrified and seems mere stone, while the rest is crumbly and is unaltered wood. That this alteration is made in wood, even at this time, is also abundantly proved by the instances of wood being put into the hollows of mines, as props and supports to the roofs, which is found after a number of years as truly petrified as that which is dug up from the natural strata of the earth. In the pieces of petrified wood found in Germany, there are frequently veins of spar or of pure crystal, sometimes of earthy substances, and often of the matter of the common pebbles: these fragments of wood sometimes have the appearance of parts of the branches of trees in their natural state, but more frequently they resemble pieces of broken boards; these are usually capable of a high and elegant polish.

Many substances, it is certain, have been preserved in the cabinets of collectors, under the title of *petrified wood*, which have very little right to that name. But where the whole outer figure of the wood, the exact lineaments of the bark, or the fibrous and fistular texture of the striæ, and the vestiges of the utriculi and tracheæ or air-vessels, are yet remaining, and the several circles yet visible which denoted the several years growth of the tree, none can deny these substances to be real fossil wood. See PETRIFACTION.

Composition for preserving Wood. See CHEMISTRY, n° 621 and 700.

WOOD *(sylva)*, in geography, a multitude of trees extended over a large continued track of land, and propagated without culture. The generality of woods only consist of trees of one kind.—The ancient Saxons had such a veneration for woods, that they made them sanctuaries.—It is ordained, that none shall destroy any wood, by turning it into tillage or pasture, &c. where there are two acres or more in quantity, on pain of forfeiting 40 s. an acre, by 35 Henry VIII. c. 17. All woods that are felled at 14 years growth, are to be preserved from destruction for eight years; and no cattle put into the ground till five years after the felling thereof, &c. 13 Eliz. c. 25. The burning of woods or underwood is declared to be felony; also those persons that maliciously cut or spoil timber-trees, or any fruit-trees, &c. shall be sent to the house of correction, there to be kept three months, and whipt once a month.

Wood-Cock, in ornithology. See SCOLOPAX.

Wood-Goat. See CAPRA.

Wood-Louse. See ONISCUS.

Wood-Pecker. See PICUS.

WOODMOTE. See *Forest-Courts*.

WOODSTOCK, a town of Oxfordshire, in England, pleasantly seated on a rising ground, and on a rivulet; a well compacted borough-town, and sends two members to parliament; but is chiefly noted for Blenheim-house, a fine palace, built in memory of the victory obtained by the duke of Marlborough over the French and Bavarians in August 1704. It was erected at the public expence, and is one of the noblest seats in Europe. One of the passages to it is over a bridge with one arch, 190 feet in diameter, resembling the Rialto at Venice. The gardens take up 100 acres of ground; and the offices, which are very grand, have room enough to accommodate 300 people. The apartments

ments of the palace are magnificently furnifhed; and the ftaircafes, ftatues, paintings, and tapeftry, furprifingly fine. The town is about half a mile from the palace, having feveral good inns; and a manufacture of fteel chains for watches, and excellent gloves. It is 8 miles north of Oxford, and 60 weft-north-weft of London. W. Long. 1. 15. N. Lat. 51. 52.

WOODWARD (Dr John), was born in 1665, and educated at a country fchool, where he learned the Latin and Greek languages, and was afterwards fent to London, where he is faid to have been put apprentice to a linen-draper. He was not long in that ftation, till he became acquainted with Dr Peter Barwick, an eminent phyfician, who took him under his tuition and into his family. Here he profecuted with great vigour and fuccefs the ftudy of philofophy, anatomy, and phyfic. In 1692, Dr Stillingfleet quitting the place of profeffor of phyfic in Grefham college, our author was chofen to fucceed him, and the year following was elected F. R. S. In 1695 he obtained the degree of M. D. by patent from archbifhop Tennifon; and the fame year he publifhed his Effay toward a Natural Hiftory of the Earth. He afterward wrote many other pieces, which have been well received by the learned world. He founded a lecture in the univerfity of Cambridge, to be read there upon his Effay, &c. and handfomely endowed it. He died in 1728.

WOOF, among manufacturers, the threads which the weavers fhoot acrofs with an inftrument called the *fhuttle*. See CLOTH.

WOOKEY or *Okey Hole*, a remarkable cavern two miles from the city of Wells in Somerfetfhire; for an account of which, fee the article GROTTO.

WOOL, the covering of fheep. See OVIS, and SHEEP.

Wool refembles hair in a great many particulars; but befides its finenefs, which conftitutes an obvious difference, there are other particulars which may ferve alfo to diftinguifh them from one another. Wool, like the hair of horfes, cattle, and moft other animals, completes its growth in a year, and then falls off as hair does, and is fucceeded by a frefh crop. It differs from hair, however, in the uniformity of its growth, and the regularity of its fhedding. Every filament of wool feems to keep exact pace with another in the fame part of the body of the animal; the whole crop fprings up at once; the whole advances uniformly together; the whole loofens from the fkin nearly at the fame period, and thus falls off if not previoufly fhorn, leaving the animal covered with a fhort coat of young wool, which in its turn undergoes the fame regular mutations.

Hairs are commonly of the fame thicknefs in every part; but wool conftantly varies in thicknefs in different parts, being generally thickeft at the points than at the roots. That part of the fleece of fheep which grows during the winter is finer than what grows in fummer. This was firft obferved by Dr Anderfon, the editor of the Bee, and publifhed in his *Obfervations on the Means of exciting a Spirit of National Induftry*.

While the wool remains in the ftate it was firft fhorn off the fheep's back, and not forted into its different kinds, it is called *fleece*. Each fleece confifts of wool of divers qualities and degrees of finenefs, which the dealers therein take care to feparate. The French and Englifh ufually feparate each fleece into three forts, *viz.* 1. Mother-wool, which is that of the back and neck. 2. The wool of the tails and legs. 3. That of the breaft and under the belly. The Spaniards make the like divifion into three forts, which they call *prime*, *fecond*, and *third*; and for the greater eafe, denote each bale or pack with a capital letter, denoting the fort. If the triage or feparation be well made, in 15 bales there will be 12 marked R, that is, refine, or prime; two marked F, for fine, or fecond; and one S, for thirds.

The wools moft efteemed are the Englifh, chiefly thofe about Leominfter, Cotfwold, and the Ifle of Wight; the Spanifh, principally thofe about Segovia; and the French, about Berry: which laft are faid to have this peculiar property, that they will knot or bind with any other kind, whereas the reft will only knot with their own kind.

Among the ancients, the wools of Attica, Megara, Laodicea, Apulia, and efpecially thofe of Tarentum, Parma, and Altino, were the moft valued. Varro affirms, that the people there ufed to clothe their fheep with fkins, to fecure the wool from being damaged.

Of late a great deal of attention has been paid to wool in this country, as well as feveral others. Several very fpirited attempts have been made to improve it, by introducing fuperior breeds of fheep, and better methods of managing them. For this purpofe has been formed the *Britifh Wool Society*.

Britifh Wool Society, an affociation formed for the purpofe of obtaining the beft breeds of fine-woolled fheep, with a view of afcertaining, by actual experiment, how far each fpecies or variety is calculated for the climate of Great Britain; the qualities of their wool refpectively; the manufactures to which each kind of wool could be moft profitably employed in different manufactures; and the comparative value of each fpecies of fheep, fo far as the fame can be determined.

Attention had for fome time been paid by the Highland Society to a famous breed of fine-woolled fheep in Shetland; but it occurred to Sir John Sinclair of Ulbfter, baronet, and to Dr James Anderfon, well known as the author of many ufeful publications, that the improvement of Britifh wool was a matter of too much importance to be entrufted to a fociety which is obliged to devote its attention to fuch a variety of objects as the general improvement of the Highlands of Scotland. The latter of thefe gentlemen, therefore, in an Appendix to the Report of the Committee of the Highland Society of Scotland, for the year 1790, propofed *the plan of a patriotic affociation for the improvement of Britifh wool*; and the former, who was convener of the committee to whom the fubject of Shetland wool had been referred, wrote circular letters, recommending the plan. The confequence of which was, that, on the 31ft of January 1791, feveral noblemen and gentlemen of the higheft refpectability met in Edinburgh, and conftituted themfelves into *a Society for the Improvement of Britifh Wool*. Of this fociety Sir John Sinclair was elected prefident; after which, in an excellent fpeech, he pointed out to the members the objects of the inftitution, the means by which thofe objects could be attained, and the advantages which would refult from their united labours. This addrefs was afterwards printed by order of the fociety.

The particular breeds of fheep to which the fociety propofed to direct its attention, were fheep for the hilly parts of Scotland; fheep for the plains, or the Lowland breed; and fheep for the iflands. They were to try experiments alfo with fheep from foreign countries, diftinguifhed by any particular property.

The principal objects which the members had in view, during the firft year of their affociation, were, 1. To collect fpecimens of the beft breeds which Great Britain at that period afforded, in order to afcertain the degree of perfection to which fheep had already been brought in this kingdom. 2. To procure from every country, diftinguifhed for the quality of its fheep and wool, fpecimens of the different breeds it poffeffed, in order to afcertain how far the original breed, or a mixed breed from it and the native

ſheep of the country, could thrive in Scotland. 3. To diſperſe as much as poſſible all theſe breeds, both foreign and domeſtic, over the whole kingdom, wherever proper perſons could be found to take charge of them, in order to try experiments on a more extenſive ſcale than the ſociety itſelf could do; to ſpread information, and to excite a ſpirit for the improvement of ſheep and wool in every part of the country.

Sir John Sinclair had previouſly collected a flock, conſiſting of ſheep of the Spaniſh, Herefordſhire, Southdown, Cheviot, Lomond hills, and Shetland breeds, and of a mixed breed from theſe different ſheep. This flock amounted to 110 rams, ewes, and lambs. M. D'Aubenton, in conſequence of a correſpondence with Sir John Sinclair, ſent over to the ſociety ten rams and five ewes, of real Spaniſh breed, which had been originally intruſted to his care by the late king of France: theſe, after encountering a number of obſtacles, and after being ſtopped and threatened to be ſlaughtered at the cuſtomhouſe of Brighthelmſtone for the uſe of the poor, arrived ſafe at Leith. Lord Sheffield, at the ſame time, ſent to the ſociety four rams and ſix ewes of the Southdown and Spaniſh breeds. Mr Biſhton of Kilſall, in Shropſhire, preſented them with three Hereford rams, reckoned by many the beſt breed in England; the ſociety at the ſame time ordered 150 ewes of the ſame breed, and two ewes of the Long Mountain breed, reckoned the beſt in Wales, to be ſent along with them. They purchaſed 57 rams and 173 ewes of the Cheviot breed, reckoned the beſt in Scotland, for the hilly parts of the country. Lord Daer ſent them 20 ewes of an excellent breed, which exiſted at Mochrum in Galloway. The late earl of Oxford ſent them in a preſent three rams of the Norfolk croſſed by the Cape of Good Hope breed. Mr Iſaac Grant junior of Leghorn, in conjunction with Mr Sibbald merchant at Leith, preſented them an Apulian ram and ewe; the ram arrived in ſafety, but the ewe unfortunately died on the paſſage. Mr Baron Seton of Preſton, in Linlithgowſhire, ſent them a ram and two ewes of a Spaniſh breed, which had been for ſome time kept in Sweden unmixed with any other. They purchaſed 107 ewes of a ſmall breed exiſting in the pariſh of Leuchars in Fife, much reſembling the Shetland. The Right Honourable William Conynghame of Ireland ſent them 11 Spaniſh rams, 7 Spaniſh ewes, 1[illegible] three-fourth breed and 16 one half breed Spaniſh and Iriſh ewes. Lord Sheffield ſent them 8 rams and 18 ewes; and his Majeſty made them a preſent of two rams.

Thus, in the courſe of one year, the ſociety acquired by donation or purchaſe about 800 ſheep of different ſorts and ages, and many of them from foreign countries: about 500 of theſe were diſtributed over different parts of Scotland, the greater number of which were ſold to gentlemen anxious to promote the views of the ſociety, and well qualified to make experiments on the different breeds which they had obtained. The greateſt part of the remainder were taken by different gentlemen who kept them for the ſociety, and according to their directions, without any expence.

It is impoſſible to produce an inſtance of ſo much having been accompliſhed by a ſociety of private individuals in ſo ſhort a time. Nor was this all; the ſame year Mr Andrew Kerr, a very intelligent ſheep-farmer on the borders of England, was ſent, at the expence of the ſociety, to examine the ſtate of ſheep-farming along the eaſt coaſt of Scotland and the interior parts of the Highlands. His tour was printed by order of the ſociety, and contains the firſt intimation of the poſſibility of the Cheviot breed thriving in the north of Scotland.

In the year 1792, Meſſrs Redhead, Laing, and Marſhall, were ſent by the ſociety, to make a ſurvey of the ſtate of ſheep-farming through ſome of the principal counties of England; the reſult of which was alſo publiſhed by the ſociety, and contains more information on the ſubject of the different breeds of England than any work hitherto publiſhed; and in 1794, Mr John Naiſmyth was ſent on a tour through the ſouthern diſtricts of Scotland, which completed the circuit of almoſt the whole kingdom.

Thus a few private individuals, unaided by the public purſe, had boldneſs enough to undertake aſcertaining the comparative value of the different kinds of ſheep in their own country, and to introduce ſome of the moſt celebrated breeds of other countries, and ſucceeded in the ſpirited attempt. It is impoſſible in this place to ſtate more minutely the various other tranſactions of the ſociety; to enter into any detail of the premiums given by this reſpectable inſtitution for the improvement of the celebrated Shetland breed; or to explain how, as if it were by magic, in a country where the manufacture of wool was little known, articles manufactured of that material were made, rivalling, and in ſome caſes ſurpaſſing, the moſt celebrated fabrics of other countries. A war having unfortunately ariſen, it became impoſſible to pay the ſame attention, or to carry on with the ſame ſucceſs, novel enterprizes; even old eſtabliſhments often fall a ſacrifice amidſt the horrors of war. The utmoſt that the Britiſh Wool Society could expect to do, was to preſerve the inſtitution in ſuch a ſtate, that when peace ſhall be happily reſtored it may revive with double energy and ſpirit.

WOOLSTON (Thomas), an Engliſh divine, was born at Northampton in 1669, and educated at Cambridge. His firſt appearance in the learned world was in 1705, in a work intitled, The old Apology for the Truth of the Chriſtian Religion, againſt the Jews and Gentiles, revived. He afterward wrote many pieces: but what made the moſt noiſe, were his Six Diſcourſes on the Miracles of Chriſt; which occaſioned a great number of books and pamphlets upon the ſubject, and raiſed a proſecution againſt him. At his trial in Guildhall, before the lord chief-juſtice Raymond, he ſpoke ſeveral times himſelf; and urged, that "he thought it very hard that he ſhould be tried by a ſet of men who, though otherwiſe very learned and worthy perſons, were no more judges of the ſubjects on which he wrote, than himſelf was a judge of the moſt crabbed points of the law." He was ſentenced to a year's impriſonment, and to pay a fine of 100l. He purchaſed the liberty of the rules of the King's bench, where he continued after the expiration of the year, being unable to pay the fine. The greateſt obſtruction to his deliverance from confinement was, the obligation of giving ſecurity not to offend by any future writings, he being reſolved to write again as freely as before. Whilſt ſome ſuppoſed that this author wrote with the ſettled intention of ſubverting Chriſtianity under the pretence of defending it, others believed him diſordered in his mind; and many circumſtances concurred which gave countenance to this opinion. He died, January 27. 1732-3, after an illneſs of four days; and, a few minutes before his death, uttered theſe words: "This is a ſtruggle which all men muſt go through, and which I bear not only patiently, but with willingneſs." His body was interred in St George's church-yard, Southwark.

WOOLWICH, a town in Kent, with a market on Fridays, but no fair. It is ſeated on the river Thames, and of great note for its fine docks and yards, where men of war are built; as alſo for its vaſt magazines of great-guns, mortars, bombs, cannon-balls, powder, and other warlike ſtores. It has likewiſe an academy, where the mathematics are taught, and young officers inſtructed in the military art.

It is nine miles eaſt of London. E. Long. 0. 10. N. Lat. 51. 30.

WORCESTER, in Latin *Wigornia*, the capital of a county of England of the ſame name, ſtands on the river Severn, but ſo low that it can hardly be ſeen till one is cloſe upon it. It is ſuppoſed to be the Branonium of Antoninus, the Branonenium of Ptolemy, and to have been built by the Romans to awe the Britons on the other ſide of the Severn. It was made an epiſcopal ſee about the year 680 by Sexulphus biſhop of the Mercians; but the preſent cathedral was begun by Wulſton in the year 1084. The town hath been ſeveral times burnt down: firſt, in 1041, by Hardicanute, who alſo maſſacred the citizens; ſecondly, not long after William Rufus's time; and a third time, when king Stephen beſieged and took it. Here, in latter times, was fought that battle, in which Charles II. with his Scots army, was defeated by Cromwell. In a garden, near the ſouth gate of the city, where the action was hotteſt, the bones of the ſlain are often dug up. It had formerly ſtrong walls and a caſtle; but theſe have been demoliſhed long ago. It is now a large city, the ſtreets broad and well paved, and ſome of them very regular and well built, particularly Foregate-ſtreet; ſo that in general it is a very agreeable place. The cathedral is a ſtately edifice, and among other monuments in it are thoſe of king John, of Arthur, elder brother to Henry VIII. and of the counteſs of Saliſbury, who gave occaſion to the inſtitution of the order of the Garter. There are ſeven or eight hoſpitals in and about the city; of which that built and endowed by Robert Berkley of Spetchley, Eſq; is a very noble one. There is a ſchool founded by Henry VIII. three other ſchools, and ſix charity-ſchools. The Guildhall and the workhouſe are ſtately ſtructures. The churches, St Nicholas and All-Saints, have been lately rebuilt, and are very handſome edifices. The city carries on a great trade; for which it is chiefly indebted to its ſituation upon the Severn. A prodigious number of people are employed in and about it in the manufacture of broad-cloth and gloves. The Welch inhabit a part of it, and ſpeak their own language. Its market is well ſupplied with proviſions, corn, and cattle, and its quay is much frequented by ſhips. By a charter from James I. it is governed by a mayor, ſix aldermen, who are juſtices of the peace, and choſen out of 24 capital citizens; a ſheriff, the city being a county of itſelf, a common council, conſiſting of 48 other citizens, out of which two chamberlains are yearly choſen, a recorder, town-clerk, two coroners, a ſword-bearer, 13 conſtables, and four ſerjeants at mace. Of the biſhops of this ſee, there have been, it is ſaid, one pope, four ſaints, ſeven lord high-chancellors, 11 archbiſhops, two lord treaſurers, one chancellor to the queen, one lord preſident of Wales, and one vice-preſident. The city at preſent gives title of earl and marquis to the duke of Beaufort. W. Long. 1. 55. N. Lat 52. 10.

Worcester (earl of). See Tiptoft.

WORCESTERSHIRE, a county of England, bounded by Warwickſhire on the eaſt, by Glouceſterſhire on the ſouth, by the counties of Hereford and Salop on the weſt, and on the north by Staffordſhire. According to Templeman, it is 36 miles in length, 28 in breadth, and about 130 in circumference, within which it contains ſeven hundreds, and a part of two others, 11 market towns, of which three are boroughs, one city, namely *Worceſter*, 152 pariſhes, about 540,000 acres, and 103,000 inhabitants.

This being an inland county, well cultivated, and free from lakes, marſhes, or ſtagnant waters, the air is very ſweet and wholeſome all over it. The ſoil in general is very rich, producing corn, fruit, eſpecially pears, of which they make a great deal of perry; hops, and paſture. The hills are covered with ſheep, and the meadows with cattle. Hence they have wool, cloth, ſtuffs, butter, and cheeſe in abundance. They are alſo well ſupplied with fuel, either wood or coal, and ſalt from their brine pits and ſalt ſprings. Of the laſt they have not only enough for themſelves, but export large quantities by the Severn; which noble river, to the great convenience and emolument of the inhabitants, runs from north to ſouth through the very middle of the country, enriching the ſoil, and yielding it plenty of fiſh, and an eaſy expeditious conveyance of goods to and from it. The other rivers by which it is watered are the Stour, Avon, Teme, &c. It ſends nine members to parliament, viz. two for the county, two for the city of Worceſter, two for Droitwich, two for Eveſham, and one for Bewdley; and lies in the dioceſe of Worceſter, and Oxford circuit.

WORD, in language, an articulate ſound deſigned to repreſent ſome idea or notion. See Grammar and Language. See alſo Logic, Part I. chap. 1.

Word, or *Watch-Word*, in military affairs, is ſome peculiar word or ſentence, by which the ſoldiers know and diſtinguiſh one another in the night, &c. and by which ſpies and deſigning perſons are diſcovered. It is uſed alſo to prevent ſurpriſes. The word is given out in an army every night to the lieutenant, or major-general of the day, who gives it to the majors of the brigades, and they to the adjutants; who give it firſt to the field-officers, and afterwards to a ſerjeant of each company, who carry it to the ſubalterns. In garriſons it is given after the gate is ſhut to the town major, who gives it to the adjutants, and they to the ſerjeants.

Words of Command. See Exercise and Manual.

Signals by the Drum, made uſe of in exerciſing of the Army, inſtead of the Word of Command, viz.

Signals by the drum.	*Operations.*
A ſhort roll,	To caution.
A flam,	To perform any diſtinct thing.
To arms,	To form the line or battalion.
The march,	To advance, except when intended for a ſalute.
The quick march,	To advance quick.
The point of war,	To march and charge.
The retreat,	To retreat.
Drum ceaſing,	To halt.
Two ſhort rolls,	To perform the flank firing.
The dragoon march,	To open the battalion.
The grenadier march,	To form the column.
The troop,	To double diviſions.
The long roll,	To form the ſquare.
The grenadier march,	To reduce the ſquare to the column.
The preparative,	To make ready and fire.
The general	To ceaſe firing.
Two long rolls,	To bring or lodge the colours.

WORK, in the manege. To work a horſe, is to exerciſe him at pace, trot, or gallop, and ride him at the manege. To work a horſe upon volts, or head and haunches in or between two heels, is to paſſage him, or make him go ſidewiſe upon parallel lines.

To Work, in ſea language, is to direct the movements of a ſhip, by adapting the ſails to the force and direction of the wind. See Seamanship.

Work, Carpenters, Clock, Crown, Field, Fire, Fret, Groteſque, Horn, Moſaic. See the ſeveral articles, together with Fortification and Pyrotechny.

Work-Houſe, a place where indigent, vagrant, and idle people, are ſet to work, and ſupplied with food and clothing.

Work-house.

Work-houfes are of two kinds, or at leaft are employed for two different purpofes. Some are ufed as prifons for vagrants or fturdy beggars, who are there confined and compelled to labour for the benefit of the fociety which maintains them; whilft others, fometimes called *poor-houfes*, are charitable afylums for fuch indigent perfons as through age or infirmity are unable to fupport themfelves by their own labour. The former kind of work houfe, when under proper management, may be made to ferve the beft of purpofes; of the latter we are acquainted with none which entirely commands our approbation.

To make confinement in a work-houfe operate to the correction of vagrants and diforderly perfons (and if it produce not this effect it can hardly be confidered as a beneficial inftitution), the prifoners fhould be fhut up in feparate cells, and compelled to labour for their own fubfiftence. A crew of thieves and vagabonds affociating with each other is a hell upon earth, in which every individual is hardened in his crimes by the countenance and converfation of his companions; and wretches who, when at liberty, choofe to beg or fteal rather than to earn a comfortable livelihood by honeft induftry, will fubmit to any punifhment which a humane overfeer can inflict rather than work for the benefit of others. No punifhment indeed will compel a vagrant to labour. He may affume the appearance of it, but he will make no progrefs; and the pretext of ficknefs or weaknefs is ever at hand for an excufe. Hence it is that thieves and ftrumpets are too often difmiffed from work-houfes and bridewells ten times more the children of the devil than when they entered them.

To remedy thefe evils, we can think of no better method than to confine each prifoner in a cell by himfelf, and to furnifh him daily with fuch an allowance of bread and water as may preferve him from *immediate* death; for the only compulfion to make fuch men work ferioufly is the fear of want, and the only way to reform them is to leave them to their own meditations on the confequences of their paft conduct. There are furely very few perfons, if any, whofe averfion from labour would not be conquered by the pinchings of hunger and the certain profpect of perifhing by famine; and it is to be hoped that there are not many fo totally divefted of every latent principle of virtue as not to be brought by fuch folitude to a due fenfe of their former wickednefs. Should one or two, however, be occafionally found fo very obdurate as to fuffer themfelves to perifh rather than work, their deaths would prove a falutary beacon to others, and their blood would be on their own heads; for we have the exprefs command of St Paul himfelf, that "if any will not work, neither fhould he eat."

No doubt it would be proper that the meditations of vagabonds confined in a work-houfe fhould be directed by the private admonitions of a pious and intelligent clergyman; but it is not every clergyman who is qualified to difcharge fuch a duty. If he be actuated by a zeal not according to knowledge, or if he have not with equal care ftudied human nature and the word of God, his admonitions will be more likely to provoke the profane ridicule of his auditor, and harden him in his wickednefs, than to excite in his breaft fuch forrow for his fins as fhall "bring forth fruits meet for repentance." To render the inftruction of thieves and vagrants of any ufe, it muft be accurately adapted to the cafe of each individual; and however excellent it may be in itfelf, it will not be liftened to unlefs offered at feafons of uncommon ferioufnefs, which the inftructor fhould therefore carefully obferve.

That fuch wholefome feverity as this would often reform the inhabitants of work-houfes, appears extremely probable from the effects of a fimilar treatment of common proftitutes mentioned by Lord Kames in his Sketches of the Hiftory of Man: "A number of thofe wretches were in Edinburgh confined in a houfe of correction, on a daily allowance of threepence, of which part was embezzled by the fervants of the houfe. Pinching hunger did not reform their manners; for being abfolutely idle, they encouraged each other in vice, waiting impatiently for the hour of deliverance. Mr Stirling the fuperintendant, with the confent of the magiftrates, removed them to a clean houfe; and inftead of money, appointed for each a pound of oat-meal daily, with falt, water, and fire for cooking. Relieved now from diftrefs, they longed for comfort. What would they not give for milk or ale? Work (fays he) will procure you plenty. To fome who offered to fpin, he gave flax and wheels, engaging to pay them half the price of their yarn, retaining the other half for the materials furnifhed. The fpinners earned about ninepence weekly; a comfortable addition to what they had before. The reft undertook to fpin, one after another; and before the end of the firft quarter they were all of them intent upon work. It was a branch of his plan to fet free fuch as merited that favour; and fome of them appeared to be fo thoroughly reformed as to be in no danger of a relapfe"

Work-houfes erected as charitable afylums appear to us, in every view that we can take of them, as inftitutions which can ferve no good purpofe. Economy is the great motive which inclines people to this mode of providing for the poor. There is comparatively but a very fmall number of mankind in any country fo aged and infirm as not to be able to contribute, in fome degree, to their fubfiftence by their own labour; and in fuch houfes it is thought that proper work may be provided for them, fo that the public fhall have nothing to give in charity but what the poor are abfolutely unable to procure for themfelves. It is imagined likewife, that numbers collected at a common table, can be maintained at lefs expence than in feparate houfes; and foot foldiers are given for an example, who could not live on their pay if they did not mefs together. But the cafes are not parallel. "Soldiers having the mangement of their pay, can club for a bit of meat; but as the inhabitants of a poor-houfe are maintained by the public, the fame quantity of provifions muft be allotted to each. The confequence is what might be expected: the bulk of them referve part of their victuals for purchafing ale or fpirits. It is vain to expect work from them: poor wretches void of fhame will never work ferioufly, where the profit accrues to the public, not to themfelves. Hunger is the only effectual means for compelling fuch perfons to work.*"

* Kam. Sketches

The poor, therefore, fhould be fupported in their own houfes; and to fupport them properly, the firft thing to be done is, to eftimate what each can earn by his own labour; for as far only as that falls fhort of maintenance is there room for charity. In repairing thofe evils which fociety did not or could not prevent, it ought to be careful not to counteract the wife purpofes of nature, nor to do more than to give the poor a fair chance to work for themfelves. The prefent diftrefs muft be relieved, the fick and the aged provided for; but the children muft be inftructed; and labour, not alms, offered to thofe who have fome ability to work, however fmall that ability may be. They will be as induftrious as poffible, becaufe they work for themfelves; and a weekly fum of charity under their own management will turn to better account than in a poor-houfe under the direction of mercenaries. Not a penny of it will be laid out on fermented liquors, unlefs perhaps as a medicine in ficknefs. Nor does fuch low fair call for pity to thofe who can afford no better. Ale makes no part of the maintenance of thofe who, in many parts of Scotland,

Scotland, live by the ſweat of their brows; and yet the perſon who ſhould baniſh all from a charity work-houſe, would be exclaimed againſt as hard-hearted, and even void of humanity.

That ſuch a mode of ſupporting the poor in their own houſes is practicable, will hardly admit of a diſpute; for it has been actually put in practice in the city of Hamburgh ever ſince the year 1788. At that period ſuch revenues as had till then been expended in alms by the ſeveral church-wardens, and thoſe of which the adminiſtration had been connected with the work-houſe, were united under one adminiſtration with ſuch ſums as were collected from private benevolence. The city was divided into ſixty diſtricts, containing each an equal number of poor; and over theſe 180 overſeers were appointed. Actual relief was the firſt object; but at the very moment that this proviſion was ſecured, meaſures were taken to prevent any man from receiving a ſhilling which he could have been able to earn for himſelf. By methods, which our limits will not permit us to ſtate, the overſeers were able to make a calculation tolerably exact of what each pauper wanted for bare ſubſiſtence, in addition to the fruits of his own labour. A flax-yarn-ſpinning manufacture was eſtabliſhed, in which the yarn is paid for, not by its weight, but by its meaſure. The clean flax is ſold to the poor at a low price, and a certain meaſure of yarn again bought from them at 30 *per cent.* above the uſual price; ſo that the overſeers are ſure that all the yarn ſpun by the poor will be brought into their office. Every pauper brings with him a book in which the quantity delivered is carefully noted down, which furniſhes the overſeers with a continual average of the ſtate of induſtry among their poor.

As ſoon as this inſtitution was eſtabliſhed, the overſeers went through their diſtricts, and aſked, in all ſuch manſions as could be ſuppoſed to harbour want, if the inhabitants ſtood in need of ſupport? The queſtion to all ſuch poor as wiſhed for relief, and were able to ſpin, was, Whether they did earn by their work 1 s. 6d. a-week? for experience had taught the inhabitants of Hamburgh, that many poor live upon that ſum; and they knew enough of their poor to ſuppoſe, that 1 s. 6 d. avowed earning was equal to ſomething more. If the anſwer was affirmative, the pauper ſtood not in need of weekly aſſiſtance. If it was negative, work was given him, which, by being paid 30 *per cent.* above its value, afforded him 1 s. 6d. a-week eaſily, if he was even an indifferent hand. The far more frequent caſes were partial inability by age, or weakneſs, or want of ſkill. For poor of the latter deſcription a ſchool was opened, and in three months time the buſineſs was eaſily learnt. During that time, the pauper got firſt 2 s. a-week, and every week afterwards 2 d. leſs, till in the twelfth week he got nothing at all but his earnings, and was diſmiſſed, with a wheel and a pound of flax *gratis*.

The quantity of work which diſabled poor were capable of doing in a week was eaſily and accurately aſcertained by a week's trial in the ſpinning-ſchool. The reſult was produced weekly before appointed members of the committee, and the ſum which the poor could earn was noted down in their ſmall books. The overſeer was directed to pay them weekly what their earnings fell ſhort of 1 s. 6 d. in every ſuch week, when it appeared from their books that they had earned to the known extent of their abilities. From that moment applications became leſs frequent; and the committee had an infallible ſtandard for diſtinguiſhing real want: for whenever the pauper, if in health (if not, he was peculiarly provided for), had not earned what he could, then he had either been lazy, or had found more lucrative work; in either caſe, he was not entitled to a relief for that week, whatever he might be for the following.

This mode of providing for the poor, which attracted the notice and obtained the eulogium of the miniſter in the Britiſh houſe of commons, has for ſix years been in Hamburgh attended with the happieſt conſequences. In the ſtreets of that city a beggar is rarely to be ſeen, whilſt thoſe, who ſtand in need of the charitable contributions of the rich, are much more comfortably, as well as at much leſs expence, maintained at home, with their children about them, than they could be in work-houſes, under the management of mercenary overſeers. For a fuller account of this judicious inſtitution, we muſt refer the reader to Vought's *Account of the Management of the Poor in Hamburgh, ſince the year 1788, in a letter to ſome friends of the poor in Gr. Britain.*

Water-Works. Water-WORKS. Under this name may be comprehended almoſt every hydraulic ſtructure or contrivance; ſuch as, canals, conduits, locks, mills, water-engines, &c. But they may be conveniently arranged under two general heads, *1ſt*, Works which have for their object the conducting, raiſing, or otherwiſe managing, of water; and, *2dly*, Works which derive their efficacy from the impulſe or other action of water. The *firſt* claſs comprehends the methods of ſimply conducting water in aqueducts or in pipes for the ſupply of domeſtic conſumption or the working of machinery: It comprehends alſo the methods of procuring the ſupplies neceſſary for theſe purpoſes, by means of pumps, water, or fire engines. It alſo comprehends the ſubſequent management of the water thus conducted, whether in order to make the proper diſtribution of it according to the demand, or to employ it for the purpoſe of navigation, by lockage, or other contrivances.—And in the proſecution of theſe things many ſubordinate problems will occur, in which practice will derive great advantages from a ſcientific acquaintance with the ſubject. The *ſecond* claſs of water-works is of much greater variety, comprehending almoſt every kind of hydraulic machine; and would of itſelf fill volumes. Many of theſe have already occurred in various articles of this Dictionary. In deſcribing or treating them, we have tacitly referred the diſcuſſion of their general principles, in which they all reſemble each other, to ſome article where they could be taken in a connected body, ſuſceptible of general ſcientific diſcuſſion, independent of the circumſtances which of neceſſity introduced the particular modifications required by the uſes to which the ſtructures were to be applied. That part of the preſent article, therefore, which embraces theſe common principles, will chiefly relate to the theory of water-mills, or rather of water-wheels; becauſe, when the neceſſary motion is given to the axis of the water-wheel, this may be ſet to the performance of any taſk whatever.

CLASS I.

1. *Of the conducting of Water.*

This is undoubtedly a buſineſs of great importance, and makes a principal part of the practice of the civil engineer: It is alſo a buſineſs ſo imperfectly underſtood, that we believe that very few engineers can venture to ſay, with tolerable preciſion, what will be the quantity of water which his work will convey, or what plan and dimenſions of conduit will convey the quantity which may be propoſed. For proof of this we ſhall only refer our readers to the facts mentioned in the article Rivers, n° 27, &c.

In that article we have given a ſort of hiſtory of the progreſs of our knowledge in hydraulics, a branch of mechanical philoſophy which ſeems to have been entirely unknown

Water-works.

to the ancients. Even Archimedes, the author of almoft all that we know in hydroftatics, feems to have been entirely ignorant of any principles by which he could determine the motion of water. The mechanical fcience of the ancients feems to have reached no farther than the doctrine of equilibrium among bodies at reft. Guglielmini firft ventured to confider the motion of water in open canals and in rivers. Its motion in pipes had been partially confidered in detached fcraps by others, but not fo as to make a body of doctrine. Sir Ifaac Newton firft endeavoured to render hydraulics fufceptible of mathematical demonftration: But his fundamental propofition has not yet been freed from very ferious objections; nor have the attempts of his fucceffors, fuch as the Bernoullis, Euler, D'Almbert, and others, been much more fuccefsful: fo that hydraulics may ftill be confidered as very imperfect, and the general conclufions which we are accuftomed to receive as fundamental propofitions are not much better than matters of obfervation, little fupported by principle, and therefore requiring the moft fcrupulous caution in the application of them to any hitherto untried cafe. When experiments are multiplied fo as to include as great a variety of cafes as poffible; and when thefe are cleared of extraneous circumftances, and properly arranged, we muft receive the conclufions drawn from them as the general laws of hydraulics. The experiments of the Abbé Boffut, narrated in his *Hydrodynamique*, are of the greateft value, having been made in the cafes of moft general frequency, and being made with great care. The greateft fervice, however, has been done by the chevalier Buat, who faw the folly of attempting to deduce an accurate theory from any principles that we have as yet learned, and the neceffity of adhering to fuch a theory as could be deduced from experiment alone, independent of any more general principles. Such a theory muft be a juft one, if the experiments are really general, unaffected by the particular circumftances of the cafe, and if the claffes of experiment are fufficiently comprehenfive to include all the cafes which occur in the moft important practical queftions. Some principle was neceffary, however, for connecting thefe experiments. The fufficiency of this principle was not eafily afcertained. M. Buat's way of eftablifhing this was judicious. If the principle is ill-founded, the refults of its combination in cafes of actual experiments muft be irregular; but if experiments, feemingly very unlike, and in a vaft variety of diffimilar cafes, give a train of refults which is extremely regular and confiftent, we may prefume that the principle, which in this manner harmonizes and reconciles things fo unlike, is founded in the nature of things; and if this principle be fuch as is agreeable to our cleareft notions of the internal mechanifm of the motions of fluids, our prefumption approaches to conviction.

Proceeding in this way, the chevalier Buat has collected a prodigious number of facts, comprehending almoft every cafe of the motion of fluids. He firft claffed them according to their refemblance in fome one particular, and obferved the differences which accompanied their differences in other circumftances; and by confidering what could produce thefe differences, he obtained general rules, deduced from fact, by which thefe differences could be made to fall into a regular feries. He then arranged all the experiments under fome other circumftance of refemblance, and purfued the fame method; and by following this out, he has produced a general propofition, which applies to the whole of this numerous lift of experiments with a precifion far exceeding our utmoft hopes. This propofition is contained in n° 59. of the article RIVERS, and is there offered as one of the moft valuable refults of modern fcience.

We muft, however, obferve, that of this lift of experiments there is a very large clafs, which is not direct, but requires a good deal of reflection to enable us to draw a confident conclufion; and this is in cafes which are very frequent and important, *viz.* where the declivity is exceedingly fmall, as in open canals and rivers. The experiments were of the following forms: Two large cifterns were made to communicate with each other by means of a pipe. The furfaces of the water in thefe cifterns were made to differ only by a fmall fraction of an inch: and it is fuppofed that the motion in the communicating pipe will be the fame as in a very long pipe, or an open canal, having this very minute declivity. We have no difficulty in admitting the conclufion; but we have feen it contefted, and it is by no means intuitive. We had hopes that ere now this important cafe would have been determined by direct experiments, which the writer of this article was commiffioned to make by the Board for Encouraging Improvements and Manufactures in Scotland: But this has been prevented hitherto by his want of health; and we cannot expect that it will be accomplifhed before the clofe of this Work. This, however, need not occafion any hefitation in the adoption of M. Buat's general propofition, becaufe the experiments which we are now criticifing fall in precifely with the general train of the reft, and fhow no *general* deviation which would indicate a fallacy in principle.

We apprehend it to be quite unneceffary to add much to what has been already delivered on the motion of waters in an open canal. Their *general progreffive* motion, and confequently the quantity delivered by an aqueduct of any flope and dimenfion, are fufficiently determined; and all that is wanted is the tables which we promifed in n° 65. of the article RIVERS, by which any perfon who underftands common arithmetic may, in five minutes time or lefs, compute the quantity of water which will be delivered by the aqueduct, canal, conduit, or pipe; for the theorem in n° 59. of this article applies to them all without diftinction. We therefore take this opportunity of inferting thefe tables, which have been computed on purpofe for this Work with great labour.

TABLE

TABLE I. *Logarithms of the Values of the Numerator of the Fraction* $\frac{307(\sqrt{d}-0,1)}{\sqrt{d}-L\sqrt{d+1,6}}$ *for every Value of the Hydraulic mean Depth d: Also the Values of* $0,3(\sqrt{d}-0,1)$.

d.	Log. of $307\sqrt{d}-0,1$	$0,3 \times \sqrt{d}-0,1$	d.	Log. of $307\sqrt{d}-0,1$	$0,3 \times \sqrt{d}-0,1$	d.	Log. of $307\sqrt{d}-0,1$	$0,3 \times \sqrt{d}-0,1$	d.	Log. of $307\sqrt{d}-0,1$	$0,3 \times \sqrt{d}-0,1$
0,1	1.82208	0,06	4,9	2.81216	0,63	9,7	2.96634	0,9	54	[illegible]	[illegible]
0,2	2.02776	0,1	5,0	2.81674	0,63	9,8	2.96865	0,91	55	3.35143	2,19
0,3	2.13753	0,13	5,1	2.82125	0,65	9,9	2.97093	0,91	56	[illegible]	2,21
0,4	2.21343	0,16	5,2	2.82567	0,65	10	2.97319	0,92	57	[illegible]	2,23
0,5	2.27040	0,18	5,3	2.83000	0,66	11	2.99454	0,97	58	[illegible]	[illegible]
0,6	2.31618	0,2	5,4	2.83422	0,67	12	3.01421	1,01	59	[illegible]	2,27
0,7	2.35441	0,22	5,5	2.83840	0,67	13	3.03189	1,05	60	[illegible]	[illegible]
0,8	2.38719	0,24	5,6	2.84248	0,68	14	3.04843	1,09	61	[illegible]	2,31
0,9	2.41588	0,25	5,7	2.84648	0,68	15	3.06393	1,13	62	[illegible]	2,33
1,0	2.44138	0,27	5,8	2.85043	0,69	16	3.07820	1,17	63	[illegible]	[illegible]
1,1	2.46431	0,28	5,9	2.85431	0,69	17	3.09170	1,21	64	[illegible]	[illegible]
1,2	2.48518	0,3	6,0	2.85812	0,7	18	3.10441	1,24	65	[illegible]	[illegible]
1,3	2.50426	0,31	6,1	2.86185	0,7	19	3.11644	1,28	66	[illegible]	2,41
1,4	2.52185	0,32	6,2	2.86554	0,71	20	3.12783	1,31	67	[illegible]	2,42
1,5	2.53818	0,34	6,3	2.86916	0,72	21	3.13867	1,34	68	[illegible]	2,44
1,6	2.55345	0,35	6,4	2.87271	0,73	22	3.14899	1,38	69	[illegible]	2,46
1,7	2.56769	0,36	6,5	2.87622	0,73	23	3.15885	1,41	70	[illegible]	2,48
1,8	2.58112	0,37	6,6	2.87966	0,74	24	3.16828	1,44	71	[illegible]	2,49
1,9	2.59381	0,38	6,7	2.88306	0,75	25	3.17734	1,47	72	3.41065	[illegible]
2,0	2.60580	0,39	6,8	2.88641	0,75	26	3.18601	1,5	73	[illegible]	2,53
2,1	2.61713	0,4	6,9	2.88971	0,76	27	3.19438	1,53	74	[illegible]	2,55
2,2	2.62803	0,41	7,0	2.89296	0,76	28	3.20243	1,56	75	[illegible]	[illegible]
2,3	2.63829	0,42	7,1	2.89614	0,77	29	3.21020	1,58	76	[illegible]	2,58
2,4	2.64827	0,44	7,2	2.89930	0,77	30	3.21770	1,61	77	[illegible]	2,60
2,5	2.65772	0,45	7,3	2.90241	0,78	31	3.22495	1,64	78	[illegible]	2,62
2,6	2.66681	0,45	7,4	2.90549	0,78	32	3.23196	1,67	79	[illegible]	2,63
2,7	2.67556	0,46	7,5	2.90851	0,79	33	3.23877	1,69	80	[illegible]	2,65
2,8	2.68395	0,47	7,6	2.91150	0,79	34	3.24537	1,72	81	3.43653	2,67
2,9	2.69207	0,48	7,7	2.91445	0,8	35	3.25176	1,74	82	[illegible]	2,69
3,0	2.69989	0,49	7,8	2.91734	0,8	36	3.25799	1,77	83	[illegible]	2,7
3,1	2.70743	0,5	7,9	2.92022	0,81	37	3.26404	1,79	84	[illegible]	2,72
3,2	2.71472	0,51	8,0	2.92305	0,82	38	3.26993	1,82	85	3.44712	2,74
3,3	2.72181	0,52	8,1	2.92584	0,82	39	3.27566	1,84	86	3.44968	2,75
3,4	2.72866	0,53	8,2	2.92860	0,83	40	3.28125	1,87	87	3.45222	2,77
3,5	2.73531	0,53	8,3	2.93133	0,83	41	3.28669	1,89	88	3.45473	2,78
3,6	2.74178	0,54	8,4	2.93403	0,84	42	3.29201	1,91	89	3.45721	2,79
3,7	2.74805	0,55	8,5	2.93670	0,84	43	3.29720	1,93	90	3.45965	2,81
3,8	2.75417	0,56	8,6	2.93933	0,85	44	3.30227	1,95	91	3.46208	2,83
3,9	2.76009	0,56	8,7	2.94192	0,85	45	3.30722	1,98	92	3.46448	2,85
4,0	2.76589	0,57	8,8	2.94449	0,86	46	3.31207	2,00	93	3.46685	2,86
4,1	2.77153	0,58	8,9	2.94703	0,86	47	3.31681	2,03	94	3.46920	2,88
4,2	2.77704	0,59	9,0	2.94954	0,87	48	3.32145	2,05	95	3.47152	2,89
4,3	2.78240	0,59	9,1	2.95202	0,87	49	3.32599	2,07	96	3.47381	2,91
4,4	2.78765	0,6	9,2	2.95447	0,88	50	3.33043	2,09	97	3.47608	2,93
4,5	2.79277	0,6	9,3	2.95690	0,88	51	3.33480	2,11	98	3.47833	2,94
4,6	2.79779	0,61	9,4	2.95930	0,89	52	3.33908	2,13	99	3.48056	2,95
4,7	2.80269	0,62	9,5	2.96167	0,89	53	3.34327	2,15	100	3.48277	2,97
4,8	2.80747	0,63	9,6	2.96402	0,9						

TABLE II. *Logarithms of the Values of the Denominator of the Fraction* $\frac{307(\sqrt{d}-0,1)}{\sqrt{s}-L\sqrt{s+1,6}}$ *for every Value of the Slope s.*

s.	Log. of $\sqrt{s}-L\sqrt{s+1,6}$	s.	Log. of $\sqrt{s}-L\sqrt{s+1,6}$	s.	Log. of $\sqrt{s}-L\sqrt{s+1,6}$	s.	Log. of $\sqrt{s}-L\sqrt{s+1,6}$	s.	Log. of $\sqrt{s}-L\sqrt{s+1,6}$	s.	Log. of $\sqrt{s}-L\sqrt{s+1,6}$
1,0	9.71784	7,3	0.20651	45	0.67997	170	1.01983	800	1.39690	5200	1.83142
1,1	9.74210	7,4	0.20997	46	0.68574	180	1.03410	810	1.39985	5300	1.83575
1,2	9.76383	7,5	0.21336	47	0.69135	190	1.04751	820	1.40277	5400	1.84002
1,3	9.78376	7,6	0.21674	48	0.69688	200	1.06026	830	1.40564	5500	1.84421
1,4	9.80202	7,7	0.22109	49	0.70226	210	1.07237	840	1.40678	5600	1.84833
1,5	9.81882	7,8	0.22335	50	0.70749	220	1.08390	850	1.41128	5700	1.85237
1,6	9.83461	7,9	0.22663	51	0.71265	230	1.09489	860	1.41408	5800	1.85634
1,7	9.84930	8,0	0.22982	52	0.71767	240	1.10542	870	1.41683	5900	1.86022
1,8	9.86314	8,1	0.23297	53	0.72263	250	1.11553	880	1.41953	6000	1.86404
1,9	9.87622	8,2	0.23611	54	0.72746	260	1.12523	890	1.42220	6100	1.86778
2,0	9.88857	8,3	0.23923	55	0.73223	270	1.13453	900	1.42487	6200	1.87146
2,1	9.90031	8,4	0.24229	56	0.73695	280	1.14345	910	1.42746	6300	1.87507
2,2	9.91153	8,5	0.24532	57	0.74155	290	1.15204	920	1.43005	6400	1.87863
2,3	9.92267	8,6	0.24832	58	0.74601	300	1.16035	930	1.43263	6500	1.88213
2,4	9.93247	8,7	0.25128	59	0.75043	310	1.16838	940	1.43515	6600	1.88558
2,5	9.94231	8,8	0.25422	60	0.75481	320	1.17612	950	1.43464	6700	1.88898
2,6	9.95173	8,9	0.25709	61	0.75906	330	1.18363	960	1.44011	6800	1.89233
2,7	9.96085	9,0	0.25995	62	0.76328	340	1.19092	970	1.44254	6900	1.89564
2,8	9.96942	9,1	0.26281	63	0.76745	350	1.19803	980	1.44498	7000	1.89891
2,9	9.97818	9,2	0.26560	64	0.77151	360	1.20490	990	1.44737	7100	1.90214
3,0	9.98632	9,3	0.26839	65	0.78276	370	1.21158	1000	1.44976	7200	1.90532
3,1	9.99427	9,4	0.27116	66	0.77945	380	1.21806	—		7300	1.90845
3,2	0.00200	9,5	0.27387	67	0.78333	390	1.22435	1100	1.47223	7400	1.91154
3,3	0.00945	9,6	0.27656	68	0.78718	400	1.23048	1200	1.49269	7500	1.91458
3,4	0.01669	9,7	0.27921	69	0.79092	410	1.23647	1300	1.51148	7600	1.91757
3,5	0.02373	9,8	0.28186	70	0.79463	420	1.24232	1400	1.52885	7700	1.92052
3,6	0.03064	9,9	0.28450	71	0.79824	430	1.24805	1500	1.54497	7800	1.92344
3,7	0.03733	10	0.28709	72	0.80182	440	1.25360	1600	1.56014	7900	1.92632
3,8	0.04383	—		73	0.80536	450	1.25903	1700	1.57416	8000	1.92916
3,9	0.05015	11	0.31170	74	0.80882	460	1.26433	1800	1.58747	8100	1.93197
4,0	0.05638	12	0.33425	75	0.81231	470	1.26951	1900	1.60004	8200	1.93475
4,1	0.06245	13	0.35488	76	0.81571	480	1.27461	2000	1.61195	8300	1.93749
4,2	0.06839	14	0.37420	77	0.81908	490	1.27957	2100	1.62325	8400	1.94020
4,3	0.07412	15	0.39235	78	0.82236	500	1.28445	2200	1.63[illegible]03	8500	1.942[illegible]7
4,4	0.07898	16	0.40926	79	0.82562	510	1.28923	2300	1.64432	8600	1.94551
4,5	0.08533	17	0.42521	80	0.82885	520	1.29391	2400	1.65414	8700	1.94811
4,6	0.09081	18	0.44028	81	0.83206	530	1.29851	2500	1.66358	8800	1.95069
4,7	0.09615	19	0.45439	82	0.83525	540	1.30300	2600	1.67261	8900	1.95324
4,8	0.10131	20	0.46776	83	0.83835	550	1.30740	2700	1.68133	9000	1.95576
4,9	0.10644	21	0.48044	84	0.84142	560	1.31172	2800	1.68971	9100	1.95826
5,0	0.11147	22	0.49262	85	0.84442	570	1.31597	2900	1.69780	9200	1.96073
5,1	0.11635	23	0.50433	86	0.84739	580	1.32015	3000	1.70558	9300	1.96317
5,2	0.12108	24	0.51548	87	0.85034	590	1.32426	3100	1.71313	9400	1.96559
5,3	0.12595	25	0.52621	88	0.85327	600	1.32830	3200	1.72042	9500	1.96797
5,4	0.13061	26	0.53656	89	0.85618	610	1.33226	3300	1.72750	9600	1.97033
5,5	0.13519	27	0.54654	90	0.85908	620	1.33614	3400	1.73435	9700	1.97267
5,6	0.13970	28	0.55606	91	0.86189	630	1.33997	3500	1.74099	9800	1.97497
5,7	0.14410	29	0.56526	92	0.86463	640	1.34373	3600	1.74746	9900	1.97726
5,8	0.14844	30	0.57415	93	0.86741	650	1.34743	3700	1.75373	10000	1.97952
5,9	0.15274	31	0.58263	94	0.87017	660	1.35108	3800	1.75984	11000	2.00099
6,0	0.15697	32	0.59095	95	0.87286	670	1.35468	3900	1.76578	12000	2.02056
6,1	0.16113	33	0.59901	96	0.87552	680	1.35823	4000	1.77159	13000	2.03855
6,2	0.16522	34	0.60692	97	0.87818	690	1.36170	4100	1.77725	14000	2.05518
6,3	0.16927	35	0.61448	98	0.88076	700	1.36513	4200	1.78277	15000	2.07065
6,4	0.17322	36	0.62180	99	0.88338	710	1.36851	4300	1.78814	16000	2.08512
6,5	0.17713	37	0.62900	100	0.88593	720	1.37185	4400	1.79339	17000	2.09869
6,6	0.18099	38	0.63599	—		730	1.37513	4500	1.79851	18000	2.11148
6,7	0.18477	39	0.64276	110	0.91014	740	1.37839	4600	1.80352	19000	2,12357
6,8	0.18854	40	0.64933	120	0.93212	750	1.38157	4700	1.80875	20000	2.13503
6,9	0.19229	41	0.65571	130	0.95236	760	1.38471	4800	1.81321	21000	2,14594
7,0	0.19584	42	0.66200	140	0.97109	770	1.38782	4900	1.81790	22000	2.15633
7,1	0.19886	43	0.66811	150	0.98843	780	1.39089	5000	1.82249	23000	2.16624
7,2	0.20298	44	0.67413	160	1.00466	790	1.39391	5100	1.82699	24000	2.17573

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Table I. consists of three columns.—*Column* 1. entitled *l*, contains the hydraulic mean depths of any conduit in inches. This is set down for every 10th of an inch in the first 10 inches, that the answers may be more accurately obtained for pipes, the mean depth of which seldom exceeds three or four inches. The column is continued to 100 inches, which is fully equal to the hydraulic mean depth of any canal.

Column 2. contains the logarithms of the values of $\sqrt{d} - 0{,}1$, multiplied by 307; that is, the logarithm of the numerator of the fraction $\frac{307\,(\sqrt{d} - 0{,}1)}{\sqrt{s} - \mathrm{L}\,\sqrt{s+1{,}6}}$ in n° 65. of the article Rivers.

Column 3. contains the products of the values of $\sqrt{d} - 0{,}1$ multiplied by 0,3.

Table II. consists of two columns.—*Column* 1. entitled *s*, contains the denominator of the fraction expressing the slope or declivity of any pipe or canal; that is, the quotient of its length divided by the elevation of one extremity above the other. Thus, if a canal of one mile in length be three feet higher at one end than the other, then *s* is $\frac{5280}{3}$, = 1760.

Column 2. contains the logarithms of the denominators of the above mentioned fraction, or of the different values of the quantity $\sqrt{s} - \mathrm{L}\,\sqrt{s+1{,}6}$.

These quantities were computed true to the third decimal place. Notwithstanding this, the last figure in about a dozen of the first logarithms of each table is not absolutely certain to the nearest unit. But this cannot produce an error of 1 in 100,000.

Examples of the Use of these Tables.

Example 1. Water is brought into the city of Edinburgh in several mains. One of these is a pipe of five inches diameter. The length of the pipe is 14,637 feet; and the reservoir at Comiston is 44 feet higher than the reservoir into which it delivers the water on the Castle Hill. *Query*, The number of Scotch pints which this pipe should deliver in a minute?

1. We have $d = \frac{5}{4}$, = 1,25 inches. The logarithm corresponding to this *d*, being nearly the mean between the logarithms corresponding to 1,2 and 1,3, is 2.49472.

2. We have $s = \frac{14637}{44}$, or 332,7. The logarithm corresponding to this in Table II. is had by taking proportional parts for the difference between the logarithms for $s = 330$ and $s = 340$, and is 1.18533.

3. From 2.49472
Take 1.18533
Remains 1.30939, the logarithm of 20,385 inches.

4. In column 3. of Table I. opposite to $d = 1{,}2$ and $d = 1{,}3$ are 0,3 and 0,31, of which the mean is 0,305 inches, the correction for viscidity.

5. Therefore the velocity in inches *per* second is 20,385 — 0,305, or 20,08.

6. To obtain the Scotch pints *per* minute (each containing 103,4 cubic inches), multiply the velocity by 60, and this product by 25, and this by 0,7854 (the area of a circle whose diameter is 1), and divide by 103,4. Or, by logarithms,

Add the log. of 20,08	-	1.30276
log. of 60	- -	1.77815
log. of 5^2 or 25	- -	1.39794
log. of 0,7854	-	9.89509
	Carry over	4.37394
	Brought over	4.37394
Subtract the log. of 103,4	-	2.01451
Remains the log. of 228,8 pints	-	2.35943

Example 2. The canal mentioned in the article Rivers, n° 63. was 18 feet broad at the surface, and 7 feet at the bottom. It was 4 feet deep, and had a declivity of 4 inches in a mile. *Query*, The mean velocity?

1. The slant side of the canal, corresponding to 4 feet deep and $5\frac{1}{2}$ projection, is 6,8 feet; therefore the border touched by the water is 6,8 + 7 + 6,8, = 20,6. The area is $4 \times \frac{18+7}{2}$, = 50 square feet. Therefore $d = \frac{50}{20{,}6}$, = 2,427 feet, or 29,124 inches. The logarithm corresponding to this in Table I. is 3.21113, and the correction for viscidity from the third column of the same Table is 1,58.

2. The slope is one-third of a foot in a mile, or one foot in three miles. Therefore *s* is 15,840. The logarithm corresponding to this is 2.08280.

3. From 3.21113
Subtract 2.08280
Remains 1.12833 = log. of 13,438 inches.
Subtract for viscidity - 1.58
Velocity *per* second - 11,858

This velocity is considerably smaller than what was observed by Mr Watt. And indeed we observe, that in the very small declivities of rivers and canals, the formula is a little different. We have made several comparisons with a formula which is essentially the same with Buat's, and comes nearer in these cases. Instead of taking the hyperbolic logarithm of $\sqrt{s+1{,}6}$, multiply its common logarithm by $2\frac{1}{4}$, or multiply it by 9, and divide the product by 4; and this process is vastly easier than taking the hyperbolic logarithm.

We have not, however, presumed to calculate tables on the authority of our own observations, thinking too respectfully of this gentleman's labours and observations. But this subject will, ere long, be fully established on a series of observations on canals of various dimensions and declivities, made by several eminent engineers during the execution of them. Fortunately Mr Buat's formula is chiefly founded on observations on small canals; and is therefore most accurate in such works where it is most necessary, viz. in mill courses, and other derivations for working machinery.

We now proceed to take notice of a few circumstances which deserve attention, in the construction of canals, in addition to those delivered in the article Rivers.

When a canal or aqueduct is brought off from a bason or larger stream, it ought always to be widened at the entry, if it is intended for drawing off a continued stream of water: For such a canal has a slope, without which it can have no current. Suppose it filled to a dead level to the farther end. Take away the bar, and the water immediately begins to flow off at that end. But it is some time before any motion is perceived at the head of the canal, during all which time the motion of the water is augmenting in every part of the canal; consequently the slope is increasing in every part, this being the sole cause of its stream. When the water at the entry *begins* to move, the slope is scarcely sensible there; but it sensibly steepens every moment with the increase of velocity, which at last attains its maximum relative to the slope and dimensions of the whole canal; and this regulates the depth of water in every point down the stream. When all has attained a state of permanency, the slope at the entry *remains* much greater than in any other part

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part of the canal: for this slope must be such as will produce a velocity sufficient for supplying its train.

And it must be remembered, that the velocity which must be produced greatly exceeds the mean velocity corresponding to the train of the canal. Suppose that this is 25 inches. There must be a velocity of 30 inches at the surface, as appears by the Table in the article Rivers, n° 80. This must be produced by a real fall at the entry.

In every other part the slope is sufficient, if it merely serves to give the water (already in motion) force enough for overcoming the friction and other resistances. But at the entry the water is stagnant, if in a bason, or it is moving past laterally, if the aqueduct is derived from a river; and, having no velocity whatever in the direction of the canal, it must derive it from its slope. The water therefore which has acquired a permanent form in such an aqueduct, must necessarily take that form which exactly performs the offices requisite in its different portions. The surface remains horizontal in the bason, as at KC (fig. 1.), till it comes near the entry of the canal AB, and there it acquires the form of an undulated curve CDE; and then the surface acquires an uniform slope EF, in the lower part of the canal, where the water is in train.

Plate DXLI.

If this is a drain, the discharge is much less than might be produced by the same bed if this sudden slope could be avoided. If it is to be navigated, having only a very gentle slope in its whole length, this sudden slope is a very great imperfection, both by diminishing the depth of water which might otherwise be obtained along the canal, and by rendering the passage of boats into the bason very difficult, and the coming out very hazardous.

All this may be avoided, and the velocity at the entry may be kept equal to that which forms the train of the canal, by the simple process of enlarging the entry. Suppose that the water could accelerate along the slopes of the canal, as a heavy body would do on a freely polished plane. If we now make the width of the entry in its different parts inversely proportional to the fictitious velocities in those parts, it is plain that the slope of the surface will be made parallel to that of the canal which is in train. This will require a form somewhat like a bell or speaking-trumpet, as may easily be shown by a mathematical discussion. It would, however, be so much evasated at the bason as to occupy much room, and it would be very expensive to make such an excavation. But we may, at a very moderate expence of money and room, make the increase of velocity at the entry almost insensible. This should always be done, and it is not all expence: for if it be not done, the water will undermine the banks on each side, because it is moving very swiftly, and will make an excavation for itself, leaving all the mud in the canal below. We may observe this enlargement at the entry of all natural derivations from a bason or lake. It is a very instructive experiment, to fill up this enlargement, continuing the parallel sides of the drain quite to the side of the lake. We shall immediately observe the water grow shallower in the drain, and its performance will diminish. Supposing the ditch carried on with parallel sides quite to the side of the bason, if we build two walls or dykes from the extremities of those sides, bending outwards with a proper curvature (and this will often be less costly than widening the drain), the discharge will be greatly increased. We have seen instances where it was nearly doubled.

The enlargement at the mouths of rivers is generally owing to the same cause. The tide of flood up the river produces a superficial slope opposite to that of the river, and this widens the mouth. This is most remarkable when the tides are high, and the river has little slope.

After this great fall at the entry of a canal, in which all the filaments are much accelerated, and the inferior ones most of all, things take a contrary turn. The water, by rubbing on the bottom and the sides, is retarded; and therefore the section must, from being shallow, become a little deeper, and the surface will be convex for some distance till all comes into train. When this is established, the filaments nearest the bottom and side are moving slowest, and the surface (in the middle especially) retains the greatest velocity, gliding over the rest. The velocity in the canal, and the depth of the section, adjust themselves in such a manner that the difference between the surface of the bason and the surface of the uniform section of the canal corresponds exactly to the velocity. Thus, if this be observed to be two feet in a second, the difference of height will be $\frac{3}{16}$ths of an inch.

All the practical questions that are of considerable importance respecting the motion of water in aqueducts, may be easily, though not elegantly, solved by means of the tables.

But it is to be remembered, that these tables relate only to uniform motion, that is, to water that is in train, and where the velocity suffers no change by lengthening the conduit, provided the slope remain the same. It is much more difficult to determine what will be the velocity, &c. in a canal of which nothing is given but the form, and slope, and depth of the entry, without saying how deep the water runs in it. And it is here that the common doctrines of hydraulics are most in fault, and unable to teach us how deep the water will run in a canal, though the depth of the bason at the entry be perfectly known. Between the part of the canal which is in train and the bason, there is an interval where the water is in a state of acceleration, and is afterwards retarded.

The determination of the motions in this interval is exceedingly difficult, even in a rectangular canal. It was one great aim of Mr Buat's experiments to ascertain this by measuring accurately the depth of the water. But he found that when the slope was but a very few inches in the whole length of his canal, it was not in train for want of greater length; and when the slope was still less, the small fractions of an inch, by which he was to judge of the variation of depth, could not be measured with sufficient accuracy. It would be a most desirable point to determine the length of a canal, whose slope and other dimensions are given, which will bring it into train; and what is the ratio which will then obtain between the depth at the entry and the depth which will be maintained. Till this be done, the engineer cannot ascertain by a direct process what quantity of water will be drawn off from a reservoir by a given canal. But as yet this is out of our reach. Experiments, however, are in view which will promote the investigation.

But this and similar questions are of such importance, that we cannot be said to have improved hydraulics, unless we can give a tolerably precise answer. This we can do by a sort of retrograde process, proceeding on the principles of uniform motion established by the Chevalier Buat. We may suppose a train maintained in the canal, and then examine whether this train *can* be produced by any fall that is possible at the entry. If it can, we may be certain that it is so produced, and our problem is solved.

We shall now point out the methods of answering some chief questions of this kind.

Quest. 1. Given the slope s and the breadth w of a canal, and the height H of the surface of the water in the bason above the bottom of the entry, to find the depth h and

ed velocity V of the ftream, and the quantity of water Q which is [illegible]?

The chief difficulty is to find the depth of the ftream where it is in train. For this end, we may employ the hydraulic theorem of uniform motion in n° 90. of the article RIVER; making $V = \frac{\sqrt{N}\sqrt{g}}{\sqrt{S}}$, where g is the velocity (in inches) acquired in a fecond by falling, d is the hydraulic mean depth, and $\sqrt{S}$ ftands for $\sqrt{S} - L\sqrt{S+1,6}$. N is a number to be fixed by experiment (fee RIVER, n° 58.) depending on the contraction or obftruction fuftained at the entry of the canal, and it may in moft common cafes be taken = 241: fo that $\sqrt{N}g$ may be fomewhat lefs than 307. To find it, we may begin by taking for our depth of ftream a quantity h, fomewhat fmaller than H the height of the furface of the bafon above the bottom of the canal. With this depth, and the known width w of the canal, we can find the hydraulic depth d (RIVER, n° 48.). Then with $\sqrt{d}$ and the flope find V by the Table: make this $V = \frac{\sqrt{N}\sqrt{g}}{\sqrt{S}}$.

This gives $\sqrt{N}g = \frac{V\sqrt{S}}{\sqrt{i}}$. This value of $\sqrt{N}g$ is fufficiently exact; for a fmall error of depth hardly affects the hydraulic mean depth.

After this preparation, the expreffion of the mean velocity in the canal will be $\frac{\sqrt{N}g\sqrt{\frac{wh}{w+2h}}}{\sqrt{S}}$. The height which will produce this velocity is $\frac{Ng}{2GS}\left(\frac{wh}{w+2h}\right)$. Now this is the flope at the entry of the canal which produces the velocity that is afterwards maintained againft the obftructions by the flope of the canal. It is therefore $= H - h$. Hence we deduce $h = \frac{-\left(w\left(\frac{Ng}{2GS}+1\right)-2H\right)}{4}$

$$+\frac{\sqrt{8Hw+\left(w\left(\frac{Ng}{2GS}+1\right)-2H\right)^2}}{4}.$$ If there be no contraction at the entry, $g = G$ and $\frac{g}{2G} = \frac{1}{2}$.

Having thus obtained the depth h of the ftream, we obtain the quantity of water by combining this with the width w and the velocity V.

But as this was but an approximation, it is neceffary to examine whether the velocity V be poffible. This is very eafy. It muft be produced by the fall $H - h$. We fhall have no occafion for any correction of our firft affumption, if h has not been extravagantly erroneous, becaufe a fmall miftake in h produces almoft the fame variation in d. The teft of accuracy, however, is, that h, together with the height which will produce the velocity V, muft make up the whole height H. Affuming h too fmall leaves $H - h$ too great, and will give a fmall velocity V, which requires a fmall value of $H - h$. The error of $H - h$ therefore is always greater than the error we have committed in our firft affumption Therefore when this error of $H - h$ is but a trifle, fuch as one fourth of an inch, we may reft fatisfied with our anfwer.

Perhaps the eafieft procefs may be the following: Suppofe the whole ftream in train to have the depth H. The velocity V obtained for this depth and flope by the Table requires a certain productive height u. Make $\sqrt{H+u}$: H = H : h, and h will be exceedingly near the truth. The reafon is obvious.

Quest. 2. Given the [illegible] of water to be furnifhed in a fecond Q, the fall [illegible] the bottom of the canal, and the flope, to find the dimenfions of the canal?

Let w and y be the depth and mean width. It is plain that the equation $\frac{Q}{y} = \sqrt{2g}\sqrt{H-[illegible]}$ will give a value of y in terms of w. Compare this with the value of y obtained from the equation [illegible]. This will give an equation [illegible] [illegible] we fhall have recourfe to an approximation, [illegible] be underftood in the form of an example.

Suppofe the depth at the entry to be 18 inches, and the flope $\frac{1}{1500}$. Let 1200 cubic feet of water *per* minute be the quantity of water to be drawn off, for working machinery or any other purpofe; and let the canal be fuppofed of the beft form, recommended in n° 69. of the article RIVER, where the bafe of the flope is [illegible] of the height.

The flighteft confideration will fhew us that if $\frac{V^2}{[illegible]}$ be taken for the height producing the velocity, it cannot exceed 3 inches, nor be lefs than 1. Suppofe it = 2, and therefore the depth of the ftream in the canal to be 16 inches; find the mean width of the canal by the equation

$$w = \frac{Q}{h\left(\sqrt{d}-0,1\right)\left(\frac{[illegible]}{\sqrt{S}}-0,3\right)},$$ in which Q is 20 cubic feet (the 60th part of 1200), $\sqrt{S}$ is $= 28,153$, $= \sqrt{1500} - L\sqrt{1500+1,6}$, and $h = 16$. This gives $w = 5,52$ feet. The [illegible] feet, and $V = 32,6$ inches. This requires a fall of 1,52 inches inftead of 2 inches. Take this from 18, and there remains 16,48, which we fhall find but [illegible] from the exact depth which the water will acquire and maintain. We may therefore be fatisfied with [illegible] feet as the mean width, and 3,[illegible] feet for the width at the bottom.

This approximation proceeds on this confideration, that when the width diminifhes by a fmall quantity, and in the fame proportion that the depth increafes, the hydraulic mean depth remains the fame, and therefore the velocity alfo remains, and the quantity difcharged changes in the exact proportion of the fection. Any minute error which may refult from this fuppofition, may be corrected by increafing the fall producing the velocity in the proportion of the firft hydraulic mean depth to the mean depth correfponding to the new dimenfions found for the canal. It will now become 1,53, and V will be 32,72, and the depth will be 16,47. The quantity difcharged being divided by V, will give the fection [illegible], from which, and the new depth, we obtain 5,344 for the width.

This and the foregoing are the moft common queftions propofed to an engineer. We afferted with fome confidence that few of the profeffion are able to anfwer them with tolerable precifion. We cannot offend the profeffional gentlemen by this, when we inform them that the Academy of Sciences at Paris were occupied during feveral months with an examination of a plan propofed by M. Parcieux, for bringing the waters of the Yvette into Paris; and after the moft mature confideration, gave in a report of the quantity of

4 water

water which M. De Parcieux's aqueduct would yield, and that their report has been found erroneous in the proportion of at leaſt 2 to 5: For the waters have been brought in, and exceed the report in this proportion. Indeed long after the giving in the report, M. Perronet, the moſt celebrated engineer in France, affirmed that the dimenſions propoſed were much greater than were neceſſary, and ſaid, that an aqueduct of $5\frac{1}{2}$ feet wide, and $3\frac{1}{2}$ deep, with a ſlope of 15 inches in a thouſand fathoms, would have a velocity of 12 or 13 inches *per* ſecond, which would bring in all the water furniſhed by the propoſed ſources. The great diminution of expence occaſioned by the alteration encouraged the community to undertake the work. It was accordingly begun, and a part executed. The water was found to run with a velocity of near 19 inches when it was $3\frac{1}{2}$ feet deep. M. Perronet founded his computation on his own experience alone, acknowledging that he had no theory to inſtruct him. The work was carried no farther, it being found that the city could be ſupplied at a much ſmaller expence by ſteam-engines erected by Boulton and Watt. But the facts which occurred in the partial execution of the aqueduct are very valuable. If M. Perronet's aqueduct be examined by our general formula, s will be found $= \frac{1}{4800}$, and $d = 18,72$, from which we deduce the velocity $= 18\frac{2}{3}$, agreeing with the obſervation with aſtoniſhing preciſion.

The experiments at Turin by Michælotti on canals were very numerous, but complicated with many circumſtances which would render the diſcuſſion too long for this place. When cleared of theſe circumſtances, which we have done with ſcrupulous care, they are alſo abundantly conformable to our theory of the uniform motion of running waters. But to return to our ſubject:

Should it be required to bring off at once from the baſon a mill courſe, having a determined velocity for driving an under-ſhot wheel, the problem becomes eaſier, becauſe the velocity and ſlope combined determine the hydraulic mean depth at once; and the depth of the ſtream will be had by means of the height which muſt be taken for the whole depth at the entry, in order to produce the required velocity.

In like manner, having given the quantity to be diſcharged, and the velocity and the depth at the entry, we can find the other dimenſions of the channel; and the mean depth being found, we can determine the ſlope.

When the ſlope of a canal is very ſmall, ſo that the depth of the uniform ſtream differs but a little from that at the entry, the quantity diſcharged is but ſmall. But a great velocity, requiring a great fall at the entry, produces a great diminution of depth, and therefore it may not compenſate for this diminution, and the quantity diſcharged may be ſmaller. Improbable as this may appear, it is not demonſtrably falſe; and hence we may ſee the propriety of the following

Queſtion 3. Given the depth H at the entry of a rectangular canal, and alſo its width w, required the ſlope, depth, and velocity, which will produce the greateſt poſſible diſcharge?

Let x be the unknown depth of the ſtream. $H - x$ is the productive fall, and the velocity is $\sqrt{2G}\sqrt{H-x}$. This multiplied by $w\,x$ will give the quantity diſcharged. Therefore $w\,x\sqrt{2G}\sqrt{H-x}$ muſt be made a maximum. The common proceſs for this will give the equation $2H = 3x$, or $x = \frac{2}{3}H$. The mean velocity will be $\sqrt{2G}\sqrt{\frac{1}{3}H}$; the ſection will be $\frac{2}{3}w\,H$, and the diſcharge $= \frac{2}{3}\sqrt{2G}\,w\,H\sqrt{\frac{1}{3}H}$, and $d = \frac{\frac{2}{3}w\,H}{w + \frac{4}{3}H}$. With theſe data the ſlope is eaſily had by the formula for uniform motion.

If the canal is of the trapezoidal form, the inveſtigation is more troubleſome, and requires the reſolution of a cubic equation.

It may appear ſtrange that increaſing the ſlope of a canal beyond the quantity determined by this problem can diminiſh the quantity of water conveyed. But one of theſe two things muſt happen; either the motion will not acquire uniformity in ſuch a canal for want of length, or the diſcharge muſt diminiſh. Suppoſing, however, that it could augment, we can judge how far this can go. Let us take the extreme caſe, by making the canal vertical. In this caſe it becomes a ſimple weir or waſteboard. Now the diſcharge of a waſteboard is $\frac{2}{3}\sqrt{2G}\,w\,(h^{\frac{3}{2}} - (\frac{1}{2}h)^{\frac{3}{2}})$. The maximum determined by the preceding problem is to that of the waſteboard of the ſame dimenſions as $H\sqrt{\frac{1}{3}H} : H^{\frac{3}{2}} - (\frac{1}{2}H)^{\frac{3}{2}}$, or as $H\sqrt{\frac{1}{3}H} : H\sqrt{H} - \frac{1}{2}H\sqrt{\frac{1}{2}H}, = 5773 : 6465$, nearly $= 9 : 10$.

Having given the dimenſions and ſlope of a canal, we can diſcover the relation between its expenditure and the time; or we can tell how much it will ſink the ſurface of a pond in 24 hours, and the gradual progreſs of this effect; and this might be made the ſubject of a particular problem. But it is complicated and difficult. In caſes where this is an intereſting object, we may ſolve the queſtion with ſufficient accuracy, by calculating the expenditure at the beginning, ſuppoſing the baſon kept full. Then, from the known area of the pond, we can tell in what time this expenditure will ſink an inch; do the ſame on the ſuppoſition that the water is one-third lower, and that it is two-thirds lower (noticing the contraction of the ſurface of the pond occaſioned by this abſtraction of its waters). Thus we ſhall obtain three rates of diminution, from which we can eaſily deduce the deſired relation between the expenditure and the time.

Aqueducts derived from a baſon or river are commonly furniſhed with a ſluice at the entry. This changes exceedingly the ſtate of things. The ſlope of the canal may be preciſely ſuch as will maintain the mean velocity of the water which paſſes under the ſluice; in which caſe the depth of the ſtream is equal to that of the ſluice, and the velocity is produced at once by the head of water above it. But if the ſlope is leſs than this, the velocity of the iſſuing water is diminiſhed, and the water muſt riſe in the canal. This muſt check the efflux at the ſluice, and the water will be as it were ſtagnant above what comes through below it. It is extremely difficult to determine at what preciſe ſlope the water will begin to check the efflux. The contraction at the lower edge of the board hinders the water from attaining at once the whole depth which it acquires afterwards, when its velocity diminiſhes by the obſtructions. While the regorging which theſe obſtructions occaſion does not reach back to the ſluice, the efflux is not affected by it.—Even when it does reach to the ſluice, there will be a leſs depth immediately behind it than farther down the canal, where it is in train; becauſe the ſwift moving water which is next the bottom drags with it the regorged water which lies on it: but the canal muſt be rapid to make this difference of depth ſenſible. In ordinary canals, with moderate ſlopes and velocities, the velocity at the ſluice may be ſafely taken as if it were that which correſponds to the difference of depths above and below the ſluice, where both are in train.

Let therefore H be the depth above the ſluice, and h the depth in the canal. Let e be the elevation of the ſluice above the ſole, and let b be its breadth. The diſcharge will

will be $e b \sqrt{H - b} \sqrt{2 G}$ for the fluice, and $w b \frac{\sqrt{N g}}{\sqrt{s}} \sqrt{\frac{w b}{w + 2 b}}$ for the canal. Thefe muft be the fame. This gives the equation $e b \sqrt{H - b} \sqrt{2 G} = w b \frac{\sqrt{N g}}{\sqrt{s}} \sqrt{\frac{w b}{w + 2 b}}$ containing the folution of all the queftions which can be propofed. The only uncertainty is in the quantity G, which expreffes the velocity competent to the paffage of the water through the orifice, circumftanced as it is, namely, fubjected to contraction. This may be regulated by a proper form given to the entry into this orifice. The contraction may be almoft annihilated by making the mafonry of a cycloidal form on both fides, and alfo at the lower edge of the fluice-board, fo as to give the orifice a form refembling fig. 5. D, in the article RIVERS. If the fluice is thin in the face of a bafon, the contraction will reduce 2 G to 20,6. If the fluice be as wide as the canal, 2 G will be nearly 500.

Queftion 4. Given the head of water in the bafon H, the breadth b, and elevation e of the fluice, and the breadth w and flope s of the canal, to find the depth b of the ftream, the velocity, and the difcharge?

We muft (as in *Queftion* 2.) make a firft fuppofition for b, in order to find the proper value of d. Then the equation $e b \sqrt{H - b} \sqrt{2 G} = w b \frac{\sqrt{N g}}{\sqrt{s}}$ gives $b = \frac{G e^2 b^2 s}{w^2 N g d} + \sqrt{\frac{G e^2 b^2 s H}{w^2 N g d} + \left(\frac{G e^2 b^2 s}{w^2 N g d}\right)^2}$. If this value fhall differ confiderably from the one which we affumed in order to begin the computation, make ufe of it for obtaining a new value of d, and repeat the operation. We fhall rarely be obliged to perform a third operation.

The following is of frequent ufe:

Queftion 5. Given the dimenfions and the flope, with the velocity and difcharge of a river in its ordinary ftate, required the area or fection of the fluice which will raife the waters to a certain height, ftill allowing the fame quantity of water to pafs through? Such an operation may render the river navigable for fmall craft or rafts above the fluice.

The problem is reduced to the determination of the fize of orifice which will difcharge this water with a velocity competent to the height to which the river is to be raifed; only we muft take into confideration the velocity of the water above the fluice, confidering it as produced by a fall which makes a part of the height productive of the whole velocity at the fluice. Therefore H, in our inveftigation, muft confift of the height to which we mean to raife the waters, and the height which will produce the velocity with which the waters approach the fluice: b, or the depth of the ftream, is the ordinary depth of the river. Then (ufing the former fymbols) we have $e b \frac{w b \sqrt{N g d}}{\sqrt{2 G s (H - b)}}, = \frac{Q}{\sqrt{2 G (H - b)}}$.

If the area of the fluice is known, and we would learn the height to which it will raife the river, we have $H - b = \frac{Q^2}{2 G e^2 b^2}$ for the expreffion of the rife of the water above its ordinary level. But from this we muft take the height which would produce the velocity of the river; fo that if the fluice were as wide as the river, and were raifed to the ordinary furface of the water, $\frac{Q^2}{2 G e^2 b^2}$, which expreffes the height that produces the velocity under the fluice, muft be equal to the depth of the river, and $H - b$ will be $= 0$.

The performance of aqueduct drains is a very important thing, and merits our attention in this place. While the art of managing waters, and of conducting them fo as to anfwer our demands, renders us very important fervice by embellifhing our habitations, or promoting our commercial intercourfe, the art of draining creates as it were new riches, fertilizing tracts of bog or marfh, which was not only ufelefs, but hurtful by its unwholefome exhalations, and converting them into rich paftures and gay meadows. A wild country, occupied by marfhes which are inacceffible to herds or flocks, and ferve only for the haunts of water-fowls, or the retreat of a few poor fifhermen, when once it is freed from the waters in which it is drowned, opens its lap to receive the moft precious feeds, is foon clothed in the richeft garb, gives life and abundance to numerous herds, and never fails to become the delight of the induftrious cultivator who has enfranchifed it, and is attached to it by the labour which it coft him. In return, it procures him abundance, and fupplies him with the means of daily augmenting its fertility. No fpecies of agriculture exhibits fuch long, continued, and progreffive improvement. New families flock to the fpot, and there multiply; and there nature feems the more eager to repay their labours, in proportion as fhe has been obliged, againft her will, to keep her treafures locked up for a longer time, chilled by the waters. The countries newly inhabited by the human race, as is a great part of America, efpecially to the fouthward, are ftill covered to a great extent with marfhes and lakes; and they would long remain in this condition, if population, daily making new advances, did not increafe induftry, by multiplying the cultivating hands, at the fame time that it increafes their wants. The Author of this beautiful world has at the beginning formed the great maffes of mountain, has fcooped out the dales and floping hills, has traced out the courfes, and even formed the beds of the rivers: but he has left to man the care of making his place of abode, and the field which muft feed him, dry and comfortable. For this tafk is not beyond his powers, as the others are. Nay, by having this given to him in charge, he is richly repaid for his labour by the very ftate in which he finds thofe countries into which he penetrates for the firft time. Being covered with lakes and forefts, the juices of the foil are kept for him as it were in referve. The air, the burning heat of the fun, and the continual wafhing of rains, would have combined to expend and diffipate their vegetative powers, had the fields been expofed in the fame degree to their action as in the inhabited and cultivated countries, the moft fertile moulds of which are long fince lodged in the bottom of the ocean. All this would have been completely loft through the whole extent of South America, had it not been protected by the forefts which man muft cut down, by the rank herbage which he muft burn, and by the marfh and bog which he muft deftroy by draining. Let not ungrateful man complain of this. It is his duty to take on himfelf the tafk of opening up treafures, preferved on purpofe for him with fo much judgment and care. If he has difcernment and fenfibility, he will even thank the Author of all good, who has thus hufbanded them for his ufe. He will co-operate with his beneficent views, and will be careful not to proceed by wantonly fnatching at prefent and partial good, and by picking out what is moft eafily got at, regardlefs of him

who

Water-works.

who is to come afterwards to uncover and extract the remaining riches of the ground. A wise administration of such a country will think it their duty to leave a just share of this inheritance to their descendants, who are entitled to expect it as the last legatees. National plans of cultivation should be formed on this principle, that the steps taken by the present cultivators for realizing part of the riches of the infant country shall not obstruct the works which will afterwards be necessary for also obtaining the remainder. This is carefully attended to in Holland and in China. No man is allowed to conduct the drains, by which he recovers a piece of marsh, in such a way as to render it much more difficult for a neighbour, or even for his own successor, to drain another piece, although it may at present be quite inaccessible. There remains in the middle of the most cultivated countries many marshes, which industry has not yet attempted to drain, and where the legislature has not been at pains to prevent many little abuses which have produced elevations in the beds of rivers, and rendered the complete draining of some spots impossible. Administration should attend to such things, because their consequences are great. The sciences and arts, by which alone these difficult and costly jobs can be performed, should be protected, encouraged, and cherished. It is only from science that we can obtain principles to direct these arts. The problem of draining canals is one of the most important, and yet has hardly ever occupied the attention of the hydraulic speculatist. We apprehend that Mr Buat's theory will throw great light on it; and regret that the very limited condition of our present Work will hardly afford room for a slight sketch of what may be done on the subject. We shall, however, attempt it by a general problem, which will involve most of the chief circumstances which occur in works of that kind.

Quest. 6. Let the hollow ground A (fig. 2) be inundated by rains or springs, and have no outlet but the canal AB, by which it discharges its water into the neighbouring river BCDE, and that its surface is nearly on a level with that of the river at B. It can only drain when the river sinks in the droughts of summer; and even if it could then drain completely, the putrid marsh would only be an infecting neighbour. It may be proposed to drain it by one or more canals; and it is required to determine their lengths and other dimensions, so as to produce the best effects?

It is evident that there are many circumstances to determine the choice, and many conditions to be attended to.

If the canals AC, AD, AE, are respectively equal to the portions BC, BD, BE, of the river, and have the same slopes, they will have the same discharge: but they are not for this reason equivalent. The long canal AE may drain the marsh completely, while the short one AC will only do it in part; because the difference of level between A and C is but inconsiderable. Also the freshes of the river may totally obstruct the operation of AC, while the canal AE cannot be hurt by them, E being so much lower than C. Therefore the canal must be carried so far down the river, that no freshes there shall ever raise the waters in the canal so high as to reduce the slope in the upper part of it to such a level that the current shall not be sufficient to carry off the ordinary produce of water in the marsh.

Still the problem is indeterminate, admitting many solutions. This requisite discharge may be accomplished by a short but wide canal, or by a longer and narrower. Let us first see what solution can be made, so as to accomplish our purpose in the most economical manner, that is, by means of the smallest equation.—We shall give the solution in the form of an example.

Suppose that the daily produce of rains and springs raises the water $1\frac{1}{4}$ inch on an area of a square league, which gives about 120,000 cubic fathoms of water. Let the bottom of the bason be three feet below the surface of the freshes in the river at B in winter. Also, that the slope of the river is 2 inches in 100 fathoms, or $\frac{1}{3600}$dth, and that the canal is to be 6 feet deep.

The canal being supposed nearly parallel to the river, it must be at least 1800 fathoms long before it can be admitted into the river, otherwise the bottom of the bog will be lower than the mouth of the canal; and even then a hundred or two more fathoms added to this will give it so little slope, that an immense breadth will be necessary to make the discharge with so small a velocity. On the other hand, if the slope of the canal be made nearly equal to that of the river, an extravagant length will be necessary before its admission into the river, and many obstacles may then intervene. And even then it must have a breadth of 13 feet, as may easily be calculated by the general hydraulic theorem. By receding from each of these extremes, we shall diminish the expence of excavation. Therefore,

Let x and y be the breadth and length, and b the depth (6 feet), of the canal. Let q be the depth of the bog below the surface of the river, opposite to the bason, D the discharge in a second, and $\frac{1}{a}$ the slope of the river. We must make bxy a minimum, or $x\dot{y} + y\dot{x} = o$.

The general formula gives the velocity

$$V = \frac{\sqrt{ng}\,(\sqrt{d} - 0,1)}{\sqrt{s} - L\sqrt{s + 1,6}} - 0,3\,(\sqrt{d} - 0,1).$$

This would give x and y; but the logarithmic term renders it very complicated. We may make use of the simple form $V = \frac{\sqrt{Ngd}}{\sqrt{S}}$, making $\sqrt{Ng}$ nearly $2yb$. This will be sufficiently exact for all cases which do not deviate far from this, because the velocities are very nearly in the subduplicate ratio of the slopes.

To introduce these data into the equation, recollect that $V = \frac{D}{bx}$; $d = \frac{bx}{x + 2b}$. As to S, recollect that the canal being supposed of nearly equal length with the river, $\frac{y}{a}$ will express the whole difference of height, and $\frac{y}{a} - q$ is the difference of height for the canal. This quantity being divided by y, gives the value of $\frac{1}{S} = \frac{\frac{y}{a} - q}{y}$. Therefore the equation for the canal becomes $\sqrt{Ng}\sqrt{\frac{bx}{x+2b}}\sqrt{\frac{\frac{y}{a} - q}{y}}$. Hence we deduce

$$y = \frac{Ngqb^3x^3}{\frac{Ngb^3x^3}{a} - D^2(x + 2b)}$$

and

$$\dot{y} = \frac{3Ngqb^3x^2\dot{x}}{\frac{Ngb^3x^3}{a} - D^2(x+2b)} - \frac{Ngqb^3x^3\dot{x}\left(\frac{3Ngb^3x^2}{a} - D^2\right)}{\left(\frac{Ngb^3x^3}{a} - D^2(x+2b)\right)^2}.$$

If we substitute these values in the eqation $y\dot{x} + x\dot{y} = 0$, and reduce it, we obtain finally,

$$\frac{Ngb^3x^3}{aD^2} - 3x = 8b.$$

If

If we refolve this equation by making $Ng = (296)^2$, or 87616 inches; $b = 72$, $\frac{1}{a} = \frac{1}{3555}$, and $D = 518400$, we obtain $x = 392$ inches, or 32 feet 8 inches, and $\frac{D}{bx}$ or $V = 18{,}36$ inches. Now, putting thefe values in the exact formula for the velocity, we obtain the flope of the canal, which is $\frac{1}{11084}$, nearly 0,62 inches in 100 fathoms.

Let l be the length of the canal in fathoms. As the river has 2 inches fall in 100 fathoms, the whole fall is $\frac{2\,l}{100}$, and that of the canal is $\frac{0{,}62\,l}{100}$. The difference of thefe two muft be 3 feet, which is the difference between the river and the entry of the canal. We have therefore $\left(\frac{2 - 0{,}62}{100}\right)l = 36$ inches. Hence $l = 2604$ fathoms; and this multiplied by the fection of the canal gives 14177 cubic fathoms of earth to be removed.

This may furely be done, in moft cafes, for eight fhillings each cubic fathom, which does not amount to 6000l. a very moderate fum for completely draining of nine fquare miles of country.

In order to judge of the importance of this problem, we have added two other canals, one longer and the other fhorter, having their widths and flopes fo adjufted as to enfure the fame performance.

Width.	Velocity.	Slope.	Length.	Excavation.
Feet.	*Inches.*			
42	14,28	$\frac{1}{18788}$	2221	15547
$32\frac{2}{3}$	18,36	$\frac{1}{11083}$	2604	14177
21	28,57	$\frac{1}{3761}$	7381	25833

We have confidered this important problem in its moft fimple ftate. If the bafon is far from the river, fo that the drains are not nearly parallel to it, and therefore have lefs flope attainable in their courfe, it is more difficult. Perhaps the beft method is to try two very extreme cafes and a middle one, and then a fourth, nearer to that extreme which differs leaft from the middle one in the quantity of excavation. This will point out on which fide the minimum of excavation lies, and alfo the law by which it diminifhes and afterwards increafes. Then draw a line, on which fet off from one end the lengths of the canals. At each length erect an ordinate reprefenting the excavation; and draw a regular curve through the extremities of the ordinates. From that point of the curve which is neareft to the bafe line, draw another ordinate to the bafe. This will point out the beft length of the canal with fufficient accuracy. The length will determine the flope, and this will give the width, by means of the general theorem. *N. B.* Thefe draining canals muft always come off from the bafon with evafated entries. This will prevent the lofs of much fall at the entry.

Two canals may fometimes be neceffary. In this cafe expence may frequently be faved, by making one canal flow into the other. This, however, muft be at fuch a diftance from the bafon, that the fwell produced in the other by this addition may not reach back to the immediate neighbourhood of the bafon, otherwife it would impede the performance of both. For this purpofe, recourfe muft be had to the problem iii. in n° 104. of the article RIVER. We muft here obferve, that in this refpect canals differ exceedingly from rivers: rivers enlarge their beds, fo as always to convey every increafe of waters; but a canal may be gorged through its whole length, and will then greatly diminifh its difcharge. In order that the lower extremity of a canal may convey the waters of an equal canal admitted into it, their junction muft be fo far from the bafon, that the fwell occafioned by raifing its waters nearly $\frac{1}{2}$ more (viz. in the fubduplicate ratio of 1 to 2) may not reach back to the bafon.

This obfervation points out another method of economy. Inftead of one wide canal, we may make a narrower one of the whole length, and another narrow one reaching part of the way, and communicating with the long canal at a proper diftance from the bafon. But the lower extremity will now be too fhallow to convey the waters of both. Therefore raife its banks by ufing the earth taken from its bed, which muft at any rate be difpofed of. Thus the waters will be conveyed, and the expence, even of the lower part of the long canal, will fcarcely be increafed.

Thefe obfervations muft fuffice for an account of the management of open canals; and we proceed to the confideration of the conduct of water in pipes.

This is much more fimple and regular, and the general theorem requires very trifling modifications for adapting it to the cafes or queftions that occur in the practice of the civil engineer. Pipes are always made round, and therefore d is always $\frac{1}{4}$th of the diameter. The velocity of water in a pipe which is in train, is $= V, = \frac{307(\sqrt{d} - 0{,}1)}{\sqrt{s} - L\sqrt{s + 1{,}6}} - 0{,}3(\sqrt{d} - 0{,}1)$ or $= (\sqrt{d} - 0{,}1)\left(\frac{307}{\sqrt{s} - L\sqrt{s + 1{,}6}} - 0{,}3\right)$.

The chief queftions are the following:

Queft. 1. Given the height H of the refervoir above the place of delivery, and the diameter and length of the pipe, to find the quantity of water difcharged in a fecond?

Let L be the length, and h the fall which would produce the velocity with which the water enters the pipe, and actually flows in it, after overcoming all obftructions. This may be expreffed in terms of the velocity by $\frac{V^2}{2G}$, G denoting the acceleration of gravity, correfponding to the manner of entry. When no methods are adopted for facilitating the entry of the water, by a bell-fhaped funnel or otherwife, $2G$ may be affumed as $= 500$ inches, or 42 feet, according as we meafure the velocity in inches or feet. The flope is $\frac{1}{s}, = \frac{H - \frac{V^2}{2G}}{L}$, which muft be put into the general formula. This would make it very complicated. We may fimplify it by the confideration that the velocity is very fmall in comparifon of that arifing from the height H: confequently h is very fmall. Alfo, in the fame pipe, the refiftances are nearly in the duplicate ratio of the velocities when thefe are fmall, and when they differ little among themfelves. Therefore make $b = \frac{L}{h}$, taking h by guefs, a very little lefs than H. Then compute the mean velocity v correfponding to thefe data, or take it from the table. If $h + \frac{v^2}{2G}$ be $= H$, we have found the mean velocity $V = v$. If not, make the following proportion:

$$h : \frac{v^2}{2G} = H - \frac{V^2}{2G} : \frac{V^2}{2G},$$ which is the fame with this $$h + \frac{v^2}{2G} : v^2 = H : V^2,$$ and $$V^2 \text{ is } = \frac{v^2 H}{h + \frac{v^2}{2G}}, = \frac{v^2 H}{\frac{2Gh + v^2}{2G}}, = \frac{v^2 \cdot 2GH}{v^2 + 2Gh}.$$

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If the pipe has any bendings, they muft be calculated for in the manner mentioned in the article RIVER, n° 101; and the head of water neceffary for overcoming this additional refiftance being called $\frac{V^2}{m}$, the laft proportion muft be changed for

$$b + v^2\left(\frac{1}{2G} + \frac{1}{m}\right) : v^2 = H : V^2.$$

Queft. 2d. Given the height of the refervoir, the length of the pipe, and the quantity of water which is to be drawn off in a fecond, to find the diameter of the pipe which will draw it off?

Let d be confidered as $= \frac{1}{2}$th of the diameter, and let $1 : c$ reprefent the ratio of the diameter of a circle to its circumference. The fection of the pipe is $4\,c\,d^2$. Let the quantity of water *per* fecond be Q; then $\frac{Q}{4\,c\,d^2}$ is the mean velocity. Divide the length of the pipe by the height of the refervoir above the place of delivery, diminifhed by a very fmall quantity, and call the quotient S. Confider this as the flope of the conduit; the general formula now becomes

$$\frac{Q}{4\,d^2} = \frac{307\,(\sqrt{d} - 0{,}1)}{\sqrt{s} - L\sqrt{s + 1{,}06}} - 0{,}3(\sqrt{d} - 0{,}1),$$

or $\frac{Q}{4\,c\,d^2} = \frac{(307(\sqrt{d} - 0{,}1)}{\sqrt{S}} - 0{,}3\,(\sqrt{d} - 0{,}1)$. We may neglect the laft term in every cafe of civil practice, and alfo the fmall quantity 0,1. This gives the very fimple formula

$$\frac{Q}{4\,c\,d^2} = \frac{307\sqrt{d}}{\sqrt{S}}$$

from which we readily deduce

$$d = \overline{\frac{Q\sqrt{S}}{4\,c \times 307}}\Big|^{\frac{2}{5}} = \overline{\frac{Q\sqrt{S}}{3858}}\Big|^{\frac{2}{5}}$$

This procefs gives the diameter fomewhat too fmall. But we eafily rectify this error by computing the quantity delivered by the pipe, which will differ a little from the quantity propofed. Then obferving, by this equation, that two pipes having the fame length and the fame flope give quantities of water, of which the fquares are nearly as the 5th powers of the diameter, we form a new diameter in this proportion, which will be almoft perfectly exact.

It may be obferved that the height affumed for determining the flope in thefe two queftions will feldom differ more than an inch or two from the whole height of the refervoir above the place of delivery; for in conduits of a few hundred feet long the velocity feldom exceeds four feet *per* fecond, which requires only a head of 3 inches.

As no inconvenience worth minding refults from making the pipes a tenth of an inch or fo wider than is barely fufficient, and as this generally is more than the error arifing from even a very erroneous affumption of b, the anfwer firft obtained may be augmented by one or two tenths of an inch, and then we may be confident that our conduit will draw off the intended quantity of water.

We prefume that every perfon who affumes the name of engineer knows how to reduce the quantity of water meafured in gallons, pints, or other denominations, to cubic inches, and can calculate the gallons, &c. furnifhed by a pipe of known diameter, moving with a velocity that is meafured in inches *per* fecond. We farther fuppofe that all care is taken in the conftruction of the conduit, to avoid obftructions occafioned by lumps of folder hanging in the infide of the pipes; and, particularly, that all the cocks and plugs by the way have waterways equal to the fection of the pipe. Undertakers are moft tempted to fail here, by making the cocks too fmall, becaufe large cocks are very coftly. But the employer fhould be fcrupuloufly attentive to this; becaufe a fimple contraction of this kind may be the throwing away of many hundred pounds in a wide pipe, which yields no more water than can pafs through the fmall cock.

The chief obftructions arife from the depofition of fand or mud in the lower parts of pipes, or the collection of air in the upper parts of their bendings. The velocity being always very moderate, fuch depofitions of heavy matters are unavoidable. The utmoft care fhould therefore be taken to have the water freed from all fuch things at its entry by proper filtration; and there ought to be cleanfing plugs at the lower parts of the bendings, or rather a very little way beyond them. When thefe are opened, the water iffues with greater velocity, and carries the depofitions with it.

It is much more difficult to get rid of the air which choaks the pipes by lodging in their upper parts. This is fometimes taken in along with the water at the refervoir, when the entry of the pipe is too near the furface. This fhould be carefully avoided, and it cofts no trouble to do fo. If the entry of the pipe is two feet under the furface, no air can ever get in. Floats fhould be placed above the entries, having lids hanging from them, which will fhut the pipe before the water runs too low.

But air is alfo difengaged from fpring-water by merely paffing along the pipe. When pipes are fupplied by an engine, air is very often drawn in by the pumps in a difengaged ftate. It is alfo difengaged from its ftate of chemical union, when the pumps have a fuction-pipe of 10 or 12 feet, which is very common. In whatever way it is introduced, it collects in all the upper part of bendings, and choaks the paffage, fo that fometimes not a drop of water is delivered. Our cocks fhould be placed there, which fhould be opened frequently by perfons who have this in charge. Defaguliers defcribes a contrivance to be placed on all fuch eminences, which does this of itfelf. It is a pipe with a cock, terminating in a fmall ciftern. The key of the cock has a hollow ball of copper at the end of a lever. When there is no air in the main pipe, water comes out by this difcharger, fills the ciftern, raifes the ball, and thus fhuts the cock. But when the bend of the main contains air, it rifes into the ciftern, and occupies the upper part of it. Thus the floating ball falls down, the cock opens and lets out the air, and the ciftern again filling with water, the ball rifes, and the cock is again fhut.

A very neat contrivance for this purpofe was invented by the late Profeffor Ruffel of Edinburgh. The cylindrical pipe BCDE (fig. 3.), at the upper part of a bending of the main, is fcrewed on, the upper end of which is a flat plate perforated with a fmall hole F. This pipe contains a hollow copper cylinder G, to the upper part of which is faftened a piece of foft leather H. When there is air in the pipe, it comes out by the hole A, and occupies the difcharger, and then efcapes through the hole F. The water follows, and, rifing in the difcharger, lifts up the hollow cylinder G, caufing the leather H to apply itfelf to the plate CD, and fhut the hole. Thus the air is difcharged without the fmalleft lofs of water.

It is of the moft material confequence that there be no contraction in any part of a conduit. This is evident; but it is alfo prudent to avoid all unneceffary enlargements. For when the conduit is full of water moving along it, the velocity in every fection is inverfely proportional to the area of the fection: it is therefore diminifhed wherever the pipe is enlarged; but it muft again be increafed where the pipe contracts. This cannot be without expending force in the acceleration. This confumes part of the impelling power, whether

whether this be a head of water, or the force of an engine. See what is said on this subject in the article PUMPS, n° 83, &c. Nothing is gained by any enlargement; and every contraction, by requiring an augmentation of velocity, employs a part of the impelling force precisely equal to the weight of a column of water whose base is the contracted passage, and whose height is the fall which would produce a velocity equal to this augmentation. This point seems to have been quite overlooked by engineers of the first eminence, and has in many instances greatly diminished the performance of their best works. It is no less detrimental in open canals; because at every contraction a small fall is required for restoring the velocity lost in the enlargement of the canal, by which the general slope and velocity are diminished. Another point which must be attended to in the conducting of water is, that the motion should not be subsultory, but continuous. When water is to be driven along a main by the strokes of a reciprocating engine, it should be forced into an air-box, the spring of which may preserve it in motion along the whole subsequent main. If the water is brought to rest at every successive stroke of the piston, the whole mass must again be put in motion through the whole length of the main. This requires the same useless expenditure of power as to communicate this motion to as much dead matter; and this is over and above the force which may be necessary for raising the water to a certain height; which is the only circumstance that enters into the calculation of the power of the pump-engine.

An air-box removes this imperfection, because it keeps up the motion during the returning stroke of the piston. The compression of the air by the active stroke of the piston must be such as to continue the impulse in opposition to the contrary pressure of the water (if it is to be raised to some height), and in opposition to the friction or other resistances which arise from the motion that the water really acquires. Indeed a very considerable force is employed here also in changing the motion of the water, which is forced out of the capacious air-box into the narrow pipe; and when this change of motion is not judiciously managed, the expenditure of power may be as great as if all were brought to rest and again put into motion. It may even be greater, by causing the water to move in the opposite direction to its former motion. Of such consequence is it to have all these circumstances scientifically considered. It is in such particulars, unheeded by the ordinary herd of engineers or pump-makers, that the superiority of an intelligent practitioner is to be seen.

Another material point in the conduit of water in pipes is the distribution of it to the different persons who have occasion for it. This is rarely done from the rising main. It is usual to send the whole into a cistern, from which it is afterwards conducted to different places in separate pipes. Till the discovery of the general theorem by the chevalier Buat, this has been done with great inaccuracy. Engineers think that the different purchasers from water-works receive in proportion to their respective bargains when they give them pipes whose areas are proportional to these payments. But we now see, that when these pipes are of any considerable length, the waters of a larger pipe run with a greater velocity than those of a smaller pipe having the same slope. A pipe of two inches diameter will give much more water than four pipes of one inch diameter; it will give as much as five and a half such pipes, or more; because the squares of the discharges are very nearly as the fifth powers of the diameters. This point ought therefore to be carefully considered in the bargains made with the proprietors of water-works, and the payments made in this proportion. Perhaps the most unexceptionable method would be to make a double distribution. Let the water be first let off in its proper proportions into a second series of small cisterns, and let each have a pipe which will convey the whole water that is discharged into it. The first distribution may be made entirely by pipes of one inch in diameter; this would leave nothing to the calculation of the distributor, for every man would pay in proportion to the number of such pipes which run into his own cistern.

In many cases, however, water is distributed by pipes derived from a main. And here another circumstance comes into action. When water is passing along a pipe, its pressure on the sides of the pipe is diminished by its velocity; and if a pipe is now derived from it, the quantity drawn off is also diminished in the subduplicate ratio of the pressures. If the pressure is reduced to $\frac{1}{4}$th, $\frac{1}{9}$th, $\frac{1}{16}$th, &c. the discharge from the lateral pipe is reduced to $\frac{1}{2}$, $\frac{1}{3}$d, $\frac{1}{4}$th, &c.

It is therefore of great importance to determine, what this diminution of pressure is which arises from the motion along the main.

It is plain, that if the water suffered no resistance in the main, its velocity would be that with which it entered, and it would pass along without exerting any pressure. If the pipe were shut at the end, the pressure on the sides would be the full pressure of the head of water. If the head of water remain the same, and the end of the tube be contracted, but not stopped entirely, the velocity in the pipe is diminished. If we would have the velocity in the pipe with this contracted mouth augmented to what it was before the contraction was made, we must employ the pressure of a piston, or of a head of water. This is propagated through the fluid, and thus a pressure is immediately excited on the sides of the pipe. New obstructions of any kind, arising from friction or any other cause, produce a diminution of velocity in the pipe. But when the natural velocity is checked, the particles react on what obstructs their motion; and this action is uniformly propagated through a perfect fluid in every direction. The resistance therefore which we thus ascribe to friction, produces the same lateral pressure which a contraction of the orifice, which equally diminishes the velocity in the pipe, would do. Indeed this is demonstrable from any distinct notions that we can form of these obstructions. They proceed from the want of perfect smoothness, which obliges the particles next the sides to move in undulated lines. This excites transverse forces in the same manner as any constrained curvilineal motion. A particle in its undulated path tends to escape from it, and acts on the lateral particles in the same manner that it would do if moving singly in a capillary tube having the same undulations; it would press on the concave side of every such undulation. Thus a pressure is exerted among the particles, which is propagated to the sides of the pipe; or the diminution of velocity may arise from a viscidity or want of perfect fluidity. This obliges the particle immediately pressed to drag along with it another particle which is withheld by adhesion to the sides. This requires additional pressure from a piston, or an additional head of water; and this pressure also is propagated to the sides of the pipe.

Hence it should follow, that the pressure which water in motion exerts on the sides of its conduit is equal to that which is competent to the head of water which impels it into the pipe, diminished by the head of water competent to the actual velocity with which it moves along the pipe. Let H represent the head of water which impels it into the entry of the pipe, and h the head which would produce the actual velocity; then $H-h$ is the column which would produce the pressure exerted on its sides.

This is abundantly verified by very simple experiments.

 Let

Water-works.

Let an upright pipe be inserted into the fide of the main pipe. When the water runs out by the mouth of the main, it will rife in this branch till the weight of the column balances the preffure that fupports it; and if we then afcertain the velocity of the iffuing water by means of the quantity difcharged, and compute the head or height neceffary for producing this velocity, and fubtract this from the height of water above the entry of the main, we fhall find the height in the branch precifely equal to their difference. Our readers may fee this by examining the experiments related by Gravelande, and ftill better by confulting the experiments narrated by Boffut, § 558, which are detailed with great minutenefs; the refults correfponded accurately with this propofition. The experiments indeed were not heights of water fupported by this preffure, but water expelled by it through the fame orifice. Indeed the truth of the propofition appears in every way we can confider the motion of water. And as it is of the firft importance in the practice of conducting water (for reafons which will prefently appear), it merits a particular attention. When an inclined tube is in train, the accelerating power of the water (or its weight diminifhed in the proportion of the length of the oblique column to its vertical height, or its weight multiplied by the fraction $\frac{1}{s}$, which expreffes the flope), is in equilibrio with the obftructions; and therefore it exerts no preffure on the pipe but what arifes from its weight alone. Any part of it would continue to flide down the inclined plane with a conftant velocity, though detached from what follows it. It therefore derives no preffure from the head of water which impelled it into the pipe. The fame muft be faid of a horizontal pipe infinitely fmooth, or oppofing no refiftance. The water would move in this pipe with the full velocity due to the head of water which impels it into the entry. But when the pipe oppofes an obftruction, the head of water is greater than that which would impel it into the pipe with the velocity that it actually has in it; and this additional preffure is propagated along the pipe, where it is balanced by the actual refiftance, and therefore excites a *quaqua verfum* preffure on the pipe. In fhort, whatever part of the head of water in the refervoir, or of the preffure which impels it along the tube, is not employed in producing velocity, is employed in acting againft fome obftruction, and excites (by the reaction of this obftruction) an equal preffure on the tube. The rule therefore is general, but is fubject to fome modifications which deferve our attention.

In the fimply inclined pipe BC (fig. 4.), the preffure on any point S is equal to that of the head AB of water which impels the water into the pipe wanting; or *minus* that of the head of water which would communicate to it the velocity with which it actually moves. This we fhall call x, and confider it as the weight of a column of water whofe length alfo is x. In like manner H may be the column AB, which impels the water into the pipe, and would communicate a certain velocity; and h may reprefent the column which would communicate the actual velocity. We have therefore $x = \mathrm{H} - h$.

In the pipe HIKL, the preffure at the point I is AH $- h -$ IO, $= \mathrm{H} - h -$ IO; and the preffure at K is $\mathrm{H} - h +$ PK.

And in the pipe DEFG. the preffure on E is $=$ AR $- h -$ EM, $= \mathrm{H} - h -$ EM; and the preffure at F is H $- h +$ FN.

We muft carefully diftinguifh this preffure on any fquare inch of the pipe from the obftruction or refiftance which that inch actually exerts, and which is part of the caufe of this preffure. The preffure is (by the laws of hydroftatics) the fame with that exerted on the water by a fquare inch of the pifton or forcing head of water. This muft balance the united obftructions of the whole pipe, in as far as they are not balanced by the relative weight of the water in an inclofed pipe. Whatever be the inclination of a pipe, and the velocity of the water in it, there is a certain part of this refiftance which may not be balanced by the tendency which the water has to flide along it, provided the pipe be long enough; or if the pipe is too fhort, the tendency down the pipe may more than balance all the refiftances that obtain below. In the firft cafe, this overplus muft be balanced by an additional head of water; and in the latter cafe the pipe is not in train, and the water will accelerate. There is fomething in the mechanifm of thefe motions which makes a certain length of pipe neceffary for bringing it into train; a certain portion of the furface which acts in concert in obftructing the motion. We do not completely underftand this circumftance, but we can form a pretty diftinct notion of its mode of acting. The film of water contiguous to the pipe is withheld by the obftruction, but glides along; the film immediately within this is withheld by the outer film, but glides through it: and thus all the concentric films glide within thofe around them, fomewhat like the fliding tubes of a fpy-glafs, when we draw it out by taking hold of the end of the innermoft. Thus the fecond film paffes beyond the firft or outermoft, and becomes the outermoft, and rubs along the tube. The third does the fame in its turn; and thus the central filaments come at laft to the outfide, and all fuftain their greateft poffible obftruction. When this is accomplifhed, the pipe is in train. This requires a certain length, which we cannot determine by theory. We fee however that pipes of greater diameter muft require a greater length, and this in a proportion which is probably that of the number of filaments, or the fquare of the diameter. Buat found this fuppofition agree well enough with his experiments. A pipe of one inch in diameter fuftained no change of velocity by gradually fhortening it till he reduced it to fix feet, and then it difcharged a little more water. A pipe of two inches diameter gave a fenfible augmentation of velocity when fhortened to 25 feet. He therefore fays, that the fquare of the diameter in inches, multiplied by 72, will exprefs (in inches) the length neceffary for putting any pipe in train.

The refiftance exerted by a fquare inch of the pipe makes but a fmall part of the preffure which the whole refiftances occafion to be exerted there before they can be overcome. The refiftance may be reprefented by $\frac{d}{s}$, when d is the hydraulic depth ($\frac{1}{4}$th of the diameter), and s the length of a column whofe vertical height is one inch, and it is the relative weight of a column of water whofe bafe is a fquare inch, and height is d. For the refiftance of any length s of pipe which is in train, is equal to the tendency of the water to flide down (being balanced by it); that is, is equal to the weight of this column multiplied by $\frac{1}{s}$. The magnitude of this column is had by multiplying its length by its fection. The fection is the product of the border b or circumference, multiplied by the mean depth d, or it is $b\,d$. This, multiplied by the length, is $b\,d\,s$; and this multiplied by the flope $\frac{1}{s}$ is $b\,d$, the relative weight of the column whofe length is s. The relative weight of one inch is therefore $\frac{b\,d}{s}$; and this is in equilibrio with the refiftance of a ring of the pipe one inch broad. This, when unfolded, is a parallelogram b inches in length. One inch of this therefore

r- s. forc is $\frac{d}{s}$, the relative weight of a column of water having d for its height and a square inch for its base. Suppose the pipe four inches in diameter, and the slope = 253, the resistance is one grain; for an inch of water weighs 253 grains.

This knowledge of the pressure of water in motion is of great importance. In the management of rivers and canals it instructs us concerning the damages which they produce in their beds by tearing up the soil; it informs us of the strength which we must give to the banks: but it is of more consequence in the management of close conduits. By this we must regulate the strength of our pipes; by this also we must ascertain the quantities of water which may be drawn off by lateral branches from any main conduit.

With respect to the first of these objects, where security is our sole concern, it is proper to consider the pressure in the most unfavourable circumstances, viz. when the end of the main is shut. This case is not unfrequent. Nay, when the water is in motion, its velocity in a conduit seldom exceeds a very few feet in a second. Eight feet *per* second requires only one foot of water to produce it. We should therefore estimate the strain on all conduits by the whole height of the reservoir.

In order to adjust the strength of a pipe to the strain, we may conceive it as consisting of two half cylinders of insuperable strength, joined along the two seams, where the strength is the same with the ordinary strength of the materials of which it is made. The inside pressure tends to burst the pipe by tearing open these seams, and each of them sustains half of the strain. The strain on an inch of these two seams is equal to the weight of a column of water whose height is the depth of the seam below the surface of the reservoir, and whose base is an inch broad and a diameter of the pipe in length. This follows from the common principles of hydrostatics.

Suppose the pipe to be of lead, one foot in diameter and 100 feet under the surface of the reservoir. Water weighs $62\frac{1}{2}$ pounds *per* foot. The base of our column is therefore $\frac{1}{12}$th of a foot, and the tendency to burst the pipe is $100 \times 62\frac{1}{2} \times \frac{1}{12}\text{th} = \frac{6250}{12} = 521$ pounds nearly. Therefore an inch of one seam is strained by $260\frac{1}{2}$ pounds. A rod of lead one inch square is pulled asunder by 860 pounds (see STRENGTH *of Materials*, n° 40). Therefore, if the thickness of the seam is $= \frac{260}{860}$ inches, or $\frac{1}{3}$d of an inch, it will just withstand this strain. But we must make it much stronger than this, especially if the pipe leads from an engine which sends the water along it by starts. Belidor and Desaguliers have given tables of the thickness and weights of pipes which experience has found sufficient for the different materials and depths. Desaguliers says, that a leaden pipe of $\frac{3}{4}$ths of an inch in thickness is strong enough for a height of 140 feet and diameter of 7 inches. From this we may calculate all others. Belidor says, that a leaden pipe 12 inches diameter and 60 feet deep should be half an inch thick: but these things will be more properly computed by means of the list given in n° 40 of the article STRENGTH *of Materials*.

The application which we are most anxious to make of the knowledge of the pressure of moving waters is the derivation from a main conduit by lateral branches. This occurs very frequently in the distribution of waters among the inhabitants of towns; and it is so imperfectly understood by the greatest part of those who take the name of engineers, that individuals have no security that they shall get even one half of the water they bargain and pay for; yet this may be as accurately ascertained as any other problem in hydraulics by means of our general theorem. The case therefore merits our particular attention.

Water-works.

It appears to be determined already, when we have ascertained the pressures by which the water is impelled into these lateral pipes especially after we have said that the experiments of Bossut on the actual discharges from a lateral pipe fully confirm the theoretical doctrine. But much remains to be considered. We have seen that there is a vast difference between the discharge made through a hole, or even through a short pipe, and the discharge from the far end of a pipe derived from a main conduit. And even when this has been ascertained by our new theory, the discharge thus modified will be found considerably different from the real state of things: For when water is flowing along a main with a known velocity, and therefore exerting a known pressure on the circle which we propose for the entry of a branch, if we insert a branch there water will go along it: but this will generally make a considerable change in the motion along the main, and therefore in the pressure which is to expel the water. It also makes a considerable change in the whole quantity which passes along the anterior part of the main, and a still greater change on what moves along that part of it which lies beyond the branch: it therefore affects the quantity necessary for the whole supply, the force that is required for propelling it, and the quantity delivered by other branches. This part therefore of the management of water in conduits is of considerable importance and intricacy. We can propose in this place nothing more than a solution of such leading questions as involve the chief circumstances, recommending to our readers the perusal of original works on this subject. M. Bossut's experiments are fully competent to the establishment of the fundamental principle. The hole through which the lateral discharges were made was but a few feet from the reservoir. The pipe was successively lengthened, by which the resistances were increased, and the velocity diminished. But this did not affect the lateral discharges, except by affecting the pressures; and the discharges from the end of the main were supposed to be the same as when the lateral pipe was not inserted. Although this was not strictly true, the difference was insensible, because the lateral pipe had but about the 18th part of the area of the main.

Suppose that the discharge from the reservoir remains the same after the derivation of this branch, then the motion of the water all the way to the insertion of the branch is the same as before; but, beyond this, the discharge is diminished by all that is discharged by the branch, with the head x equivalent to the pressure on the side. The discharge by the lower end of the main being diminished, the velocity and resistance in it are also diminished. Therefore the difference between x and the head employed to overcome the friction in this second case, would be a needless or inefficient part of the whole load at the entry, which is impossible; for every force produces an effect, or it is destroyed by some reaction. The effect of the forcing head of water is to produce the greatest discharge corresponding to the obstructions; and thus the discharge from the reservoir, or the supply to the main, must be augmented by the insertion of the branch, if the forcing head of water remains the same. A greater portion therefore of the forcing head was employed in producing a greater discharge at the entry of the main, and the remainder, less than x, produced the pressure on the sides. This head was the one competent to the obstructions resulting from the velocity beyond the insertion of the branch; and this velocity, diminished by the discharge already made, was less than that at the entry, and even than that of the main without a branch. This will appear more distinctly by putting the case into the form of an equation. Therefore let $H - x$ be the height due to the velocity at the entry, of which the effect obtains only

hori-

horizontally. The head x is the only one which acts on the sides of the tube, tending to produce the discharge by the branch, at the same time that it must overcome the obstructions beyond the branch. If the orifice did not exist and if the force producing the velocity on a short tube be represented by $2\,G$, and the section of the main by A, the supply at the entry of the main would be $A\sqrt{2G}\sqrt{H-x}$; and if the orifice had no influence on the value of x, the discharge by the orifice would be $D\sqrt{\frac{x}{H}}$, D being its discharge by means of the head H, when the end of the main is shut; for the discharges are in the subduplicate ratio of the heads of water by which they are expelled; and therefore $\sqrt{H} : \sqrt{x} = D : D\sqrt{\frac{x}{H}}\ (=\delta)$. But we have seen that x must diminish; and we know that the obstructions are nearly as the square roots of the velocities, when these do not differ much among themselves. Therefore calling y the pressure or head which balances the resistances of the main without a branch, while x is the head necessary for the main with a branch, we may institute this proportion $y : H-y = x : \frac{x(H-y)}{y}$; and this 4th term will express the head producing the velocity in the main beyond the branch (as $H-y$ would have done in a main without a branch). This velocity beyond the branch will be $\sqrt{2G}\sqrt{\frac{x(H-y)}{y}}$, and the discharge at the end will be $A\sqrt{2G}\sqrt{\frac{x(H-y)}{y}}$. If to this we add the discharge of the branch, the sum will be the whole discharge, and therefore the whole supply. Therefore we have the following equation, $A\sqrt{2G}\sqrt{H-y} = A\sqrt{2G}\sqrt{\frac{x(H-y)}{y}} + D\sqrt{\frac{x}{H}}$. From this we deduce the value of $x =$

$$\frac{2\,GHA^2}{\left(A\sqrt{2G}\sqrt{\frac{H-y}{y}}+\frac{D}{\sqrt{H}}\right)^2+2\,GA^2}.$$

This value of x being substituted in the equation of the discharge δ of the branch, which was $= D\sqrt{\frac{x}{H}}$, will give the discharges required, and they will differ so much the more from the discharges calculated according to the simple theory, as the velocity in the main is greater. By the simple theory, we mean the supposition that the lateral discharges are such as would be produced by the head $H-h$, where H is the height of the reservoir, and h the head due to the actual velocity in the main.

And thus it appears that the proportion of the discharge by a lateral pipe from a main that is shut at the far end, and the discharge from a main that is open, depends not only on the pressures, but also on the size of the lateral pipe, and its distance from the reservoir. When it is large, it greatly alters the train of the main, under the same head, by altering the discharge at its extremity, and the velocity in it beyond the branch; and if it be near the reservoir, it greatly alters the train, because the diminished velocity takes place through a greater extent, and there is a greater diminution of the resistances.

When the branch is taken off at a considerable distance from the reservoir, the problem becomes more complicated, and the head x is resolved into two parts; one of which balances the resistance in the first part of the main, and the other balances the resistances beyond the lateral pipe, with a velocity diminished by the discharge from the branch.—A branch at the end of the main produces very little change in the train of the pipe.

When the lateral discharge is great, the train may be so altered, that the remaining part of the main will not run full, and then the branch will not yield the same quantity. The velocity in a very long horizontal tube may be so small (by a small head of water and great obstructions in a very long tube) that it will just run full. An orifice made in its upperside will yield nothing; and yet a small tube inserted into it will carry a column almost as high as the reservoir. So that we cannot judge in all cases of the pressures by the discharges, and *vice versa*.

If there be an inclined tube, having a head greater than what is competent to the velocity, we may bring it into train by an opening on its upper side near the reservoir. This will yield some water, and the velocity will diminish in the tube till it is in train. If we should now enlarge the hole, it will yield no more water than before.

And thus we have pointed out the chief circumstances which affect these lateral discharges. The discharges are afterwards modified by the conduits in which they are conveyed to their places of destination. These being generally of small dimensions, for the sake of economy, the velocity is much diminished. But, at the same time, it approaches nearer to that which the same conduit would bring directly from the reservoir, because its small velocity will produce a less change in the train of the main conduit.

We should now treat of jets of water, which still make an ornament in the magnificent pleasure grounds of the wealthy. Some of these are indeed grand objects, such as the two at Peterhoff in Russia, which spout about 60 feet high a column of nine inches diameter, which falls again, and shakes the ground with its blow. Even a spout of an inch or two inches diameter, lancing to the height of 150 feet, is a gay object, and greatly enlivens a pleasure-ground; especially when the changes of a gentle breeze bend the jet to one side. But we have no room left for treating this subject, which is of some nicety; and must conclude this article with a very short account of the management of water as an active power for impelling machinery.

II. *Of Machinery drawn by Water.*

This is a very comprehensive article, including almost every possible species of mill. It is no less important, and it is therefore matter of regret, that we cannot enter into the detail which it deserves. The mere description of the immense variety of mills which are in general use, would fill volumes, and a scientific description of their principles and maxims of construction would almost form a complete body of mechanical science. But this is far beyond the limits of a Work like ours. Many of these machines have been already described under their proper names, or under the articles which give an account of their manufactures; and for others we must refer our readers to the original works, where they are described in minute detail. The great academical collection *Des Arts et Metiers*, published at Paris in many folio volumes, contains a description of the peculiar machinery of many mills; and the volumes of the *Encyclopédie Methodique*, which particularly relate to the mechanic arts, already contain many more. All that we can do in this place is, to consider the chief circumstances that are common to all water-mills, and from which all must derive their efficacy. These circumstances are to be found in the manner of employing water as an acting power, and most of

them

them are comprehended in the conſtruction of water-wheels. When we have explained the principles and the maxims of conſtruction of a water-wheel, every reader converſant in mechanics knows, that the axis of this wheel may be employed to tranſmit the force impreſſed on it to any ſpecies of machinery. Therefore nothing ſubſequent to this can with propriety be conſidered as *water-works*.

Water-wheels are of two kinds, diſtinguiſhed by the manner in which water is made an impelling power, viz. by its weight, or by its impulſe. This requires a very different form and manner of adaptation; and this forms an oſtenſible diſtinction, ſufficiently obvious to give a name to each claſs. When water is made to act by its weight, it is delivered from the ſpout as high on the wheel as poſſible, that it may continue long to preſs it down: but when it is made to ſtrike the wheel, it is delivered as low as poſſible, that it may have previouſly acquired a great velocity. And thus the wheels are ſaid to be OVERSHOT or UNDERSHOT.

Of Overſhot Wheels.

THIS is nothing but a frame of open buckets, ſo diſpoſed round the rim of a wheel as to receive the water delivered from a ſpout; ſo that one ſide of the wheel is loaded with water, while the other is empty. The conſequence muſt be, that the loaded ſide muſt deſcend. By this motion the water runs out of the lower buckets, while the empty buckets of the riſing ſide of the wheel come under the ſpout in their turn, and are filled with water.

If it were poſſible to conſtruct the buckets in ſuch a manner as to remain completely filled with water till they come to the very bottom of the wheel, the preſſure with which the water urges the wheel round its axis would be the ſame as if the extremity of the horizontal radius were continually loaded with a quantity of water ſufficient to fill a ſquare pipe, whoſe ſection is equal to that of the bucket, and whoſe length is the diameter of the wheel. For let the buckets BD and EF (fig. 5.) be compared together, the arches DB and EF are equal. The mechanical energy of the water contained in the bucket EF, or the preſſure with which its weight urges the wheel, is the ſame as if all this water were hung on that point T of the horizontal arm CF, where it is cut by the vertical or plumb-line BT. This is plain from the moſt elementary principles of mechanics. Therefore the effect of the bucket BD is to that of the bucket EF as CT to CF or CB. Draw the horizontal lines PBbb, QDdd. It is plain, that if BD is taken very ſmall, ſo that it may be conſidered as a ſtraight line, BD : BO = CB : BP, and EF : bd = CF : CT, and EF × CT = bd × CF. Therefore if the priſm of water, whoſe vertical ſection is $bbdd$, were hung on at F, its force to urge the wheel round would be the ſame as that of the water lying in the bucket BD. The ſame may be ſaid of every bucket; and the effective preſſure of the whole ring of water AfHKFI, in its natural ſituation, is the ſame with the pillar of water $abba$ hung on at F. And the effect of any portion BF of this ring is the ſame with that of the correſponding portion bFfb of the vertical pillar. We do not take into account the ſmall difference which ariſes from the depth B or Ff, becauſe we may ſuppoſe the circle deſcribed through the centres of gravity of the buckets. And in the farther proſecution of this ſubject, we ſhall take ſimilar liberties, with the view of ſimplifying the ſubject, and ſaving time to the reader.

But ſuch a ſtate of the wheel is impoſſible. The bucket at the very top of the wheel may be completely filled with water; but when it comes into the oblique poſition BD, a part of the water muſt run over the outer edge s, and the bucket will only retain the quantity ZBDs; and if the buckets are formed by partitions directed to the axis of the wheel, the whole water muſt be run out by the time that they deſcend to the level of the axis. To prevent this many contrivances have been adopted. The wheel has been ſurrounded with a hoop or ſweep, conſiſting of a circular board, which comes almoſt into contact with the rim of the wheel, and terminates at H, where the water is allowed to run off. But unleſs the work is executed with uncommon accuracy, the wheel made exactly round, and the ſweep exactly fitting it, a great quantity of water eſcapes between them; and there is a very ſenſible obſtruction to the motion of ſuch a wheel, from ſomething like friction between the water and the ſweep. Froſt alſo effectually ſtops the motion of ſuch a wheel. Sweeps have therefore been generally laid aſide, although there are ſituations where they might be uſed with good effect. Water-works.

Mill-wrights have turned their whole attention to the giving a form to the buckets which ſhall enable them to retain the water along a great portion of the circumference of the wheel. It would be endleſs to deſcribe all theſe contrivances; and we ſhall therefore content ourſelves with one or two of the moſt approved. The intelligent reader will readily ſee that many of the circumſtances which concur in producing the ultimate effect (ſuch as the facility with which the water is received into the buckets, the place which it is to occupy during the progreſs of the bucket from the top to the bottom of the wheel, the readineſs with which they are evacuated, or the chance that the water has of being dragged beyond the bottom of the wheel by its adheſion, &c. &c.) are ſuch as do not admit of preciſe calculation or reaſoning about their merits; and that this or that form can ſeldom be evidently demonſtrated to be the very beſt poſſible. But, at the ſame time, he will ſee the general reaſons of preference, and his attention will be directed to circumſtances which muſt be attended to, in order to have a good bucketed wheel.

Fig. 6. is the outline of a wheel having 40 buckets. The ring of board contained between the concentric circles QDS and PAR, making the ends of the buckets, is called the SHROUDING, in the language of the art, and QP is called the *depth of ſhrouding*. The inner circle PAR is called the SOLE of the wheel, and uſually conſiſts of boards nailed to ſtrong wooden rings of compaſs timber of conſiderable ſcantling, firmly united with the ARMS or radii. The partitions, which determine the form of the buckets, conſiſt of three different planes or boards AB, BC, CD, which are variouſly named by different artiſts. We have heard them named the START or SHOULDER, the ARM, and the WREST (probably for wriſt, on account of a reſemblance of the whole line to the human arm); B is alſo called the ELBOW. Fig. 7. repreſents a ſmall portion of the ſame bucketing on a larger ſcale, that the proportions of the parts may be more diſtinctly ſeen. AG, the ſole of one bucket, is made about $\frac{1}{5}$th more than the depth GH of the ſhrouding. The ſtart AB is $\frac{1}{3}$ of AI. The plane BC is ſo inclined to AB that it would paſs through H; but it is made to terminate in C, in ſuch a manner that FC is $\frac{5}{6}$ths of GH or AI. Then CD is ſo placed that HD is about $\frac{1}{5}$th of IH.

By this conſtruction, it follows that the area FABC is very nearly equal to DABC; ſo that the water which will fill the ſpace FABC will all be contained in the bucket when it ſhall come into ſuch a poſition that AD is a horizontal line; and the line AB will then make an angle of nearly 35° with the vertical, or the bucket will be 35° from the perpendicular. If the bucket deſcend ſo much lower that one half of the water runs out, the line AB will make an angle of 25°, or 24° nearly, with the vertical. Therefore

Water-works.

fore the wheel, filled to the degree now mentioned, will *begin* to lose water at about $\frac{1}{4}$th of the diameter from the bottom, and *half of the water will be discharged* from the lowest bucket, about $\frac{1}{17}$th of the diameter farther down. These situations of the discharging bucket are marked at T and V in fig. 6. Had a greater proportion of the buckets been filled with water when they were under the spout, the discharge would have begun at a greater height from the bottom, and we should lose a greater portion of the whole fall of water. The loss by the present construction is less than $\frac{1}{10}$th (supposing the water to be delivered into the wheel at the very top), and may be estimated at about $\frac{1}{12}$th; for the loss is the versed sine of the angle which the radius of the bucket makes with the vertical. The versed sine of $35°$ is nearly $\frac{1}{5}$th of the radius (being 0,18085), or $\frac{1}{10}$th of the diameter. It is evident, that if only $\frac{1}{2}$ of this water were supplied to each bucket as it passes the spout, it would have been retained for $10°$ more of a revolution, and the loss of fall would have been only about $\frac{1}{15}$th.

These observations serve to show, in general, that an advantage is gained by having the buckets so capacious that the quantity of water which each can receive as it passes the spout may not nearly fill it. This may be accomplished by making them of a sufficient length, that is, by making the wheel sufficiently broad between the two shroudings. Economy is the only objection to this practice, and it is generally very ill placed. When the work to be performed by the wheel is great, the addition of power gained by a greater breadth will soon compensate for the additional expence.

The third plane CD is not very frequent; and mill-wrights generally content themselves with continuing the board all the way from the elbow B to the outer edge of the wheel at H; and AB is generally no more than $\frac{1}{3}$d of the depth AI. But CD is a very evident improvement, causing the wheel to retain a very sensible addition to the water. Some indeed make this addition more considerable, by bringing BC more outward, so as to meet the rim of the wheel at H, for instance, and making HD coincide with the rim. But this makes the entry of the water somewhat more difficult during the very short time that the opening of the bucket passes the spout. To facilitate this as much as possible, the water should get a direction from the spout, such as will send it into the buckets in the most perfect manner. This may be obtained by delivering the water through an aperture that is divided by thin plates of board or metal, placed in the proper position, as we have represented in fig. 6. The form of bucket last mentioned, having the wrest concentric with the rim, is unfavourable to the ready admission of the water; whereas an oblique wrest conducts the water which has missed one bucket into the next below.

The mechanical consideration of this subject also shows us, that a deep shrouding, in order to make a capacious bucket, is not a good method: it does not make the buckets retain their water any longer; and it diminishes the effective fall of water: for the water received at the top of the wheel immediately falls to the bottom of the bucket, and thus shortens the fictitious pillar of water, which we showed to be the measure of the effective or useful pressure on the wheel: and this concurs with our former reasons for recommending as great a breadth of the wheel, and length of buckets, as economical considerations will permit.

A bucket-wheel has been executed lately by Mr Robert Burns, at the cotton-mills of Houston, Burns, and Co. at Cartside in Renfrewshire, of a construction entirely new, but founded on a good principle, which is susceptible of great extension. It is represented in fig. 8. The bucket consists of a start AB, an arm BC, and a wrest CD, concentric with the rim. But the bucket is also divided by a partition LM, concentric with the sole and rim, and so placed as to make the inner and outer portions of nearly equal capacity. It is evident, without any farther reasoning about it, that this partition will enable the bucket to retain its water much longer. When they are filled $\frac{1}{3}$d, they retain the whole water at $18°$ from the bottom; and they retain $\frac{1}{2}$ at $11°$. They do not admit the water quite so freely as buckets of the common construction; but by means of the contrivance mentioned a little ago for the spout (also the invention of Mr Burns, and furnished with a rack-work, which raised or depressed it as the supply of water varied, so as at all times to employ the whole fall of the water), it is found, that a slow-moving wheel allows one-half of the water to get into the inner buckets, especially if the partition do not altogether reach the radius drawn through the lip D of the outer bucket.

This is a very great improvement of the bucket-wheel; and when the wheel is made of a liberal breadth, so that the water may be very shallow in the buckets, it seems to carry the performance as far as it can go. Mr Burns made the first trial on a wheel of 24 feet diameter; and its performance is manifestly superior to that of the wheel which it replaced, and which was a very good one. It has also another valuable property: When the supply of water is very scanty, a proper adjustment of the apparatus in the spout will direct almost the whole of the water into the outer buckets; which, by placing it at a greater distance from the axis, makes a very sensible addition to its mechanical energy.

We said that this principle is susceptible of considerable extension; and it is evident that two partitions will increase the effect, and that it will increase with the number of partitions: so that when the practice now begun, of making water-wheels of iron, shall become general, and therefore very thin partitions are used, their number may be greatly increased without any inconvenience: and it is obvious, that this series of partitions must greatly contribute to the stiffness and general firmness of the whole wheel.

There frequently occurs a difficulty in the making of bucket-wheels, when the half-taught mill-wright attempts to retain the water a long time in the buckets. The water gets into them with a difficulty which he cannot account for, and spills all about, even when the buckets are not moving away from the spout. This arises from the air, which must find its way out to admit the water, but is obstructed by the entering water, and occasions a great sputtering at the entry. This may be entirely prevented by making the spout considerably narrower than the wheel. This will leave room at the two ends of the buckets for the escape of the air. This obstruction is vastly greater than one would imagine; for the water drags along with it a great quantity of air, as is evident in the *Water-blast* described by many authors.

There is another and very serious obstruction to the motion of an overshot or bucketed wheel. When it moves in back-water, it is not only resisted by the water, when it moves more slowly than the wheel, which is very frequently the case, but it lifts a great deal in the rising buckets. In some particular states of back-water, the descending bucket fills itself completely with water; and, in other cases, it contains a very considerable quantity, and air of common density; while in some rarer cases it contains less water, with air in a condensed state. In the first case, the rising bucket must come up filled with water, which it cannot drop till its mouth get out of the water. In the second

cond cafe, part of the water goes out before this; but the air rarefies, and therefore there is ftill fome water dragged or lifted up by the wheel, by fuction as it is ufually called. In the laft cafe there is no fuch back load on the rifing fide of the wheel, but (which is as detrimental to its performance) the defcending fide is employed in condenfing air; and although this air aids the afcent of the rifing fide, it does not aid it fo much as it impedes the defcending fide, being (by the form of the bucket) nearer to the vertical line drawn thro' the axis.

All this may be completely prevented by a few holes made in the ftart of each bucket. Air being at leaft 800 times rarer than water, will efcape through a hole almoft 30 times fafter with the fame preffure. Very moderate holes will therefore fuffice for this purpofe: and the fmall quantity of water which thefe holes difcharge during the defcent of the buckets, produces a lofs which is altogether infignificant. The water which runs out of one runs into another, fo that there is only the lofs of one bucket. We have feen a wheel of only 14 feet diameter working in nearly three feet of back-water. It laboured prodigioufly, and brought up a great load of water, which fell from it in abrupt dafhes, which rendered the motion very hobbling. When three holes of an inch diameter were made in each bucket (12 feet long), the wheel laboured no more, there was no more plunging of water from its rifing fide, and its power on the machinery was increafed more than $\frac{1}{4}$th.

Thefe practical obfervations may contain information that is new even to feveral experienced mill-wrights. To perfons lefs informed they cannot fail of being ufeful. We now proceed to confider the action of water thus lying in the buckets of a wheel; and to afcertain its energy as it may be modified by different circumftances of fall, velocity, &c.

With refpect to variations in the fall, there can be little room for difcuffion. Since the active preffure is meafured by the pillar of water reaching from the horizontal plane where it is delivered on the wheel, to the horizontal plane where it is fpilled by the wheel, it is evident that it muft be proportional to this pillar, and therefore we muft deliver it as high and retain it as long as poffible.

This maxim obliges us, in the firft place, to ufe a wheel whofe diameter is equal to the whole fall. We fhall not gain any thing by employing a larger wheel; for although we fhould gain by ufing only that part of the circumference where the weight will act more perpendicularly to the radius, we fhall lofe more by the neceffity of difcharging the water at a greater height from the bottom: For we muft fuppofe the buckets of both the wheels equally well-conftructed; in which cafe, the heights above the bottom, where they will difcharge the water, will increafe in the proportion of the diameter of the wheel. Now, that we fhall lofe more by this than we gain by a more direct application of the weight, is plain, without any further reafoning, by taking the extreme cafe, and fuppofing our wheel enlarged to fuch a fize, that the ufelefs part below is equal to our whole fall. In this cafe the water will be fpilled from the buckets as foon as it is delivered into them. All intermediate cafes, therefore, partake of the imperfection of this.

When our fall is exceedingly great, a wheel of an equal diameter becomes enormoufly big and expenfive, and is of itfelf an unmanageable load. We have feen wheels of 58 feet diameter, however, which worked extremely well; but they are of very difficult conftruction, and extremely apt to warp and go out of fhape by their weight. In cafes like this, where we are unwilling to lofe any part of the force of a fmall ftream, the beft form of a bucket-wheel is an inverted chain-pump. Inftead of employing a chain-pump of the beft conftruction, ABCDEA (fig. 9.) to raife water through the upright pipe CB, by means of a force applied to the upper wheel A, let the water be delivered from a fpout F, into the upper part of the pipe BC, and it will prefs down the plugs in the lower and narrower bored part of it with the full weight of the column, and efcape at the dead level of C. This weight will urge round the wheel A without any defalcation: and this is the moft powerful manner that any fall of water whatever can be applied, and exceeds the moft perfect overfhot wheel. But though it excels all chains of buckets in economy and in effect, it has all the other imperfections of this kind of machinery. Though the chain of plugs be of great ftrength, it has fo much motion in its joints that it needs frequent repairs; and when it breaks, it is generally in the neighbourhood of A, on the loaded fide, and all comes down with a great crafh. There is alfo a lofs of power by the immerfion of fo many plugs and chains in the water; for there can be no doubt but that if the plugs were big enough and light enough, they would buoy and even draw up the plugs in the narrow part at C. They muft therefore diminifh, in all other cafes, the force with which this plug is preffed down.

The velocity of an overfhot wheel is a matter of very great nicety; and authors, both fpeculative and practical, have entertained different, nay oppofite, opinions on the fubject. Mr Beledor, whom the engineers of Europe have long been accuftomed to regard as facred authority, maintains, that there is a certain velocity related to that obtainable by the whole fall, which will procure to an overfhot wheel the greateft performance. Defaguilliers, Smeaton, Lambert, Des Parcieux, and others, maintain, that there is no fuch relation, and that the performance of an overfhot-wheel will be the greater, as it moves more flowly by an increafe of its load of work. Beledor maintains, that the active power of water lying in a bucket-wheel of any diameter is equal to that of the impulfe of the fame water on the floats of an underfhot wheel, when the water iffues from a fluice in the bottom of the dam. The other writers whom we have named affert, that the energy of an underfhot-wheel is but one-half of that of an overfhot, actuated by the fame quantity of water falling from the fame height.

To a manufacturing country like ours, which derives aftonifhing fuperiority, by which it more than compenfates for the impediments of heavy taxes and luxurious living chiefly from its machinery, in which it leaves all Europe far behind, the decifion of this queftion, in fuch a manner as fhall leave no doubt or mifconception in the mind even of an unlettered artift, muft be confidered as a material fervice; and we think that this is eafily attainable.

When any machine moves uniformly, the accelerating force or preffure actually exerted on the impelled point of the machine is in equilibrio with all the refiftances which are exerted at the working point with thofe arifing from friction, and thofe that are excited in different parts of the machine by their mutual actions. This is an inconteftable truth; and though little attended to by the mechanicians, is the foundation of all practical knowledge of machines. Therefore, when an overfhot-wheel moves uniformly, with *any velocity whatever*, the water is acting with its whole weight: for gravity would accelerate its defcent, if not completely balanced by fome reaction; and in this balance gravity and the reacting part of the machine exert equal and oppofite preffures, and thus produce the uniform motion of the machine. We are thus particular on this point, becaufe we obferve mechanicians of the firft

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name employing a mode of reafoning on the queftion now before us which is fpecious, and appears to prove the conclufion which they draw; but is neverthelefs contrary to true mechanical principles. They affert, that the flower a heavy body is defcending (fuppofe in a fcale fufpended from an axis in peritrochea), the more does it prefs on the fcale, and the more does it urge the machine round: and therefore the flower an overfhot wheel turns, the greater is the force with which the water urges it round, and the more work will be done. It is very true that the machine is more forcibly impelled, and that more work is done: but this is not becaufe a pound of water preffes more ftrongly, but becaufe there is more water preffing on the wheel; for the fpout fupplies at the fame rate, and each bucket receives more water as it paffes by it.

Let us therefore examine this queftion by the unqueftionable principles of mechanics.

Let the overfhot-wheel $A f H$ (fig. 5.) receive the water from a fpout at the very top of the wheel; and, in order that the wheel may not be retarded by dragging into motion the water fimply laid into the uppermoft bucket at A, let it be received at B, with the velocity (directed in a tangent to the wheel) acquired by the head of water AP. This velocity, therefore, muft be equal to that of the rim of the wheel. Let this be v, or let the wheel and the water move over v inches in a fecond. Let the buckets be of fuch dimenfions, that all the water which each receives as it paffes the fpout is retained till it comes to the pofition R, where it is difcharged at once. It is plain that, in place of the feparate quantities of water lying in each bucket, we may fubftitute a continued ring of water, equal to their fum, and uniformly diftributed in the fpace $BER\rho f\beta$. This conftitutes a ring of uniform thicknefs. Let the area of its crofs fection βB or $F f$ be called a. We have already demonftrated, that the mechanical energy with which this water on the circumference of the wheel urges it round, is the fame with what would be exerted by the pillar $b r r b$ preffing on $F f$, or acting by the lever CF. The weight of this pillar may be expreffed by $a \times b r$, or $a \times PS$; and if we call the radius CF of the wheel R, the momentum or mechanical energy of this weight will be reprefented by $a \times PS \times R$.

Now, let us fuppofe that this wheel is employed to raife a weight W, which is fufpended by a rope wound round the axis of the wheel. Let r be the radius of this axle. Then $W \times r$ is the momentum of the work. Let the weight rife with the velocity u when the rim of the wheel turns with the velocity v, that is, let it rife u inches in a fecond.

Since a perfect equilibrium obtains between the power and the work when the motion is uniform, we muft have $W \times r = a \times PS \times R$. But it is evident that $R : r = v : u$. Therefore $W \times u = a \times v \times PS$.

Now the performance of the machine is undoubtedly meafured by the weight and the height to which it is raifed in a fecond, or by $W \times u$. Therefore the machine is in its beft poffible ftate when $a \times v \times PS$ is a maximum. But it is plain that $a \times v$ is an invariable quantity; for it is the cubic inches of water which the fpout fupplies in a fecond. If the wheel moves faft, little water lies in each bucket, and a is fmall. When v is fmall, a is great, for the oppofite reafon; but $a \times v$ remains the fame. Therefore we muft make PS a maximum, that is, we muft deliver the water as high up as poffible. But this diminifhes AP, and this diminifhes the velocity of the wheel: and as this has no limit, the propofition is demonftrated; and an overfhot wheel does the more work as it moves floweft.

Convincing as this difcuffion muft be to any mechanician, we are anxious to imprefs the fame maxim on the minds of practical men, unaccuftomed to mathematical reafoning of any kind. We therefore beg indulgence for adding a popular view of the queftion, which requires no fuch inveftigation.

We may reafon in this way: Suppofe a wheel having 30 buckets, and that fix cubic feet of water are delivered in a fecond on the top of the wheel, and difcharged without any lofs by the way at a certain height from the bottom of the wheel. Let this be the cafe, whatever is the rate of the wheel's motion; the buckets being of a fufficient capacity to hold all the water which falls into them. Let this wheel be employed to raife a weight of any kind, fuppofe water in a chain of 30 buckets, to the fame height, and with the fame velocity. Suppofe, farther, that when the load on the rifing fide of the machine is one-half of that on the wheel, the wheel makes four times in a minute, or one turn in 15 feconds. During this time 90 cubic feet of water have flowed into the 30 buckets, and each has received three cubic feet. Then each of the rifing buckets contains $1\frac{1}{2}$ feet; and 45 cubic feet are delivered into the upper ciftern during one turn of the wheel, and 180 cubic feet in one minute.

Now, fuppofe the machine fo loaded, by making the rifing buckets more capacious, that it makes only two turns in a minute, or one turn in 30 feconds. Then each defcending bucket muft contain fix cubic feet of water. If each bucket of the rifing fide contained three cubic feet, the motion of the machine would be the fame as before. This is a point which no mechanician will controvert. When two pounds are fufpended to one end of a ftring which paffes over a pulley, and one pound to the other end, the defcent of the two pound will be the fame with that of a four pounds weight, which is employed in the fame manner to draw up two pounds. Our machine would therefore continue to make four turns in the minute, and would deliver 90 cubic feet during each turn, and 360 in a minute. But, by fuppofition, it is making but two turns in a minute: this muft proceed from a greater load than three cubic feet of water in each rifing bucket. The machine muft therefore be raifing *more* than 90 feet of water during one turn of the wheel, and *more* than 180 in the minute.

Thus it appears, that if the machine is turning twice as flow as before, there is *more than twice the former quantity* in the rifing buckets, and more will be raifed in a minute by the fame expenditure of power. In like manner, if the machine go three times as flow, there muft be *more than three times* the former quantity of water in the rifing buckets, and more work will be done.

But we may go farther, and affert, that the *more* we retard the machine, by loading it with more work of a fimilar kind, the greater will be its performance. This does not immediately appear from the prefent difcuffion: But let us call the firft quantity of water in the rifing bucket A; the water raifed by four turns in a minute will be $4 \times 30 \times A, = 120\,A$. The quantity in this bucket, when the machine goes twice as flow, has been fhown to be greater than $2\,A$ (call it $2\,A + x$); the water raifed by two turns in a minute will be $2 \times 30 \times \overline{2\,A + x} = 120\,A + 60\,x$. Now, let the machine go four times as flow, making but one turn in a minute, the rifing bucket muft now contain more than twice $2\,A + x$, or more than $4\,A + 2\,x$; call it $4\,A + 2\,x + y$. The work done by one turn in a minute will now be $30 \times \overline{4\,A + 2\,x + y} = 120\,A + 60\,x + 30\,y$.

By fuch an induction of the work, done with any rates of motion we choofe, it is evident that the performance of

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the machine increafes with every diminution of its velocity that is produced by the mere addition of a fimilar load of work, or that it does the more work the flower it goes.

We have fuppofed the machine to be in its ftate of permanent uniform motion. If we confider it only in the beginning of its motion, the refult is ftill more in favour of flow motion: For, at the firft action of the moving power, the inertia of the machine itfelf confumes part of it, and it acquires its permanent fpeed by degrees; during which, the refiftances arifing from the work, friction, &c. increafe, till they exactly balance the preffure of the water; and after this the machine accelerates no more. Now the greater the power and the refiftance arifing from the work are, in proportion to the inertia of the machine, the fooner will all arrive at its ftate of permanent velocity.

There is another circumftance which impairs the performance of an overfhot-wheel moving with a great velocity, *viz.* the effects of the centrifugal force on the water in the buckets. Our mill-wrights know well enough, that too great velocity will throw the water out of the buckets; but few, if any, know exactly the diminution of power produced by this caufe. The following very fimple conftruction will determine this: Let AOB (fig. 10.) be an overfhot wheel, of which AB is the upright diameter, and C is the centre. Make CF the length of a pendulum, which will make two vibrations during one turn of the wheel. Draw FE to the elbow of any of the buckets. The water in this bucket, inftead of having its furface horizontal, as NO, will have it in the direction n O perpendicular to FE very nearly.

For the time of falling along half of FC is to that of two vibrations of this pendulum, or to the time of a revolution of the wheel as the radius of a circle is to its circumference: and it is well known, that the time of moving along half of AC, by the uniform action of the centrifugal force, is to that of a revolution as the radius of a circle to its circumference. Therefore the time of defcribing $\frac{1}{2}$ of AC by the centrifugal force, is equal to the time of defcribing $\frac{1}{2}$ of FC by gravity. Thefe fpaces, being fimilarly defcribed in equal times, are proportional to the accelerating forces. Therefore $\frac{1}{2}$ FC : $\frac{1}{2}$ AC, or FC : AC = gravity : centrifugal force. Complete the parallelogram FCEK. A particle at E is urged by its weight in the direction KE, with a force which may be expreffed by FC or KE; and it is urged by the centrifugal force in the direction CE, with a force = AC or CE. By their combined action it is urged in the direction FE. Therefore, as the furface of ftanding water is always at right angles to the action of gravity, that is, to the plum-line, fo the furface of the water in the revolving bucket is perpendicular to the action of the combined force FE.

Let NEO be the pofition of the bucket, which juft holds all the water which it received as it paffed the fpout when not affected by the centrifugal force; and let NDO be its pofition when it would be empty. Let the vertical lines through D and E cut the circle defcribed round C with the radius CF in the points H and I. Draw HC, IC, cutting the circle AOB in L and M. Make the arch $d\delta$ equal to AL, and the arch $d\epsilon$ equal to AM: Then C δ and C ϵ will be the pofitions of the bucket on the revolving wheel, correfponding to CDO and CEO on the wheel at reft. Water will begin to run out at ϵ, and it will be all gone at δ.—The demonftration is evident.

The force which now urges the wheel is ftill the weight *really* in the buckets: For though the water is urged in the direction and with the force FE, one of its conftituents, CE, has no tendency to impel the wheel; and KE is the only impelling force.

It is but of late years that mills have been conftructed or attended to with that accuracy and fcientific fkill which are neceffary for deducing confidential conclufions from any experiments that can be made with them; and it is therefore no matter of wonder that the opinions of mill-wrights have been fo different on this fubject. There is a natural wifh to fee a machine moving brifkly; it has the appearance of activity: but a very flow motion always looks as if the machine were overloaded. For this reafon mill-wrights have always yielded flowly, and with fome reluctance, to the repeated advices of the mathematicians: but they have yielded; and we fee them adopting maxims of conftruction more agreeable to found theory; making their wheels of great breadth, and loading them with a great deal of work. Mr Euler fays, that the performance of the beft mill cannot exceed that of the worft above $\frac{1}{5}$th: but we have feen a ftream of water completely expended in driving a fmall flax mill, which now drives a cotton mill of 4000 fpindles, with all its carding, roving, and drawing machinery, befides the lathes and other engines of the fmith and carpenters workfhops, exerting a force not lefs than ten times what fufficed for the flax-mill.

Water-works.

The above difcuffion only demonftrates in general the advantage of flow motion; but does not point out in any degree the relation between the rate of motion and the work performed, nor even the principles on which it depends. Yet this is a fubject fit for a mathematical inveftigation; and we would profecute it in this place, if it were neceffary for the improvement of practical mechanics. But we have feen that there is not, in the nature of things, a maximum of performance attached to any particular rate of motion which fhould therefore be preferred. For this reafon we omit this difcuffion of mere fpeculative curiofity. It is very intricate: For we muft not now exprefs the preffure on the wheel by a *conftant* pillar of water incumbent on the extremity of the horizontal arm, as we did before when we fuppofed the buckets completely filled; nor by a fmaller *conftant* pillar, correfponding to a fmaller but equal quantity lying in every bucket. Each different velocity puts a different quantity of water into the bucket as it paffes the fpout; and this occafions a difference in the place where the difcharge is begun and completed. This circumftance is fome obftacle to the advantages of very flow motions, becaufe it brings on the difcharge fooner. All this may indeed be expreffed by a fimple equation of eafy management; but the whole procefs of the mechanical difcuffion is both intricate and tedious, and the refults are fo much diverfified by the forms of the buckets, that they do not afford any rule of fufficient generality to reward our trouble. The curious reader may fee a very full inveftigation of this fubject in two differtations by Elvius in the Swedifh Tranfactions, and in the *Hydrodynamique* of Profeffor Karftner of Gottingen; who has abridged thefe Differtations of Elvius, and confiderably improved the whole inveftigation, and has added fome comparifons of his deductions with the actual performance of fome great works. Thefe comparifons, however, are not very fatisfactory. There is alfo a valuable paper on this fubject by Mr Lambert, in the Memoirs of the Academy of Berlin for the year 1775. From thefe differtations, and from the *Hydrodynamique* of the Abbé Boffut, the reader will get all that theory can teach of the relation between the preffures of the power and work on the machine and the rates of its motion. The practical reader may reft with confidence on the fimple demonftration we have given, that the performance is improved by diminifhing the velocity.

All we have to do, therefore, is to load the machine, and thus to diminifh its fpeed, unlefs other phyfical circumftances throw obftacles in the way: but there are fuch ob-

ftacles. In all machines there are little inequalities of action that are unavoidable. In the action of a wheel and pinion, though made with the utmoft judgment and care, there are fuch inequalities. Thefe increafe by the changes of form occafioned by the wearing of the machine—much greater irregularities arife from the fubfultory motions of cranks, ftampers, and other parts which move unequally or reciprocally. A machine may be fo loaded as juft to be in equilibrio with its work, in the favourable pofition of its parts. When this changes into one lefs favourable, the machine may ftop; if not, it at leaft ftaggers, hobbles, or works unequally. The rubbing parts bear long on each other, with enormous preffures, and cut deep, and increafe friction. Such flow motions muft therefore be avoided. A little more velocity enables the machine to get over thofe increafed refiftances by its inertia, or the great quantity of motion inherent in it. Great machines poffefs this advantage in a fuperior degree, and will therefore work fteadily with a fmaller velocity. Thefe circumftances are hardly fufceptible of mathematical difcuffion, and our beft reliance is on well directed experience.

For this purpofe, the reader will do well to perufe with care the excellent paper by Mr Smeaton in the Philofophical Tranfactions for 1759. This differtation contains a numerous lift of experiments, moft judicioufly contrived by him, and executed with the accuracy and attention, to the moft important circumftances, which is to be obferved in all that gentleman's performances.

It is true, thefe experiments were made with fmall models; and we muft not, without great caution, transfer the refults of fuch experiments to large works. But we may fafely transfer the *laws* of variation which refult from a variation of circumftances, although we muft not adopt the abfolute quantities of the variations themfelves. Mr Smeaton was fully aware of the limitations to which conclufions drawn from experiments on models are fubject, and has made the applications with his ufual fagacity.

His general inference is, that, in fmaller works, the rim of the overfhot-wheel fhould not have a greater velocity than three feet in a fecond; but that larger mills may be allowed a greater velocity than this. When every thing is executed in the beft manner, he fays that the work performed will amount to fully two-thirds of the power expended; that is, that three cubic feet of water defcending from any height will raife two to the fame height. See fome farther account of this differtation under the word MECHANICS, fect. 5.

It is not very eafy to compare thefe deductions with obfervations on large works; becaufe there are few cafes where we have good meafures of the refiftances oppofed by the work performed by the machine. Mills employed for pumping water afford the beft opportunities. But the inertia of their working gear diminifhes their ufeful performance very fenfibly; becaufe their great beams, pump-rods, &c. have a reciprocating motion, which muft be deftroyed, and produced anew in every ftroke. We have examined fome machines of this kind which are efteemed good ones; and we find few of them whofe performance exceeds one half of the power expended.

By comparing other mills with thefe, we get the beft information of their refiftances. The comparifon with mills worked by Watt and Boulton's fteam-engines is perhaps a better meafure of the refiftances oppofed by different kinds of work, becaufe their power is very diftinctly known. We have been informed by one of the moft eminent engineers, that a ton and half of water *per* minute falling one foot will grind and drefs one bufhel of wheat *per* hour. This is equivalent to 9 tons falling 10 feet.

If an overfhot-wheel oppofed no refiftance, and only one bucket were filled, the wheel would acquire the velocity due to a fall through the whole height. But when it is in this ftate of accelerated motion, if another bucket of water is delivered into it, its motion muft be checked at the firft, by the neceffity of dragging forward this water. If the buckets fill in fucceffion as they pafs the fpout, the velocity acquired by an unrefifting wheel is but half of that which one bucket would give. In all cafes, therefore, the velocity is diminifhed by the inertia of the entering water when it is fimply laid into the upper buckets. The performance will therefore be improved by delivering the water on the wheel with that velocity with which the wheel is really moving. And as we cannot give the direction of a tangent to the wheel, the velocity with which it is delivered on the wheel muft be fo much greater than the intended velocity of the rim, that it fhall be precifely equal to it when it is eftimated in the direction of the tangent. Three or four inches of fall are fufficient for this purpofe; and it fhould never be neglected, for it has a very fenfible influence on the performance. But it is highly improper to give it more than this, with the view of impelling the wheel by its ftroke. For even although it were proper to employ part of the fall in this way (which we fhall prefently fee to be very improper), we cannot procure this impulfe; becaufe the water falls among other water, or it ftrikes the boards of the wheel with fuch obliquity that it cannot produce any fenfible effect.

It is a much debated queftion among mill-wrights, Whether the diameter of the wheel fhould be fuch as that the water will be delivered at the top of the wheel? or larger, fo that the water is received at fome diftance from the top, where it will act more perpendicularly to the arm? We apprehend that the obfervations formerly made will decide in favour of the firft practice. The fpace below, where the water is difcharged from the wheel, being proportional to the diameter of the wheel, there is an undoubted lofs of fall attending a large wheel; and this is not compenfated by delivering the water at a greater diftance from the perpendicular. We fhould therefore recommend the ufe of the whole defcending fide, and make the diameter of the wheel no greater than the fall, till it is fo much reduced that the centrifugal force begins to produce a fenfible effect. Since the rim can hardly have a fmaller velocity than three feet *per* fecond, it is evident that a fmall wheel muft revolve more rapidly. This made it proper to infert the determination that we have given, of the lofs of power produced by the centrifugal force. But even with this in view, we fhould employ much fmaller wheels than are generally done on fmall falls. Indeed the lofs of water at the bottom may be diminifhed, by nicely fitting the arch which furrounds the wheel, fo as not to allow the water to efcape by the fides or bottom. While this improvement remains in good order, and the wheel entire, it produces a very fenfible effect; but the paffage widens continually by the wearing of the wheel. A bit of ftick or ftone falling in about the wheel tears off part of the fhrouding or bucket, and frofty weather frequently binds all faft. It therefore feldom anfwers expectations. We have nothing to add on this cafe to what we have already extracted from Mr Smeaton's Differtation on the Subject of Breaft or half Overfhot Wheels.

There is another form of wheel by which water is made to act on a machine by its weight, which merits confideration. This is known in this country by the name of *Barker's mill*, and has been defcribed by Defaguilliers, vol. ii. p. 460. It confifts of an upright pipe or trunk AB (fig. 11.), communicating with two horizontal branches BC, Bc, which have a hole Cc near their ends, opening in oppofite direc-

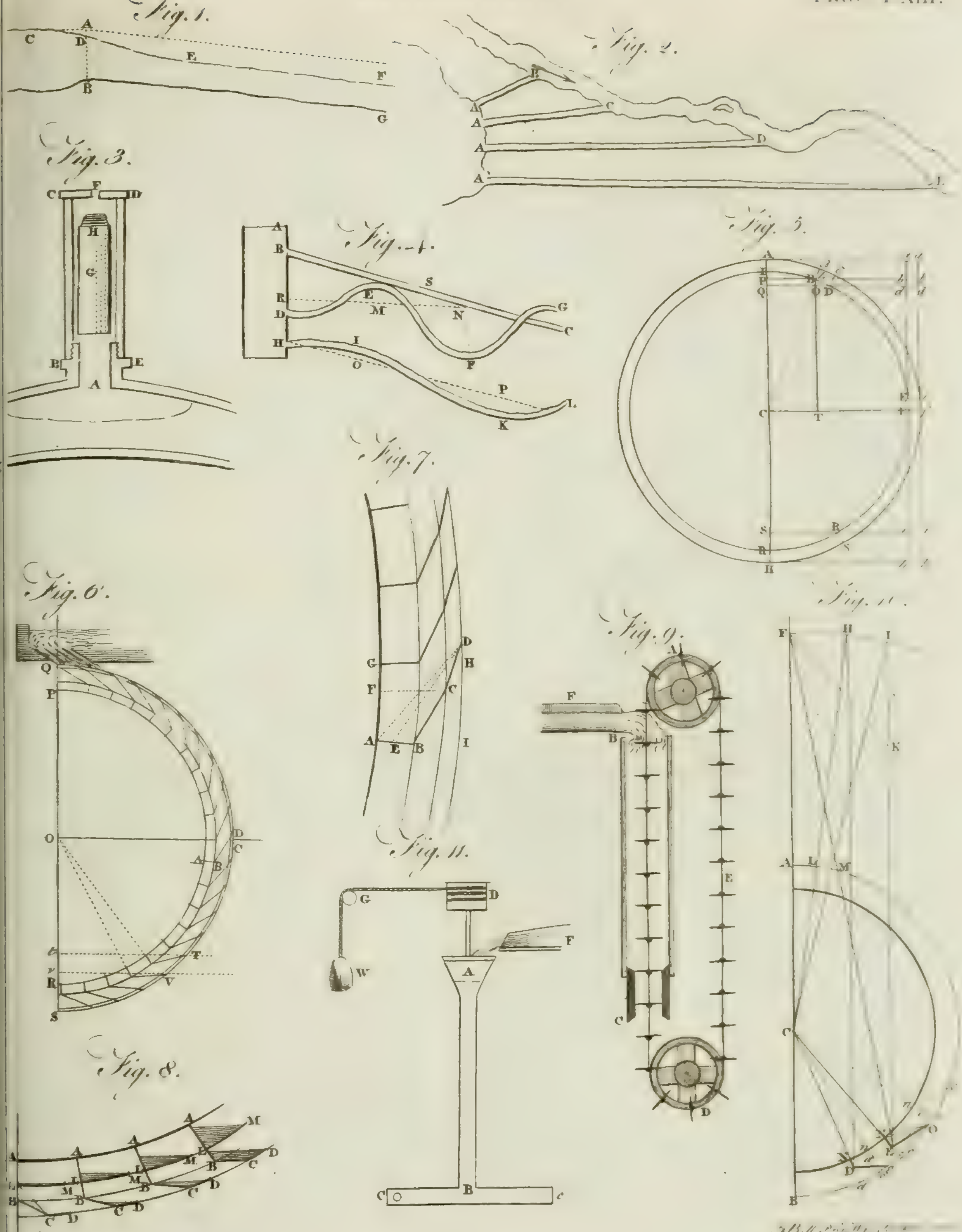


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.

directions, at right angles to their lengths. Suppose water to be poured in at the top from the spout F, it will run out by the holes C and c with the velocity corresponding to the depth of these holes under the surface. The consequence of this must be, that the arms will be pressed backwards; for there is no solid surface at the hole C, on which the lateral pressure of the water can be exerted, while it acts with its full force on the opposite side of the arm. This unbalanced pressure is equal to the weight of a column having the orifice for its base, and twice the depth under the surface of the water in the trunk for its height. This measure of the height may seem odd, because if the orifice were shut, the pressure on it is the weight of a column reaching from the surface. But when it is open, the water issues with nearly the velocity acquired by falling from the surface, and the quantity of motion produced is that of a column of twice this length, moving with this velocity. This is actually produced by the pressure of the fluid, and must therefore be accompanied by an equal reaction.

Now suppose this apparatus set on the pivot E, and to have a spindle AD above the trunk, furnished with a cylindrical bobbin D, having a rope wound round it, and passing over a pulley G. A weight W may be suspended there, which may balance this backward pressure. If the weight be too small for this purpose, the retrograde motion of the arms will wind up the cord, and raise the weight; and thus we obtain an acting machine, employing the pressure of the water, and applicable to any purpose. A runner millstone may be put on the top of the spindle; and we should then produce a flour mill of the utmost simplicity, having neither wheel nor pinion, and subject to hardly any wear. It is somewhat surprising, that although this was invented at the beginning of this century, and appears to have such advantage in point of simplicity, it has not come into use. So little has Dr Desaguilliers's account been attended to (although it is mentioned by him as an excellent machine, and as highly instructive to the hydraulist), that the same invention was again brought forward by a German professor (Segner) as his own, and has been honoured by a series of elaborate disquisitions concerning its theory and performance by Euler and by John Bernoulli. Euler's Dissertations are to be found in the Memoirs of the Academy of Berlin, 1751, &c. and in the *Nov. Comment. Petropol.* tom. vi. Bernoulli's are at the end of his Hydraulics. Both these authors agree in saying, that this machine excels all other methods of employing the force of water. Simple as it appears, its true theory, and the best form of construction, are most abstruse and delicate subjects; and it is not easy to give such an account of its principles as will be understood by an ordinary reader.

We see, in general, that the machine must press backwards; and little investigation suffices for understanding the intensity of this pressure, when the machine is at rest. But when it is allowed to run backwards, withdrawing itself from the pressure, the intensity of it is diminished; and if no other circumstances intervened, it might not be difficult to say what particular pressure corresponded to any rate of motion. Accordingly, Desaguilliers, presuming on the simplicity of the machine, affirms the pressure to be the weight of a column, which would produce a velocity of efflux equal to the difference of the velocity of the fluid and of the machine; and hence he deduces, that its performance will be the greatest possible, when its retrograde velocity is one-third of the velocity acquired by falling from the surface, in which case, it will raise $\frac{8}{27}$ths of the water expended to the same height, which is double of the performance of a mill acted on by the impulse of water.

But this is a very imperfect account of the operation. When the machine (constructed exactly as we have described) moves round, the water which issues descends in the vertical trunk, and then, moving along the horizontal arms, partakes of this circular motion. This excites a centrifugal force, which is exerted against the ends of the arms by the intervention of the fluid. The whole fluid is subjected to this pressure (increasing for every section across the arm in the proportion of its distance from the axis), and every particle is pressed with the accumulated centrifugal forces of all the sections that are nearer to the axis. Every section therefore sustains an actual pressure proportional to the square of its distance from the axis. This increases the velocity of efflux, and this increases the velocity of revolution; and this mutual co-operation would seem to terminate in an infinite velocity of both motions. But, on the other hand, this circular motion must be given anew to every particle of water as it enters the horizontal arm. This can be done only by the motion already in the arm, and at its expence. Thus there must be a velocity which cannot be overpassed even by an unloaded machine. But it is also plain, that by making the horizontal arm very capacious, the motion of the water from the axis to the jet may be made very slow, and much of this diminution of circular motion prevented. Accordingly, Euler has recommended a form by which this is done in the most eminent degree. His machine consists of a hollow conoidal ring, of which fig. 12. is a section. The part AH h a is a sort of funnel bason, which receives the water from the spout F; not in the direction pointing towards the axis, but in the direction, and with the precise velocity, of its motion. This prevents any retardation by dragging forward the water. The water then passes down between the outer conoid AC c a and the inner conoid HG g h along spiral channels formed by partitions soldered to both conoids. The curves of these channels are determined by a theory which aims at the annihilation of all unnecessary and improper motions of the water, but which is too abstruse to find a place here. The water thus conducted arrives at the bottom CG, cg. On the outer circumference of this bottom are arranged a number of spouts (one for each channel), which are all directed one way in tangents to the circumference.

Water-works.

Plate DXLII.

Adopting the common theory of the reaction of fluids, this should be a very powerful machine, and should raise $\frac{8}{27}$ths of the water expended. But if we admit the reaction to be equal to the force of the issuing fluid (and we do not see how this can be refused), the machine must be nearly twice as powerful. We therefore repeat our wonder, that it has not been brought into use. But it appears that no trial has been made even of a model; so that we have no experiments to encourage an engineer to repeat the trial. Even the late author Professor Segner has not related any thing of this kind in his *Exercitationes Hydraulicæ*, where he particularly describes the machine. This remissness probably has proceeded from fixing the attention on Euler's improved construction. It is plain that this must be a most cumbrous mass, even in a small size, requiring a prodigious vessel, and carrying an unwieldy load. If we examine the theory which recommends this construction, we find that the advantages, tho' real and sensible, bear but a small proportion to the whole performance of the simple machine as invented by Dr Barker. It is therefore to be regretted, that engineers have not attempted to realise the first project. We beg leave to recommend it, with an additional argument taken from an addition made to it by Mr Mathon de la Cour, in Rozier's *Journal de Physique*, January and August 1775. This gentleman brings down a large pipe FEH (fig. 13.) from a reservoir, bends it upward at H, and introduces it into two horizontal arms DA, DB, which have an upright spindle DK, carrying

Water-works.

ing a millſtone in the ſtyle of Dr Barker's mill. The ingenious mechanician will have no difficulty of contriving a method of joining theſe pipes, ſo as to permit a free circular motion without loſing much water. The operation of the machine in this form is evident. The water, preſſed by the column FG, flows out at the holes A and B, and the unbalanced preſſure on the oppoſite ſides of the arms forces them round. The compendiouſneſs and other advantages of this conſtruction are moſt ſtriking, allowing us to make uſe of the greateſt fall without any increaſe of the ſize of the machine. It undoubtedly enables us to employ a ſtream of water too ſcanty to be employed in any other form. The author gives the dimenſions of an engine which he had ſeen at Bourg Argental. AB is 92 inches, and its diameter 3 inches; the diameter of each orifice is $1\frac{1}{6}$; FG is 21 feet; the pipe D was fitted into C by grinding; and the internal diameter of D is 2 inches.

When the machine was performing no work, or was unloaded, and emitted water by one hole only, it made 115 turns in a minute. This gives a velocity of 46 feet *per* ſecond for the hole. This is a curious fact: For the water would iſſue from this hole at reſt with the velocity of $37\frac{1}{2}$. This great velocity (which was much leſs than the velocity with which the water actually quitted the pipe) was undoubtedly produced by the prodigious centrifugal force, which was nearly 17 times the weight of the water in the orifice.

The empty machine weighed 80 pounds, and its weight was half ſupported by the upper preſſure of the water, ſo that the friction of the pivots was much diminiſhed. It is a pity that the author has given no account of any work done by the machine. Indeed it was only working ventilators for a large hall. His theory by no means embraces all its principles, nor is it well-founded.

We think that the free motion round the neck of the feeding pipe, without any loſs of water or any conſiderable friction, may be obtained in the following manner: AB (fig. 14.) repreſents a portion of the revolving horizontal pipe, and CE*e c* part of the feeding pipe. The neck of the firſt is turned truly cylindrical, ſo as to turn eaſily, but without ſhake, in the collar C *c* of the feeding-pipe, and each has a ſhoulder which may ſupport the other. That the friction of this joint may not be great, and the pipes deſtroy each other by wearing, the horizontal pipe has an iron ſpindle EF, fixed exactly in the axis of the joint, and reſting with its pivot F in a ſtep of hard ſteel, fixed to the iron bar GH, which goes acroſs the feeding-pipe, and is firmly ſupported in it. This pipe is made bell-ſhaped, widening below. A collar or hoſe of thin leather is fitted to the inſide of this pipe, and is repreſented (in ſection) by LKM *m k l*. This is kept in its place by means of a metal or wooden ring N *n*, thin at the upper edge, and taper ſhaped. This is drawn in above the leather, and ſtretches it, and cauſes it to apply to the ſide of the pipe all around. There can be no leakage at this joint, becauſe the water will preſs the leather to the ſmooth metal pipe; nor can there be any ſenſible friction, becauſe the water gets at the edge of the leather, and the whole unbalanced preſſure is at the ſmall crevice, between the two metal ſhoulders. Theſe ſhoulders need not touch, ſo that the friction muſt be inſenſible. We imagine that this method of tightening a turning joint may be uſed with great advantage in many caſes.

We have only further to obſerve on this engine, that any imperfection by which the paſſage of the water is diminiſhed or obſtructed produces a ſaving of water which is in exact proportion to the diminution of effect. The only inaccuracy that is not thus compenſated is when the jets are not at right angles to the arms.

We repeat our wiſhes, that engineers would endeavour to bring this machine into uſe, ſeeing many ſituations where it may be employed to great advantage. Suppoſe, for inſtance, a ſmall ſupply of water from a great height applied in this manner to a centrifugal pump, or to a hair belt paſſing over a pulley, and dipping in the water of a deep well. This would be a hydraulic machine exceeding all others in ſimplicity and durability, though inferior in effect to ſome other conſtructions.

2. *Of Underſhot Wheels.*

All wheels go by this name where the motion of the water is quicker than that of the partitions or boards of the wheel, and it therefore impels them. Theſe are called the *float-boards*, or *floats*, of an underſhot wheel. The water, running in a mill-row, with a velocity derived from a head of water, or from a declivity of channel, ſtrikes on theſe floats, and occaſions, by its deflections ſidewiſe and upwards, a preſſure on the floats ſufficient for impelling the wheel.

There are few points of practical mechanics that have been more conſidered than the action of water on the floats of a wheel; hardly a book of mechanics being ſilent on the ſubject. But the generality of them, at leaſt ſuch as are intelligible to perſons who are not very much converſant in dynamical and mathematical diſcuſſion, have hardly done any thing more than copied the earlieſt deductions from the ſimple theory of the reſiſtance of fluids. The conſequence has been, that our practical knowledge is very imperfect; and it is ſtill chiefly from experience that we muſt learn the performance of underſhot wheels. Unfortunately this ſtops their improvement; becauſe thoſe who have the only opportunities of making the experiments are not ſufficiently acquainted with the principles of hydraulics, and are apt to aſcribe differences in their performance to trifling noſtrums in their conſtruction, or in the manner of applying the impulſe of the water.

We have ſaid ſo much on the imperfection of our theories of the impulſe of fluids in the article *Resistance of Fluids*, that we need not repeat here the defects of the common explanations of the motions of underſhot wheels. The part of this theory of the impulſe of fluids which agrees beſt with obſervation is, *that the impulſe is in the duplicate proportion of the velocity with which the water ſtrikes the float.* That is, if v be the velocity of the ſtream, and u the velocity of the float, we ſhall have F, the impulſe on the float when held faſt to its impulſe f on the float moving with the velocity u, as v^2 to $\overline{v-u}^2$, and $f = F \times \frac{\overline{v-u}^2}{v^2}$.

This is the preſſure acting on the float, and urging the wheel round its axis. The wheel muſt yield to this motion, if the reſiſtance of the work does not exert a ſuperior preſſure on the float in the oppoſite direction. By yielding, the float withdraws from the impulſe, and this is therefore diminiſhed. The wheel accelerates, the reſiſtances increaſe, and the impulſes diminiſh, till they become an exact balance for the reſiſtances. The motion now remains uniform, and the momentum of impulſe is equal to that of reſiſtance. The performance of the mill therefore is determined by this; and, whatever be the conſtruction of the mill, its performance is beſt when the momentum of impulſe is greateſt. This is had by multiplying the preſſure on the float by its velocity. Therefore the momentum will be expreſſed by $F \times \frac{\overline{v-u}^2}{v^2} \times u$. But ſince F and v^2 are conſtant quanti-

ties,

ties, the momentum will be proportional to $u \times \overline{v-u}^2$. Let x represent the relative velocity. Then $v-x$ will be $=u$, and the momentum will be proportional to $\overline{v-x} \times x^2$, and will be a maximum when $\overline{v-x} \times x^2$ is a maximum, or when $v x^2 - x^3$ is a maximum. This will be discovered by making its fluxion $=o$. That is,

$$2 v x \dot{x} - 3 x^2 \dot{x} = o.$$

and $\quad 2 v x - 3 x^2 = o$

or $\quad 2 v - 3 x = o$

and $\quad 2 v = 3 x$, and $x = \frac{2}{3} v$; and therefore $v - x$, or $u, = \frac{1}{3} v$. That is, the velocity of the float must be one third of the velocity of the stream. It only remains to say what is the absolute pressure on the float thus circumstanced. Let the velocity v be supposed to arise from the pressure of a head of water h. The common theory teaches that the impulse on a given surface S at rest is equal to the weight of a column h S; put this in place of F, and $\frac{4}{9} v^2$ in place of $\overline{v-u}^2$ and $\frac{1}{3} v$ for u. This gives us $S h \times \frac{4}{27} v$ for the momentum. Now the power expended is $S h v$, or the column $S h$ moving with the velocity v. Therefore the greatest performance of an undershot wheel is equivalent to raising $\frac{4}{27}$ of the water that drives it to the same height.

But this is too small an estimation; for the pressure exerted on a plane surface, situated as the float of a mill-wheel, is considerably greater than the weight of the column S h. This is nearly the pressure on a surface wholly immersed in the fluid. But when a small vein strikes a larger plane, so as to be deflected on all sides in a thin sheet, the impulse is almost double of this. This is in some measure the case in a mill wheel. When the stream strikes it, it is heaped up along its face, and falls back again—and during this motion it is acting with a hydrostatic pressure on it. When the wheel dips into an open river, this accumulation is less remarkable, because much escapes laterally. But in a mill course it may be considerable.

We have considered only the action on one float, but several generally act at once. The impulse on most of them must be oblique, and is therefore less than when the same stream impinges perpendicularly; and this diminution of impulse is, by the common theory, in the proportion of the sine of the obliquity. For this reason it is maintained, that the impulse of the whole stream on the lowest float board, which is perpendicular to the stream, is equal to the sum of the impulses made on all the floats which then dip into the water; or that the impulse on any oblique float is precisely equal to the impulse which that part of the stream would have made on the lowest floatboard had it not been interrupted. Therefore it has been recommended to make such a number of floatboards, that when one of them is at the bottom of the wheel, and perpendicular to the stream, the next in succession should be just entering into the water. But since the impulse on a float by no means annihilates all the motion of the water, and it bends round it and hits the one behind with its remaining force, there must be some advantage gained by employing a greater number of floats than this rule will permit. This is abundantly confirmed by the experiments of Smeaton and Bossut. Mr Bossut formed three or four suppositions of the number of floats, and calculated the impulse on each; according to the observations made in a course of experiments made by the Academy of Sciences, and inserted by us in the article *Resistance of Fluids*; and when he summed them up and compared the results with his experiments, he found the agreement very satisfactory. He deduces a general rule, that if the velocity of the wheel is $\frac{1}{3}$d of that of the stream, and if 72 degrees of the circumference are immersed in the stream, the wheel should have 36 floats. Each will dip $\frac{1}{4}$th of the radius. The velocity being still supposed the same, there should be more or fewer floats according as the arch is less or greater than 72 degrees. Water-works.

Such is the theory, and such are the circumstances which it leaves undetermined. The accumulation of the water on a floatboard, and the force with which it may still strike another, are too intricate to be assigned with any tolerable precision: For such reasons we must acknowledge that the theory of undershot wheels is still very imperfect, and that recourse must be had to experience for their improvement. We therefore strongly recommend the perusal of Mr Smeaton's experiments on undershot-wheels, contained in the same dissertation with those we have quoted on overshot-wheels. We have only to observe, that to an ordinary reader the experiments will appear too much in favour of undershot-wheels. His aim is partly to establish a theory, which will state the relation between their performance and the velocity of the stream, and partly to state the relation between the power expended and the work done. The velocity in his experiments is always considerably below that which a body would acquire by falling from the surface of the head of water; or it is the velocity acquired by a shorter fall. Therefore if we estimate the power expended by the quantity of water multiplied by this diminished fall, we shall make it too small; and the difference in some cases is very great: yet, even with these concessions, it appears that the utmost performance of an undershot wheel does not surpass the raising $\frac{1}{3}$d of the expended water to the place from which it came. It is therefore far inferior to an overshot wheel expending the same power; and Mr Belidor has led engineers into very mistaken maxims of construction, by saying that overshot wheels should be given up, even in the case of great falls, and that we should always bring on the water from a sluice in the very bottom of the dam, and bring it to the wheel with as great velocity as possible. Mr Smeaton also says, that the maximum takes place when the velocity of the wheel is $\frac{2}{5}$ths of that of the stream, instead of $\frac{2}{6}$ths according to the theory; and this agrees with the experiments of Bossut. But he measured the velocity by means of the quantity of water which run past. This must give a velocity somewhat too small; as will appear by attending to Buat's observations on the superficial, the mean, and the bottom velocities.

The rest of his observations, of which we have given an abstract in MECHANICS, Sect V. are most judicious and well adapted to the instruction of practitioners. We have only to add to them the observations of Deparceux and Bossut, who have evinced, by very good experiments, that there is a very sensible advantage gained by inclining the floatboards to the radius of the wheel about 20 degrees, so that the lowest floatboard shall not be perpendicular, but have its point turned up the stream about 20 degrees. This inclination causes the water to heap up along the floatboard, and act by its weight. The floats should therefore be made much broader than the vein of water interrupted by them is deep.

Some engineers, observing the great superiority of overshot wheels above undershot wheels driven by the same expence of power, have proposed to bring the water home to the bottom of the wheel on an even bottom, and to make the floatboard no deeper than the aperture of the sluice, which would permit the water to run out. The wheel is to be fitted with a close sole and sides, exactly fitted to the end of this trough, so that if the wheel is at rest, the water may be dammed up by the sole and floatboard. It will therefore press foreward the floatboard with the whole force of the head of water. But this cannot answer: for if we suppose no floatboards, the water will flow out at the bottom, propelled in the manner those persons suppose; and it will be supplied from the head.

Water-works.

kind, the water coming *slowly* from all parts of the trough to the hole below the wheel. But now add the floats, and suppose the wheel in motion with the velocity that is expected. The other floats must drag into motion all the water which lies between them, giving to the greatest part of it a motion vastly greater than it would have taken in consequence of the pressure of the water behind it; and the water out of the reach of the floats will remain still, which it would not have done independent of the floatboards above it, because it would have contributed to the expence of the hole. The motion therefore which the wheel will acquire by this construction must be so different from what is expected, that we can hardly say what it will be.

We are therefore persuaded, that the best way of delivering the water on an undershot-wheel in a close mill course is, to let it slide down a very smooth channel, without touching the wheel till near the bottom, where the wheel should be exactly fitted to the course; or, to make the floats exceedingly broader than the depth of the vein of water which glides down the course, and allow it to be partly intercepted by the first floats, and heap up along them, acting by its weight, after its impulse has been expended. If the bottom of the course be an arch of a circle described with a radius much greater than that of the wheel, the water which slides down will be thus gradually intercepted by the floats.

Attempts have been made to construct water-wheels which receive the impulse obliquely, like the sails of a common wind-mill. This would, in many situations, be a very great acquisition. A very slow but deep river could in this manner be made to drive our mills; and although much power is lost by the obliquity of the impulse, the remainder may be very great. It is to be regretted, that these attempts have not been more zealously prosecuted; for we have no doubt of their success in a very serviceable degree. Engineers have been deterred, because when such wheels are plunged in an open stream, their lateral motion is too much impeded by the motion of the stream. We have seen one, however, which was very powerful: It was a long cylindrical frame, having a plate standing out from it about a foot broad, and surrounding it with a very oblique spiral like a cork-screw. This was plunged about ¼th of its diameter (which was about 12 feet), having its axis in the direction of the stream. By the work which it was performing, it seemed more powerful than a common wheel which occupied the same *breadth* of the river. Its length was not less than 20 feet: it might have been twice as much, which would have doubled its power, without occupying more of the water-way. Perhaps such a spiral, continued to the very axis, and moving in a hollow canal wholly filled by the stream, might be a very advantageous way of employing a deep and slow stream.

But mills with oblique floats are most useful for employing small streams, which can be delivered from a spout with a great velocity. Mr Bossut has considered these with due attention, and ascertained the best modes of construction. There are two which have nearly equal performances: 1. The vanes being placed like those of a wind-mill, round the rim of a horizontal or vertical wheel, and being made much broader than the vein of water which is to strike them, let the spout be so directed that the vein may strike them perpendicularly. By this measure it will be spread about on the vane in a thin sheet, and exert a pressure nearly equal to twice the weight of a column whose base is the orifice of the spout, and whose height is the fall producing the velocity.

Mills of this kind are much in use in the south of Europe. The wheel is horizontal, and the vertical axis carries the millstone; so that the mill is of the utmost simplicity: and this is its chief recommendation; for its power is greatly inferior to that of a wheel constructed in the usual manner.

2. The vanes may be arranged round the rim of the wheel, not like the sails of a wind-mill, but in planes inclined to the radii, but parallel to the axis, or to the planes passing through the axis. They may either stand on a sole, like the oblique floats recommended by De Parceux, as above mentioned; or they may stand on the side of the rim, not pointing to the axis, but aside from it.

This disposition will admit the spout to be more conveniently disposed either for a horizontal or a vertical wheel.

We shall conclude this article by describing a contrivance of Mr Burns, the inventor of the double bucketed wheel, for fixing the arms of a water-wheel. It is well known to mill-wrights that the method of fixing them by making them to pass through the axle, weakens it exceedingly, and by lodging water in the joint, soon causes it to rot and fail. They have, therefore, of late years put cast-iron flanches on the axis, to which each arm is bolted: or the flanches are so fashioned as to form boxes, serving as mortises to receive the ends of the arms. These answer the purpose completely, but are very expensive; and it is found that arms of fir, bolted into flanches of iron, are apt to work loose. Mr Burns has made wooden flanches of a very curious construction, which are equally firm, and cost much less than the iron ones.

This flanch consists of eight pieces, four of which compose the ring represented in fig. 15. meeting in the joints ab, ab, ab, ab, directed to the centre O. The other four are covered by these, and their joints are represented by the doted lines $\alpha\beta$, $\alpha\beta$, $\alpha\beta$, $\alpha\beta$. These two rings break joint in such a manner that an arm MN is contained between the two nearest joints $a'b'$ of the one, and $\alpha'\beta'$ of the other. The tenon formed on the end of the arm A, &c. is of a particular shape: one side; GF, is directed to the centre O; the other side, BCDE, has a small shoulder BC; then a long side CD directed to the centre O; and then a third part DE parallel to GF, or rather diverging a little from it, so as to make up at E the thickness of the shoulder BC; that is, a line from B to E would be parallel to CD. This side of the tenon fits exactly to the corresponding side of the mortise; but the mortise is wider on the other side, leaving a space GFKh a little narrower at FK than at Gh. These tenons and mortises are made extremely true to the square; the pieces are put round the axle, with a few blocks or wedges of soft wood put between them and the axle, leaving the space empty opposite to the place of each arm, and firmly bolted together by bolts between the arm-mortises. The arms are then put in, and each is pressed home to the side CDE, and a wedge HF of hard wood is then put into the empty part of the mortise and driven home. When it comes through the flanch and touches the axle, the part which has come through is cut off with a thin chisel, and the wedge is driven better home. The spaces under the ends of the arms are now filled with wedges, which are driven home from opposite sides, till the circle of the arms stands quite perpendicular on the axle, and all is fast. It needs no hoops to keep it together, for the wedging it up round the axle makes the two half rings draw close on the arms, and it cannot start at its own joints till it crushes the arms. Hoops, however, can do no harm, when all is once wedged up, but it would be improper to put them on before this be done. For the account of another very curious hydraulic machine, see ZURICH.

WORLD, the assemblage of parts which compose the globe of the earth. See GEOGRAPHY and ASTRONOMY.

WORM, in gunnery, a screw of iron, to be fixed on the end of a rammer, to pull out the wad of a firelock, carabine, or pistol, being the same with the wad-hook, only the one

Fig. 12.

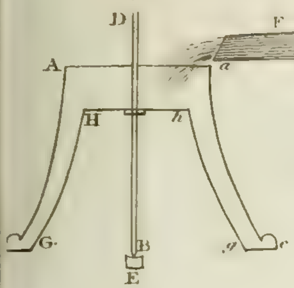


Fig. 13.

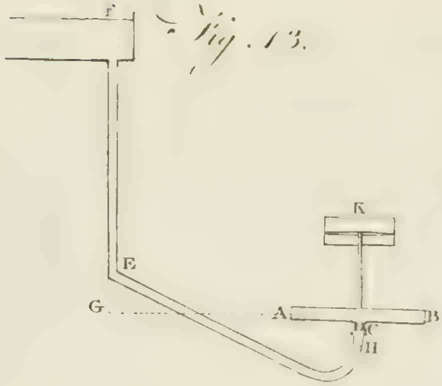


Fig. 14.

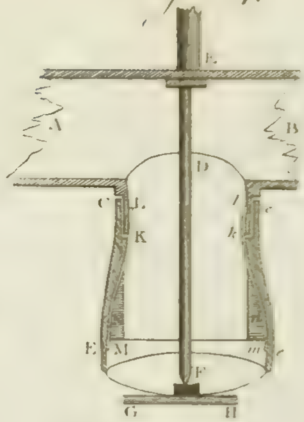


Fig. 15.

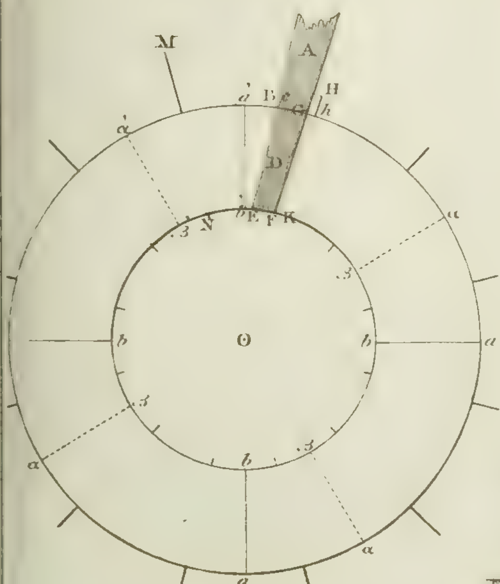


Fig. 16.

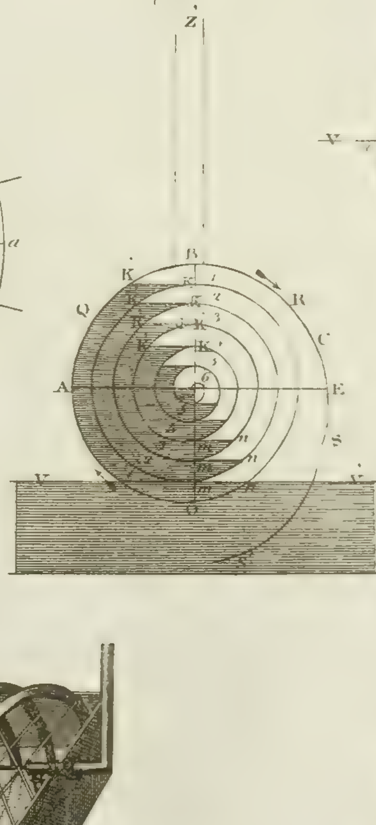


Fig. 18.

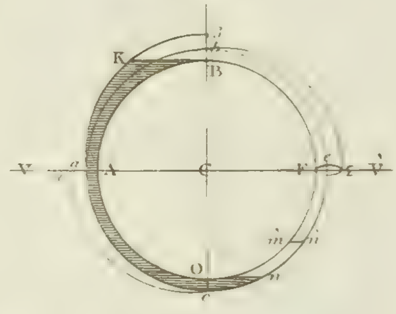


Fig. 20.

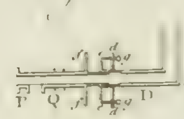


Fig. 17.

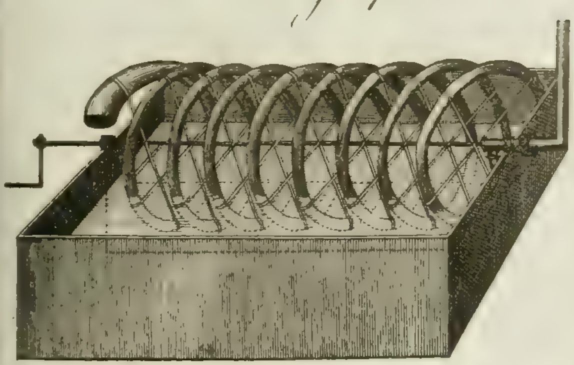
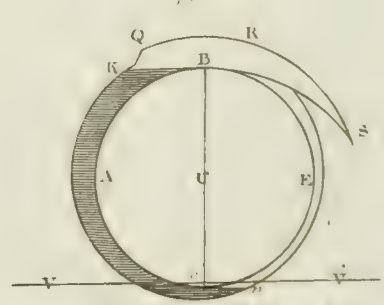


Fig. 19.



one is more proper for small arms, and the other for cannon.

Worm, in chemistry, is a long, winding pipe, placed in a tub of water, to cool and condense the vapours in the distillation of spirits.

Blind-Worm, or *Slow-Worm*. See Anguis, n° 2.

Earth-Worm. See Lumbricus.

Glow Worm. See Lampyris

Silk Worm. See Silk, n° 5.

WORMS, Vermes, in natural history. See Zoology.

Worms, in the human body. See Medicine, n° 4-7.

Worms, in horses. See Farriery, sect. 19.

Worms, in dogs. See Dog, art. 4.

Worms for bait. See Fishing, vol. 7. p. 271.

Worms, an ancient, large, and famous city of Germany, in the palatinate of the Rhine, with a bishop's see, whose bishop is a sovereign and prince of the empire. It is a free and imperial city, and the inhabitants are Protestants. In the war of 1689 it was taken by the French, who almost reduced it to ashes.—The bishop afterwards built a new palace in it; and it is famous for a diet held here in 1521, at which Luther assisted in person. The Protestants have lately built a handsome church, where Luther is represented as appearing at the diet. It is noted for the excellent wine that grows in the neighbourhood, which they call *our Lady's milk*. In the campaign of 1743, king Geo. II. took up his quarters in this city, and lodged at the bishop's palace after the battle of Dettingen. It is seated on the western bank of the Rhine, 14 miles north-west of Heidelburg, 20 south east of Mentz, and 32 south-west of Frankfort. E. Long. 8. 29. N. Lat. 49. 32.

WORMING of dogs. All spaniels have certain strings under their tongues, by most called *a worm*; this must be taken out when they are about two months old, with the help of a sharp knife to slit it, and a shoemaker's awl to raise it up; you must be careful to take all out, or else your pains is to little purpose; for till then he will be hardly ever fat and right, in regard the worm or string will grow foul and troublesome, and hinder his rest and eating. This operation is generally recommended as a preventative of madness in dogs, or at least as disabling them, if mad, from biting in that condition.

WORMIUS (Olaus), a learned Danish physician, born in 1588 at Arhusen in Jutland. After beginning his studies at home, he studied at several foreign universities, and travelled to various parts of Europe for improvement. He returned to his native country in 1613, and was made professor of the belles lettres in the university of Copenhagen. In 1615, he was translated to the chair of the Greek professor; and in 1624 to the professorship of physic, which he held to his death. These occupations did not hinder him from practising in his profession, and from being the fashionable physician: the king and court of Denmark always employed him; and Christian IV. as a recompense for his services, conferred on him a canonry of Lunden. He published some pieces on subjects relating to his profession, several works in defence of Aristotle's philosophy, and several concerning the antiquities of Denmark and Norway; for which latter he is principally regarded, as they are very learned, and contain many curious particulars. He died in 1654.

WORMWOOD, in botany. See Artemisia.

WORSHIP of God (*cultus Dei*), amounts to the same with what we otherwise call *religion*. This worship consists in paying a due respect, veneration, and homage to the Deity, under a certain expectation of reward. And this internal respect, &c. is to be shown and testified by external acts; as prayers, sacrifices, thanksgivings, &c.

The Quietists, and some other mystic divines, [illegible] not only all use of external worship, [illegible] tion of rewards and punishments. Yet even the heathens had a notion that God did not require [illegible] merit: "Dii quamvis [illegible] Cicero, [illegible] intelligo, nullo nec accepto [illegible]"

The school divines divide worship into divers kinds, *viz.* *Latria*, that rendered to God; and *idololatria*, that rendered to idols or images. To which the Romanists add, *dulia*, that rendered to saints; and *hyperdulia*, that to the Virgin. Some theological writers have observed, that the Greek word, [illegible], *to worship*, is not descriptive only of the honour which is appropriated to God, but is indifferently used to signify the honour and respect which are paid to superiors of all kinds in heaven or on earth. Accordingly, they have distinguished between civil and religious worship.

That it is the duty of man to worship his Maker, has been sufficiently proved under other articles (see Prayer; and Theology, n° 42—45.). It is not indeed easy to be conceived how any one who has tolerably just notions of the attributes and providence of God, can possibly neglect the duty of *private* worship; and though we have admitted in the last of the two articles referred to, that *public* worship does not seem to be enjoined in that system which is called the religion of *nature*, yet it is most expressly commanded by the religion of Christ, and will be regularly performed by every one who reflects on its great utility.

As the illiterate vulgar cannot form to themselves correct notions of the divine providence and attributes, it is obvious, that without the institution of public worship, they would never think of worshipping God at all, unless perhaps occasionally, when under the pressure of some severe calamity; but occasional worship, the offspring of compulsion, could have little of the resigned spirit of true devotion. Ignorant, however, as the lowest of the vulgar are, and necessarily must be, it cannot be denied, that in most Christian countries, perhaps in all, they are more accurately accquainted with the first principles of religion, and the laws of morality, than even the leaders of barbarous nations. This superiority is doubtless owing in some measure to their access to the Sacred Scriptures, but much more, we are persuaded, to the instruction which they receive in the assemblies which they frequent for public worship. If this be admitted, public worship may be easily proved to be the duty of every individual of the community: For were those, who may be supposed to stand in no need either of the contagion of society to kindle their own devotion, or of the preaching of a clergyman to instruct them in the doctrines and precepts of the gospel, to "forsake, on these accounts, the assembling of themselves together, as the manner of some is," the assemblies for public worship would very quickly fall into universal disuse. Man is an animal prone to imitation; and every order in society is ambitious of treading in the steps of the order immediately above it. Were the wise and the good, therefore, permitted to absent themselves from the assemblies instituted for the public worship of the Creator and Redeemer of the world, others would quickly follow their example; impelled to it not only by their natural propensity, but by the additional motive of wishing to appear both to the world and to themselves as wise and as good as their privileged neighbours. The consequence is obvious: one man would stay from church with the serious intention perhaps of employing the Lord's-day in private devotion and religious study; another following his example, would absent himself upon the same pretence, but would in reality waste

waſte the day in dozing indolence or in ſecret ſenſuality. For theſe and other reaſons which might be eaſily aſſigned, no ſincere Chriſtian will think himſelf at liberty to diſpute a practice enjoined by the inſpired preachers of his religion, coeval with the inſtitution, and retained by every ſect into which it has ſince been unhappily divided.

As Chriſtian worſhip conſiſts of prayers and praiſes, it has been a matter of ſome debate whether it is moſt properly performed by preconcerted forms or liturgies, or by extemporaneous addreſſes to the Almighty. Both theſe modes have their advantages and diſadvantages; and by the ſacred writers neither of them is preſcribed in oppoſition to the other.

The advantages of a liturgy are, that it prevents abſurd, extravagant, or impious addreſſes to God, which the folly of enthuſiaſm of individuals muſt always be in danger of producing: it gives the congregation an opportunity of *joining* in the prayers which are put up for them, which they cannot poſſibly do in a ſeries of extemporaneous petitions, ſince before they can aſſent to any one of theſe and make it their own, their attention is neceſſarily called away to that which ſucceeds it; and it relieves the clergyman from the labour of compoſition, which ſeems incompatible with that fervour which conſtitutes the ſpirit of devotion.

The diſadvantages of a fixed liturgy, which are the recommendations of extemporary prayer, are principally two. The forms compoſed in one age muſt, by the unavoidable change of language, circumſtances, and opinions, become in ſome degree unfit for another; and the perpetual repetition of the ſame form of words is very apt to produce inattentive laſſitude in the congregation. Would the clergy of the church of England take that liberty which is allowed them in the bidding prayer before ſermon, perhaps the ſervice of that church would unite in itſelf all the advantages both of liturgic and extemporary worſhip. We have only to add on this ſubject, that public prayers, whether precompoſed or not, ought to be compendious; that they ought to expreſs juſt conceptions of the Divine attributes; recite ſuch wants as the congregation are likely to feel and no other; that they ought to contain as few controverted propoſitions as poſſible; and that, if it can be done without offence, the pompous ſtyle of *the ſtate* ſhould be laid aſide in our prayers for the king and all that are in authority; becauſe in every act which carries the mind to God, human greatneſs muſt be annihilated.

WORT, the infuſion of malt, of which beer is made. The uſes of this infuſion in common affairs are well known. By Dr M'Bride it has lately been found to have a ſtrong antiſeptic virtue, and to be uſeful in preventing the ſcurvy and other diſeaſes to which ſailors are liable; which was confirmed by captain Cook in his late voyages. See *Means of Preſerving the Health of* SEAMEN.

WOTTON (Sir Henry), an eminent writer, was the ſon of Thomas Wotton, Eſq; and was born in 1568. He ſtudied for ſome time at New-college, Oxford, whence he removed to Queen's-college, where he made a great progreſs in logic and philoſophy; wrote a tragedy for the uſe of that college, called *Tancredo;* and afterwards received the degree of maſter of arts. After this, leaving the univerſity, he travelled into France, Germany, and Italy; and having ſpent about nine years abroad, he returned to England, and became ſecretary to Robert earl of Eſſex, with whom he continued till that earl was apprehended for high-treaſon. He then retired to Florence, where he became known to the grand duke of Tuſcany, who ſent him privately with letters to James VI. king of Scotland, under the name of *Octavio Baldi*, to inform that king of a deſign againſt his life. Some months after he went back to Florence; but King James coming to the poſſeſſion of the crown of England, Mr Wotton returned home, was knighted by his majeſty, and ſent ambaſſador to the republic of Venice; and afterwards was employed in many other embaſſies to that and other courts; but the only reward he obtained for theſe ſervices was his having the provoſtſhip of Eton conferred upon him about the year 1623, which he kept till his death, which happened in 1639. After his deceaſe ſome of his manuſcripts and printed tracts were publiſhed together in a volume, intitled, *Reliquiæ Wottonianæ.*

WOTTON (Dr William), a very learned divine and writer, was the ſon of Mr Henry Wotton, B. D. rector of Wrentham, in Suffolk, where he was born in 1666. He was educated by his father, a gentleman well ſkilled in the learned languages: under whom he made ſuch amazing proficiency, that at five years of age it is ſaid he could render ſeveral chapters in the goſpels out of Latin and Greek, and many pſalms in Hebrew, into his mother tongue. When he was very young, he remembered the whole of almoſt every diſcourſe he had heard, and often ſurpriſed a preacher by repeating his ſermon to him. He was admitted into Catharine hall in Cambridge ſome months before he was ten years old: when the progreſs he made in learning in that univerſity engaged Dr Duport, then maſter of Magdalen college, and dean of Peterborough, to write an elegant copy of Latin verſes in his praiſe. In 1679 he took the degree of bachelor of arts when he was but twelve years and five months old; and the winter following he was invited to London by Dr Gilbert Burnet, then preacher at the Rolls, who introduced him to moſt of the learned men in that city, and particularly to Dr William Lloyd, biſhop of St Aſaph; to whom he recommended himſelf by repeating to him one of his ſermons, as Dr Burnet had engaged he ſhould. In 1691 he commenced bachelor of divinity. The ſame year biſhop Lloyd gave him the ſinecure of Llandrillo, in Denbighſhire. He was afterwards made chaplain to the earl of Nottingham, then ſecretary of ſtate, who preſented him to the rectory of Middleton Keynes, in Bucks, and to whom he dedicated his Reflections upon Ancient and Modern Learning. In 1705, biſhop Burnet gave him a prebend in the church of Saliſbury: and in 1707, archbiſhop Teniſon preſented him with the degree of doctor of divinity: but in 1714, the difficulties he laboured under with reſpect to his private fortune, obliged him to retire into South Wales, where he was treated with great kindneſs and humanity by the gentlemen of that country; and wrote there the "Memoirs of the Cathedral Churches of St David's and Landaff," and his "Miſcellaneous Diſcourſes relating to the Traditions and Uſages of the Scribes and Pharaſees;" which were afterwards printed. He died in 1726. This great man was remarkable for his humanity and friendlineſs of temper; the narrowneſs of a party ſpirit never broke in upon any of his friendſhips; and his time and abilities were at the ſervice of any perſon who was making advances in real learning. He wrote, beſides the above works, 1. A Hiſtory of Rome. 2. A Defence of his Reflections upon Ancient and Modern Learning. 3. A Diſcourſe concerning the Languages of Babel. 4. Advice to a young Student, with a Method of Study for the firſt four Years; and other learned pieces.

WOUNDS. See SURGERY, chap. ii.

WOUNDS, in farriery. See there, § xxvii.

WRASSE, or old wife, in ichthyology. See LABRUS.

WREATH, in heraldry, a roll of fine linen or ſilk (like that of a Turkiſh turban), conſiſting of the colours born in the eſcutcheon, placed in an atchievement between the

the helmet and the creft, and immediately fupporting the creft.

Wreck.

WRECK, or SHIPWRECK, the deftruction of a fhip by rocks or fhallows at fea.

By the ancient common law, where any fhip was loft at fea, and the goods or cargo were thrown upon the land, thefe goods, fo wrecked, were judged to belong to the king: for it was held, that, by the lofs of the fhip, all property was gone out of the original owner. But this was undoubtedly adding forrow to forrow, and was confonant neither to reafon nor humanity. Wherefore it was firft ordained by king Henry I. that if any perfon efcaped alive out of the fhip, it fhould be no wreck; and afterwards king Henry II. by his charter, declared, that if on the coafts of either England, Poictou, Oleron, or Gafcony, any fhip fhould be diftreffed, and either man or beaft fhould efcape or be found therein alive, the goods fhould remain to the owners, if they claimed them within three months; but otherwife fhould be efteemed a wreck, and fhould belong to the king, or other lord of the franchife. This was again confirmed with improvements by king Richard I.; who, in the fecond year of his reign, not only eftablifhed thefe conceffions, by ordaining that the owner, if he was fhipwrecked and efcaped, *omnes res fuas liberas, et quietas haberet*, but alfo, that if he perifhed, his children, or in default of them, his brethern and fifters, fhould retain the property; and in default of brother or fifter, then the goods fhould remain to the king (A). And the law, as laid down by Bracton in the reign of Henry III. feems ftill to have improved in its equity. For then, if not only a dog (for inftance) efcaped, by which the owner might be difcovered, but if any certain mark were fet on the goods, by which they might be known again, it was held to be no wreck. And this is certainly moft agreeable to reafon; the rational claim of the king being only founded upon this, that the true owner cannot be afcertained. Afterwards, in the firft ftatute of Weftminfter, the time of limitation of claims, given by the charter of Henry II. is extended to a year and a day, according to the ufage of Normandy: and it enacts, that if any man, a dog, or a cat, efcape alive, the veffel fhall not be adjudged a wreck. Thefe animals, as in Bracton, are only put for examples; for it is now held, that not only if any live thing efcape, but if proof can be made of the property of any of the goods or lading which come to fhore, they fhall not be forfeited as wreck. The ftatute further ordains, that the fheriff of the county fhall be bound to keep the goods a year and a day (as in France for one year, agreeable to the maritime laws of Oleron, and in Holland for a year and a half), that if any man can prove a property in them, either in his own right or by right of reprefentation, they fhall be reftored to him without delay; but if no fuch property be proved within that time, they then fhall be the king's. If the goods are of a perifhable nature, the fheriff may fell them, and the money fhall be liable in their ftead. This revenue of wrecks is frequently granted out to lords of manors as a royal franchife; and if any one be thus intitled to wrecks in his own land, and the king's goods are wrecked thereon, the king may claim them at any time, even after the year and day.

It is to be obferved, that, in order to conftitute a legal wreck, the goods muft come to land. If they continue at fea, the law diftinguifhes them by the barbarous and uncouth appellations of *jetfam*, *flotfam*, and *ligan*. Jetfam is where goods are caft into the fea, and there fink and remain under water: flotfam is where they continue fwimming on the furface of the waves: ligan is where they are funk in the fea, but tied to a cork or buoy, in order to be found again. Thefe are alfo the king's, if no owner appears to claim them; but if any owner appears, he is intitled to recover the poffeffion. For even if they be caft overboard, without any mark or buoy, in order to lighten the fhip, the owner is not by this act of neceffity conftrued to have renounced his property: much lefs can things ligan be fuppofed to be abandoned, fince the owner has done all in his power to affert and retain his property. Thefe three are therefore accounted fo far a diftinct thing from the former, that by the king's grant to a man of wrecks, things jetfam, flotfam, and ligan, will not pafs.

Wrecks, in their legal acceptation, are at prefent not very frequent: for if any goods come to land, it rarely happens, fince the improvement of commerce, navigation, and correfpondence, that the owner is not able to affert his property within the year and day limited by law. And in order to preferve this property entire for him, and if poffible to prevent wrecks at all, our laws have made many very humane regulations; in a fpirit quite oppofite to thofe favage laws which formerly prevailed in all the northern regions of Europe, and a few years ago were ftill faid to fubfift on the coafts of the Baltic Sea, permitting the inhabitants to feize on whatever they could get as lawful prize; or, as an author of their own expreffes it, "*in naufragorum miferia et calamitate tanquam vultures ad prædam currere.*" For by the ftatute 27 Edw. III. c. 13. if any fhip be loft on the fhore, and the goods come to land (which cannot, fays the ftatute, be called *wreck*), they fhall be prefently delivered to the merchants, paying only a reafonable reward to thofe that faved and preferved them, which is intitled *falvage*. Alfo by the common law, if any perfons (other than the fheriff) take any goods fo caft on fhore, which are not legal wreck, the owners might have a commiffion to inquire and find them out, and compel them to make reftitution. And by 12 Ann. ft. 2. c. 18. confirmed by 4 Geo. I. c. 12. in order to affift the diftreffed, and prevent the fcandalous illegal practices on fome of our fea-coafts (too fimilar to thofe on the Baltic), it is enacted, that all head-officers and others of towns near the fea, fhall, upon application made to them, fummon as many hands as are neceffary, and fend them to the relief of any fhip in diftrefs, on forfeiture of L. 100; and in cafe of affiftance given, falvage fhall be paid by the owners, to be affeffed by three neighbouring juftices. All perfons that fecrete any goods fhall forfeit their treble value: and if they wilfully do any act whereby the fhip is loft or deftroyed, by making holes in her, ftealing her pumps, or otherwife, they are guilty of felony without benefit of clergy. Laftly, by the ftatute 26 Geo. II. c. 19. plundering any veffel, either in diftrefs or wrecked, and whether any living creature be on board or not (for whether wreck or otherwife, it is clearly not the property of the populace), fuch plundering or preventing the efcape of any perfon that endeavours to fave his life, or wounding him with intent to deftroy him, or putting out falfe lights in order to bring any veffel into danger, are all declared to be capital felonies; in like manner as the deftroying of trees, fteeples, or

(A) In like manner Conftantine the Great, finding that by the imperial law the revenue of wrecks was given to the prince's treafury or fifcus, reftrained it by an edict (Cod. 11. 5. 1.) and ordered them to remain to the owners; adding this humane expoftulation: "Quod enim jus habet fifcus in aliena calamitate, ut de re tam luctuofa compendium fectetur?"

or other fixed sea marks, is punished by the statute 8 Eliz c. 12. with a forfeiture of l. 10 or outlawry. Moreover, by the statute of Geo. II. pilfering any goods cast ashore is declared to be petty larceny; and many other salutary regulations are made, for the more effectually preserving ships of any nation in distress.

By the civil law, to destroy persons shipwrecked, or prevent their saving the ship, is capital. And to steal even a plank from a vessel in distress or wrecked, makes the party liable to answer for the whole ship and cargo. The laws also of the Wisigoths, and the most early Neapolitan constitutions, punished with the utmost severity all those who neglected to assist any ship in distress, or plundered any goods cast on shore.

WREN, in ornithology. See MOTACILLA.

WREN (Sir Christopher), a great philosopher, and one of the most learned and most eminent architects of his age, was the son of Christopher Wren dean of Windsor, and was born in 1632. He studied at Wadham college in Oxford; where he took the degree of master of arts in 1653, and was chosen fellow of All Souls college. When very young he discovered a surprising genius for the mathematics; in which science he made great advances before he was sixteen years old. In 1657, he was made professor of astronomy at Gresham college, London; which he resigned in 1660, on his being chosen to the Savilian professorship of astronomy in Oxford: he was the next year created doctor of laws, and in 1663 was elected fellow of the Royal Society. He was one of the commissioners for the reparation of St Paul's; and in 1665 travelled into France, to examine the most beautiful edifices there, when he made many curious observations. At his return to England, he drew a noble plan for rebuilding the city of London after the fire, which he presented to parliament; and upon the decease of Sir John Denham in 1668, was made surveyor-general of his majesty's works; and from that time had the direction of a great number of public edifices, by which he acquired the highest reputation. He built the magnificent theatre at Oxford, St Paul's cathedral, the churches of St Stephen Walbrook, and St Mary-le-Bow, the Monument, the modern part of the palace of Hampton Court, Chelsea College, one of the wings of Greenwich Hospital, and many other beautiful edifices. He was president of the Royal Society, one of the commissioners of Chelsea College, and twice member of parliament; first for Plymouth in Devonshire, and then for Melcomb Regis in the same county; but in 1718 was removed from his place of surveyor-general. He died in 1723, and was interred in the vault under St Paul's.

This great man also distinguished himself by many curious inventions and discoveries in natural philosophy; and, among many others, contrived an instrument for measuring the quantity of rain that falls on any space of land for a year; he invented many ways of making astronomical observations more accurate and easy; and was the first author of the anatomical experiment of injecting liquors into the veins of animals, &c. He translated into Latin Mr Oughtred's *Horologiographica Geometrica*; and wrote a Survey of the cathedral church of Salisbury, and other pieces. After his death his posthumous works and draughts were published by his son.

WRESTLING, a kind of combat or engagement between two persons unarmed, body to body, to prove their strength and dexterity, and try which can throw his opponent to the ground.

Wrestling is an exercise of very great antiquity and fame. It was in use in the heroic age; witness Hercules, who wrestled with Antæus.

It continued a long time in the highest repute, and had considerable rewards and honours assigned to it at the Olympic games. It was the custom for the Athletæ to anoint their bodies with oil, to give the less hold to their antagonists.

Lycurgus ordered the Spartan maids to wrestle in public quite naked, in order, as it is observed, to break them of their too much delicacy and niceness, to make them appear more robust, and to familiarize the people, &c. to such nudities.

WRIST, in ANATOMY. See there, n° 53.

WRIT, in law, signifies, in general, the king's precept in writing under seal, issuing out of some court, directed to the sheriff or other officer, and commanding something to be done in relation to a suit or action, or giving commission to have the same done. And, according to Fitzherbert, a writ is said to be a formal letter of the king in parchment, sealed with his seal, and directed to some judge, officer, or minister, &c. at the suit of a subject, for the cause briefly expressed, which is to be determined in the proper court according to law.

WRITS, in civil actions, are either original or judicial: original, are such as are issued out of the court of chancery for the summoning of a defendant to appear, and are granted before the suit is commenced, in order to begin the same; and judicial writs issue out of the court where the original is returned, after the suit is begun. See PROCESS.

The original writ is the foundation of the suit. See SUIT.

When a person hath received an injury, and thinks it worth his while to demand a satisfaction for it, he is to consider with himself, or take advice, what redress the law has given for that injury; and thereupon is to make application or suit to the crown, the fountain of all justice, for that particular specific remedy which he is determined or advised to pursue. As for money due on bond, an action of debt; for goods detained without force, an action of *detinue or trover*; or, if taken with force, an action of *trespass vi et armis*; or, to try the title of lands, a writ of entry or action of trespass in ejectment; or for any consequential injury received, a special action on the case. To this end he is to sue out, or purchase by paying the stated fees, an *original* or original writ, from the court of chancery, which is the *officina justitiæ*, the shop or mint of justice, wherein all the king's writs are framed. It is a mandatory letter from the king in parchment, sealed with his great seal, and directed to the sheriff of the county wherein the injury is committed, or supposed so to be, requiring him to command the wrong-doer or party accused, either to do justice to the complainant, or else to appear in court, and answer the accusation against him. Whatever the sheriff does in pursuance of this writ, he must return or certify to the court of common-pleas, together with the writ itself: which is the foundation of the jurisdiction of that court, being the king's warrant for the judges to proceed to the determination of the cause. For it was a maxim introduced by the Normans, that there should be no proceedings in common-pleas before the king's justices without his original writ; because they held it unfit that those justices, being only the substitutes of the crown, should take cognizance of any thing but what was thus expressly referred to their judgment. However, in small actions, below the value of forty shillings, which are brought in the court-baron or county-court, no royal writ is necessary; but the foundation of such suits continue to be (as in the times of the Saxons), not by original writ, but by plaint; that is, by a private memorial tendered in open court to the judge, wherein the party injured sets forth his cause of action: and the judge is bound of common right to administer justice therein, without any special mandate from the king. Now indeed even the royal writs are held to be demandable of common right, on paying the usual fees: for any

any delay in the granting them, or setting an unusual or exorbitant price upon them, would be a breach of magna charta, c. 29 "nulli vendemus, nulli negabimus, aut differemus justitiam vel rectum."

Original writs are either optional or peremptory; or, in the language of our law, they are either a *præcipe*, or a *si te fecerit securum*. The *præcipe* is in the alternative, commanding the defendant to do the thing required, or show the reason wherefore he hath not done it. The use of this writ is where something certain is demanded by the plaintiff, which is in the power of the defendant himself to perform; as, to restore the possession of land, to pay a certain liquidated debt, to perform a specific covenant, to render an account, and the like; in all which cases the writ is drawn up in the form of a *præcipe* or command, to do thus, or show cause to the contrary; giving the defendant his choice to redress the injury or stand the suit. The other species of original writs is called a *si fecerit te securum*, from the words of the writ; which directs the sheriff to cause the defendant to appear in court, without any option given him, provided the plaintiff gives the sheriff security effectually to prosecute his claim. This writ is in use where nothing is specifically demanded, but only a satisfaction in general; to obtain which, and minister complete redress, the intervention of some judicature is necessary. Such are writs of trespass, or on the case, wherein no debt or other specific thing is sued for in certain, but only damages to be assessed by a jury. For this end the defendant is immediately called upon to appear in court, provided the plaintiff gives good security of prosecuting his claim. Both species of writs are tested, or witnessed, in the king's own name; "witness ourself at Westminster," or wherever the chancery may be held.

The security here spoken of, to be given by the plaintiff for prosecuting his claim, is common to both writs, though it gives denomination only to the latter. The whole of it is at present become a mere matter of form; and John Doe and Richard Roe are always returned as the standing pledges for this purpose.—The ancient use of them was to answer for the plaintiff, who in case he brought an action without cause, or failed in the prosecution of it when brought, was liable to an amercement from the crown for raising a false accusation; and so the form of the judgment still is. In like manner, as by the Gothic constitutions no person was permitted to lay a complaint against another, *nisi sub scriptura aut specificatione trium testium, quod actionem vellet persequi*: and, as by the laws of Sancho I. king of Portugal, damages were given against a plaintiff who prosecuted a groundless action.

The day on which the defendant is ordered to appear in court, and on which the sheriff is to bring in the writ, and report how far he has obeyed it, is called the *return of the writ*; it being then returned by him to the king's justices at Westminster. And it is always made returnable at the distance of at least 15 days from the date or test, that the defendant may have time to come up to Westminster, even from the most remote parts of the kingdom; and upon some day in one of the four terms, in which the court sits for the dispatch of business.

WRITING, the art or act of signifying and conveying our ideas to others, by letters or characters visible to the eye. See COMPOSITION, GRAMMAR, and LANGUAGE.

The most ancient remains of writing, which have been transmitted to us, are upon hard substances, such as stones and metals, which were used by the ancients for edicts and matters of public notoriety; the decalogue was written on two tables of stone; but this practice was not peculiar to the Jews, for it was used by most of the eastern nations, as well as by the Greeks and Romans; and therefore the ridicule which Voltaire attempts to cast upon that part of the book of Genesis, where the people are commanded to write the law on stones, is absurd; for that command by no means implies, that other materials might not be used in common occasions. The laws of Solon, and [illegible], among the Greeks, were engraved on tables of brass which were called cyrbes.

We find that wood was also used for writing on in different countries. In the Sloane library [illegible] are specimens of Kufic writing, on boards, about two feet in length, and six inches in depth. The Chinese, before the invention of paper, wrote with an iron tool upon thin boards or on bamboo. Pliny says, that table books of wood were in use before the time of Homer. These table books were called by the Romans *pugillares*. The wood was cut into thin slices, and finely planed and polished. The writing was at first upon the bare wood, with an iron instrument called a *stylus*. In later times these tables were usually waxed over, and written upon with that instrument. The matter written upon the tables which were thus waxed over was easily effaced, and by smoothing the wax new matter might be substituted in the place of what had been written before. The Greeks and Romans continued the use of waxed table-books long after the use of papyrus, leaves, and skins, became common, because they were so convenient for correcting extemporary compositions.

Table books of ivory are still used for memorandums, but they are commonly written upon with black lead pencils. The practice of writing on table books covered with wax was not entirely laid aside till the commencement of the 14th century.

The bark of trees was also used for writing by the ancients, and is so still in several parts of Asia. The same thing may be said of the leaves of trees. It is needless to observe the use of parchment and vellum, papyrus and paper, for writing; it is too well known. The method of fabricating these substances has been already described as they occurred in the order of the alphabet.

It is obvious, that when men wrote, or rather engraved, on hard substances, instruments of metal were necessary, such as the chisel and the stylus; but the latter was chiefly used for writing upon boards, waxed tablets, or on bark.

When the ancients wrote on softer materials than wood or metal, other instruments were used for writing with, of which reeds and canes seem to have been the first. Reeds and canes are still used as instruments for writing with by the Tartars, the Indians, the Persians, the Turks, and the Greeks. Pencils made of hair are used by the Chinese for their writing: they first liquify their ink, and dip their pencils into it. Hair-pencils have likewise been used for writing in Europe. Large capital letters were made with them from the time of the Roman emperors till the 16th century. After the invention of printing they were drawn by the illuminators. Quills of geese, swans, peacocks, crows, and other birds, have been used in these western parts for writing with, but how long is not easy to ascertain. St Isidore of Seville, who lived about the middle of the 7th century, describes a pen made of a quill as used in his time.

Method of restoring decayed Writings. In the 77th vol. of the Phil. Transf. there is a paper on this subject by Sir Charles Blagden. One of the best methods he found upon experiment to be, covering the letters with phlogisticated or prussic alkali, with the addition of a diluted mineral acid; upon the application of which, the letters changed very speedily to a deep blue colour, of great beauty and intensity. To prevent the spreading of the colour, which, by blotting the parchment, detracts greatly from the legibility, the alkali should be put on first, and the diluted acid added upon it.

The

Writings || Wurtemburg.

The method found to answer best has been, to spread the alkali thin with a feather over the traces of the letters, and then to touch it gently, as nearly upon or over the letters as can be done with the diluted acid, by means of a feather or a bit of stick cut to a blunt point. Though the alkali should occasion no sensible change of colour, yet the moment the acid comes upon it, every trace of a letter turns at once to a fine blue, which soon acquires its full intensity, and is beyond comparison stronger than the colour of the original trace had been. If, then, the corner of a bit of blotting paper be carefully and dexterously applied near the letters, so as to imbibe the superfluous liquor, the staining of the parchment may be in a great measure avoided: for it is this superfluous liquor which, absorbing part of the colouring matter from the letters, becomes a dye to whatever it touches. Care must be taken not to bring the blotting paper in contact with the letters, because the colouring matter is soft whilst wet, and may easily be rubbed off. The acid chiefly employed was the marine; but both the vitriolic and nitrous succeed very well. They should be so far diluted as not to be in danger of corroding the parchment, after which the degree of strength does not seem to be a matter of much nicety.

Method of Copying Writings. The ingenious Mr Watt, about 16 years ago, invented a method of copying writings very speedily, and without the possibility of committing mistakes. A piece of thin unsized paper is to be taken exactly of the size of the paper to be copied; it is to be moistened with water, or, what is better, with the following liquid: Take of distilled vinegar two pounds weight, dissolve it in one ounce of boracic acid; then take four ounces of oyster-shells calcined to whiteness, and carefully freed from their brown crust; put them into the vinegar, shake the mixture frequently for 24 hours, then let it stand until it deposits its sediment; filter the clear part through unsized paper into a glass vessel; then add two ounces of the best blue Aleppo galls bruised, and place the liquor in a warm place, shaking it frequently for 24 hours; then filter the liquor again through unsized paper, and add to it after filtration one quart, ale measure, of pure water. It must then stand 24 hours, and be filtered again if it shows a disposition to deposit any sediment, which it generally does. When the paper has been wet with this liquid, put it between two thick unsized papers to absorb the superfluous moisture; then lay it over the writing to be copied, and put a piece of clean writing paper above it. Put the whole on the board of a rolling-press, and press them thro' the rolls, as is done in printing copperplates, and a copy of the writing shall appear on both sides of the thin moistened paper; on one side in a reversed order and direction, but on the other side in the natural order and direction of the lines.

WRITTEN MOUNTAINS. See MOUNTAINS.

WRY-NECK, in ornithology. See JYNX.

WURTEMBURG, or WIRTENBURG, a sovereign duchy of Germany, in Suabia; bounded on the north by Franconia, the archbishopric of Mentz, and the palatinate of the Rhine; on the east by the county of Oeting, the marquisate of Burgau, and the territory of Ulm; on the south by the principality of Hoen-Zollern, Furstenburg, and the marquisate of Hohenburg; and on the west by the palatinate of the Rhine, the marquisate of Baden, and the Black Forest. It is 65 miles in length, and as much in breadth, and the river Neckar runs almost through the middle of it from south to north. Though there are many mountains and woods, yet it is one of the most populous and fertile countries in Germany, producing plenty of grass, corn, fruits, and a great deal of wine towards the confines of the palatinate. There are also mines, and salt springs, with plenty of game and fish. It contains 645 villages, 88 towns, and 26 cities, of which Stutgard is the capital.

Wurtemburg || Wycherley.

WURTSBURG, a large bishopric in Germany, comprehending the principal part of Franconia. It is bounded by the county of Henneburg, the duchy of Coburg, the abbey of Fuld, the archbishopric of Mentz, the marquisate of Anspach, the bishopric of Bamberg, and the county of Wertheim; being about 65 miles in length, and 50 in breadth, and divided into 50 bailiwicks. The soil is very fertile, and produces more corn and wine than the inhabitants consume. The territories of the bishop comprehend above 400 towns and villages, of which he is sovereign, being one of the greatest ecclesiastical princes of the empire.

WURTZBURG, a large and handsome city of Germany, and one of the principal in the circle of Franconia. It is defended with good fortifications, and has a magnificent palace. There is a handsome hospital, in which are generally 400 poor men and women. The castle is at a small distance from the city, and commands it, as it stands upon an eminence. It communicates with the city by a stone-bridge, on which are 12 statues, representing as many saints. The arsenal and the cellars of the bishop deserve the attention of the curious. There is also an university, founded in 1403. It is seated on the river Maine, in E. Long. 10. 2. N. Lat. 49. 40.

WYCHERLEY (William), an eminent English comic poet, was born about 1640. A little before the restoration of King Charles II. he became a gentleman commoner of Queen's college Oxford, where he was reconciled by Dr Barlow to the Protestant religion, which he had a little before abandoned in his travels. He afterward entered himself in the Middle-temple, but soon quitted the study of the law for pursuits more agreeable to his own genius, as well as to the taste of the age. Upon writing his first play, intitled, Love in a Wood, or St James's Park, which was acted in 1672, he became acquainted with several of the celebrated wits both of the court and town, and likewise with the duchess of Cleveland. Some time after appeared his comedies, called The Gentleman-Dancing-Master, the Plain Dealer, and the Country Wife; all which were acted with applause. George duke of Buckingham had a very high esteem for him, and bestowed on him several advantageous posts. King Charles also showed him signal marks of favour; and once gave him a proof of his esteem, which perhaps never any sovereign prince before had given to a private gentlemen. Mr Wycherley being ill of a fever, at his lodgings in Bow-street, the king did him the honour of a visit. Finding him extremely weakened, he commanded him to take a journey to the south of France, and assured him, at the same time, that he would order him 500 l. to defray the charges of the journey. Mr Wycherley accordingly went into France; and having spent the winter there, returned to England entirely restored to his former vigour. The king, shortly after his arrival, told him, that he had a son, who he was resolved should be educated like the son of a king, and that he could not choose a more proper man for his governor than Mr Wycherley; for which service 1500 l. *per annum* should be settled upon him.

Immediately after this offer he went down to Tunbridge, where walking one day upon the Well's-walk with his friend Mr Fairbeard of Gray's Inn, just as he came up to the bookseller's shop, the countess of Drogheda, a young widow, rich, noble, and beautiful, came there to enquire for The Plain Dealer; "Madam," says Mr Fairbeard, "since you are for the Plain Dealer, there he is for you;" pushing Mr Wycherley towards her. "Yes," says Mr

Wycherley,

Wycherley.

Wycherley, "this lady can bear plain-dealing; for she appears to be so accomplished, that what would be a compliment to others, would be plain dealing to her." "No, truly, Sir", said the countess, "I am not without my faults, any more than the rest of my sex; and yet, notwithstanding, I love plain-dealing, and am never more fond of it than when it tells me of them." "Then, madam," says Mr Fairbeard, "you and the Plain-Dealer seem designed by Heaven for each other."—In short, Mr Wycherley walked a turn or two with the countess, waited upon her home, visited her daily while she staid at Tunbridge, and married her soon after without acquainting the king. By this step, which was looked upon as a contempt of his majesty's orders, he forfeited the royal favour. The countess of Drogheda settled her whole fortune upon him; but his title being disputed after her death, he was so reduced by the expences of the law and other incumbrances, as to be unable to satisfy the impatience of his creditors, who threw him into prison; and the bookseller who printed his Plain-Dealer, by which he got almost as much money as the other gained reputation, was so ungrateful as to refuse to lend him 20 l. in his extreme necessity. In that confinement he languished seven years; but at length king James going to see the above play, was so charmed with it, that he gave immediate orders for the payment of his debts, and even granted him a pension of 200 l. *per annum*. But that prince's bountiful intentions were in a great measure defeated merely through Mr Wycherley's modesty; he being ashamed to tell the earl of Mulgrave, whom the king had sent to demand it, a true state of his debts. He laboured under the weight of these difficulties till his father died, who left him 600 l. a year. But this estate was under uneasy limitations, he being only a tenant for life, and not being allowed to raise any money for the payment of his debts. However, he took a method of doing it which few suspected to be his choice; and this was making a jointure. He had often declared, that he was resolved to die married, though he could not bear the thoughts of living in that state again: accordingly, just at the eve of his death, he married a young gentlewoman with 1500 l. fortune, part of which he applied to the uses he wanted it for. Eleven days after the celebration of these nuptials, in December 1715, he died, and was interred in the vault of Covent-garden church.

Wyndham | Wye.

Besides his plays above-mentioned, he published a volume of poems in folio. In 1728 his posthumous works in prose and verse were published by Mr Theobald.

WYNDHAM (Sir William), descended of an ancient family, was born about the year 1687, and succeeded young to the title and estate of his father. On his return from his travels, he was chosen member for the county of Somerset; in which station he served in the three last parliaments of Queen Anne, and as long as he lived: after the change of the ministry in 1710, he was appointed secretary at war; and in 1713 was raised to be chancellor of the exchequer. Upon the breach between the earl of Oxford and lord Bolingbroke, he adhered to the interests of the latter. He was removed from his employment on the accession of George I. and falling under suspicion on the breaking out of the rebellion in 1715, was apprehended. He made his escape; a reward was published for apprehending him; he surrendered, was committed to the Tower, but never brought to a trial. After he regained his liberty, he continued in opposition to the several administrations under which he lived; and died in 1740.

WYKEHAM (William of). See William.

WYE, a river of Wales, which rises on the confines of Cardiganshire, and running south-east, divides the counties of Radnor and Brecknock; then crossing Herefordshire, it runs south and falls into the mouth of the Severn at Chepstow.

X.

Xanthium.

X, or x, is the 22d letter of our alphabet, and a double consonant. It was not used by the Hebrews or ancient Greeks; for as it is a compound letter, the ancients, who used great simplicity in their writings, expressed this letter by its component letters *cs*. Neither have the Italians this letter, but express it by *ſſ*. X begins no word in our language but such as are of Greek original; and is in few others but what are of Latin derivation; as *perplex*, *reflexion*, *defluxion*, &c. We often express this sound by single letters, as *cks*, in *backs*, *necks*: by *ks*, in *books*, *breaks*: by *cc*, in *accept*, *accident*: by *ct*, in *action*, *unction*, &c. The English and French pronounce it like *cs* or *ks*; the Spaniards like *c* before *a*. viz. *Alexandro*, as if it were *Alecandro*. In numerals it expresseth 10, whence in old Roman manuscripts it is used for *denarius*; and as such seems to be made of two V's placed one over the other. When a dash is added over it, thus $\bar{X}$, it signifies 10,000.

XANTHIUM, in botany; a genus of plants of the class *monœcia*, order *pentandria*, and arranged in the natural classification under the 49th order, *compositæ*. The male flowers are composite, common calyx imbricated; corollulæ monopetalous, tubular, quinquefid. Female: calyx involucrum of two leaves, containing two flowers; corolla 0; drupe, dry, prickly; nucleus bilocular. There are five species, only one of which is a native of Britain, the *strumarium* or less burdock. The stem of this plant is a foot and a half high, thick, often spotted. Leaves heart-shaped, lobed, on long footstalks. Flowers, male and female, many together, in the alæ of the leaves. The leaves are bitter and astringent. A decoction of the whole plant affords a showy yellow colour, but it is better if only the flowers are used. Horses and goats eat it; cows, sheep, and swine refuse it.

Xanthoxylum | Xebec.

XANTHOXYLUM. See Zanthoxylum.

XEBEC, or Zebec, a small three-masted vessel, navigated in the Mediterranean Sea, and on the coasts of Spain, Portugal, and Barbary. See Plate CCCCLII, fig. 12.

The sails of the xebec are in general similar to those of the polacre, but the hull is extremely different from that and almost every other vessel. It is furnished with a strong prow: and the extremity of the stern, which is nothing more than a sort of railed platform or gallery, projects farther behind the counter and buttock than that of any European ship.

Being generally equipped as a corsair, the xebec is constructed with a narrow floor, to be more swift in pursuit of the enemy; and of a great breadth, to enable her to carry a

Xenocrates.

a great force of sail for this purpose without danger of overturning. As these vessels are usually very low built, their decks are formed with a great convexity from the middle of their breadth towards the sides, in order to carry off the water which falls aboard more readily by their scuppers. But as this extreme convexity would render it very difficult to walk thereon at sea, particularly when the vessel rocks by the agitation of the waves, there is a platform of grating extending along the deck from the sides of the vessel towards the middle, whereon the crew may walk dry-footed whilst the water is conveyed through the grating to the scuppers.

The xebecs, which are generally armed as vessels of war by the Algerines, mount from 16 to 24 cannon, and carry from 300 to 450 men, two thirds of whom are generally soldiers.

By the very complicated and inconvenient method of working these vessels, what one of their captains of Algiers told Mr Falconer will be readily believed, viz. that every xebec requires at least the labour of three square-rigged ships, wherein the standing sails are calculated to answer every situation of the wind.

XENOCRATES, a celebrated ancient Grecian philosopher, was born at Chalcedon in the 95th Olympiad. At first he attached himself to Æschines, but afterwards became a disciple of Plato, who took much pains in cultivating his genius, which was naturally heavy. His temper was gloomy, his aspect severe, and his manners little tinctured with urbanity. These material defects his master took great pains to correct; frequently advising him to sacrifice to the Graces: and the pupil was patient of instruction, and knew how to value the kindness of his preceptor. As long as Plato lived, Xenocrates was one of his most esteemed disciples; after his death he closely adhered to his doctrine; and, in the second year of the 110th Olympiad, he took the chair in the academy, as the successor of Speusippus.

Xenocrates was celebrated among the Athenians, not only for his wisdom, but for his virtues. So eminent was his reputation for integrity, that when he was called upon to give evidence in a judicial transaction, in which an oath was usually required, the judges unanimously agreed, that his simple asseveration should be taken, as a public testimony to his merit. Even Philip of Macedon found it impossible to corrupt him. So abstemious was he with respect to food, that his provision was frequently spoiled before it was consumed. His chastity was invincible. Phryne, a celebrated Athenian courtezan, attempted without success to seduce him. Of his humanity the following pathetic incident is a sufficient proof: A sparrow, which was pursued by a hawk, flew into his bosom; he afforded it protection till its enemy was out of sight, and then let it go, saying, that he would never betray a suppliant. He was fond of retirement, and was seldom seen in the city. He was discreet in the use of his time, and carefully allotted a certain portion of each day to its proper business. One of these he employed in silent meditation. He was an admirer of the mathematical sciences; and was so fully convinced of their utility, that when a young man, who was unacquainted with geometry and astronomy, desired admission into the academy, he refused his request, saying, that he was not yet possessed of the handles of philosophy. In fine, Xenocrates was eminent both for the purity of his morals and for his acquaintance with science, and supported the credit of the Platonic school, by his lectures, his writings, and his conduct. He lived to the first year of the 116th Olympiad, or the 82 of his age, when he lost his life by accidentally falling, in the dark, into a reservoir of water.

Enfield's Hist. of Philos., vol. ii.

Xenophanes.

XENOPHANES, the founder of the Eleaic sect of philosophy among the Greeks, was born at Colophon probably about the 65th Olympiad. From some cause or other he left his country early, and took refuge in Sicily, where he supported himself by reciting, in the court of Hiero, elegiac and iambic verses, which he had written in reprehension of the theogonies of Hesiod and Homer. From Sicily he passed over into Magna Græcia, where he took up the profession of philosophy, and became a celebrated preceptor in the Pythagorean school. Indulging, however, a greater freedom of thought than was usual among the disciples of Pythagoras, he ventured to introduce new opinions of his own, and in many particulars to oppose the doctrines of Epimenides, Thales, and Pythagoras. Xenophanes possessed the Pythagorean chair of philosophy about seventy years, and lived to the extreme age of an hundred years, that is, according to Eusebius, till the 81st Olympiad. The doctrine of Xenophanes concerning nature is so imperfectly preserved, and obscurely expressed, that it is no wonder that it has been differently represented by different writers. Perhaps the truth is, that he held the universe to be one in nature and substance, but distinguished in his conception between the matter of which all things consist, and that latent divine force which, though not a distinct substance but an attribute, is necessarily inherent in the universe, and is the cause of all its perfection.

Xenophon.

XENOPHON, an illustrious philosopher, general, and historian, was born at Athens in the 3d year of the 82d Olympiad. When he was a youth, Socrates, struck with his external appearance, determined to admit him into the number of his pupils. Meeting him by accident in a narrow passage, the philosopher put his staff across the path, and stopping him, asked, where those things were to be purchased which are necessary to human life? Xenophon appearing at a loss for a reply to this unexpected salutation, Socrates proceeded to ask him, where honest and good men were to be found? Xenophon still hesitating, Socrates said to him, "Follow me, and learn." From that time Xenophon became a disciple of Socrates, and made a rapid progress in that moral wisdom for which his master was so eminent. Xenophon accompanied Socrates in the Peloponnesian war, and fought courageously in defence of his country. He afterwards entered into the army of Cyrus as a private volunteer in his expedition against his brother. This enterprize proving unfortunate, Xenophon, after the death of Cyrus, advised his fellow soldiers to attempt a retreat into their own country. They listened to his advice; and having had many proofs of his wisdom as well as courage, they gave him the command of the army, in the room of Proxenus who had fallen in battle. In this command he acquired great glory by the prudence and firmness with which he conducted them back, through the midst of innumerable dangers, into their own country. The particulars of this memorable adventure are related by Xenophon himself in his Retreat of the Ten Thousand. After his return into Greece, he joined Agesilaus, king of Sparta, and fought with him against the Thebans in the celebrated battle of Chæronea. The Athenians, displeased at this alliance, brought a public accusation against him for his former conduct in engaging in the service of Cyrus, and condemned him to exile. The Spartans, upon this, took Xenophon, as an injured man, under their protection, and provided him a comfortable retreat at Scilluntes in Elea. Here, with his wife and two children, he remained several years, and passed his time in the society of his friends, and

in

in writing those historical works which have rendered his name immortal. A war at length arose between the Spartans and Eleans; and Xenophon was obliged to retire to Lepreus, where his eldest son had settled. He afterwards removed, with his whole family, to Corinth, where, in the first year of the hundred and fifth Olympiad, he finished his days.

XENOPHON the *Younger*, a Greek writer, so called to distinguish him from the celebrated Xenophon, was born at Ephesus, and lived, according to some authors, before Heliodorus, that is, about the beginning of the 4th century. He is only known by his *Ephesiaca*, a Greek romance in five books, which is esteemed, and contains the amours or adventures of Abracomes and Anthia. This romance was printed at London, in Greek and Latin, in 1724, 4to.

XERXES I. the fifth king of Persia, memorable for the vast army he is said to have carried into the field against Leonidas king of Sparta; consisting, according to some historians, of 500,000 men, while others make it amount to 3,000,000, exclusive of attendants. The fleet that attended this prodigious land force is likewise made to consist of 2000 sail; and all the success they met with was the taking and burning the city of Athens; for the army was shamefully repulsed near the straits of Thermopylæ by Leonidas, and the fleet was dispersed and partly destroyed by Themistocles at the straits of Salamis, who had only 380 sail under his command. Xerxes was assassinated by Artabanes, chief captain of his guards, and his distinguished favourite. See SPARTA.

XIMENES (Francis), a justly celebrated cardinal, bishop of Toledo, and prime minister of Spain, was born at Torrelaguna, in Old Castile, in 1437, and studied at Alcola and Salamanca. He then went to Rome; and being robbed on the road, brought nothing back but a bull for obtaining the first vacant prebend: but the archbishop of Toledo refused it him, and threw him in prison. Being at length restored to liberty, he obtained a benefice in the diocese of Siguença, where cardinal Gonzales de Mendoza, who was the bishop, made him his grand vicar. Ximenes some time after entered among the Franciscans of Toledo; but being there troubled with visits, he retired to a solitude named *Castanel*, and applied himself to the study of divinity and the oriental tongues. At his return to Toledo, queen Isabella of Castile chose him for her confessor, and afterwards nominated him archbishop of Toledo; which, next to the papacy, is the richest dignity in the church of Rome. "This honour (says Dr Robertson) he declined with a firmness which nothing but the authoritative injunction of the pope was able to overcome. Nor did this height of promotion change his manners. Though obliged to display in public that magnificence which became his station, he himself retained his monastic severity. Under his pontifical robes he constantly wore the coarse frock of St Francis, the rents of which he used to patch with his own hands. He at no time used linen, but was commonly clad in hair-cloth. He slept always in his habit; most frequently on the floor or on boards, and rarely in a bed. He did not taste any of the delicacies which appeared at his table, but satisfied himself with that simple diet which the rule of his order prescribed. Notwithstanding these peculiarities, so opposite to the manners of the world, he possessed a thorough knowledge of its affairs, and discovered talents for business which rendered the fame of his wisdom equal to that of his sanctity." His first care was to provide for the necessities of the poor; to visit the churches and hospitals; to purge his diocese of usurers and places of debauchery; to degrade corrupt judges, and place in their room persons whom he knew to be distinguished by their probity and disinterestedness. He erected a famous university at Alcala; and in 1499 founded the college of St [illegible] after he undertook the Polyglot Bible; and [illegible] pose sent for many learned [illegible] purchased seven copies [illegible] and gave a great price for Latin and Greek [illegible] this Bible they laboured [illegible] Hebrew text of the Bible; the [illegible] with a literal translation; [illegible] St Jerom, and the Chaldee paraphrases of Onkelos; and [illegible] tionary of the Hebrew and Chaldee [illegible] Bible. This work is called *Ximenes's Polyglot*. In 1507 pope Julius II. gave him the cardinal's hat, and king Ferdinand the Catholic entrusted him with the administration of affairs. Cardinal Ximenes was from this moment the soul of every thing that passed in Spain. He distinguished himself at the beginning of his ministry by discharging the people from the burdensome tax called *alcavala*, which had been continued on account of the war against Granada; and laboured with such zeal and [illegible] in the conversion of the Mahometans, that he made [illegible] converts, among whom was a prince of the blood of the kings of Granada. In 1509 cardinal Ximenes extended the dominions of Ferdinand, by taking the city of Oran in the kingdom of Algiers. He undertook this conquest at his own expence, and marched in person at the head of the Spanish army cloathed in his pontifical ornaments, and accompanied by a great number of ecclesiastics and monks. Some time after, foreseeing an extraordinary scarcity, he erected public granaries at Toledo, Alcala, and Torrelaguna, and had them filled with corn at his own expence; which gained the people's hearts to such a degree, that to preserve the memory of this noble action they had an eulogium upon it cut on marble, in the hall of the senate-house at Toledo, and in the market-place. King Ferdinand dying in 1516, left cardinal Ximenes regent of his dominions; and the archduke Charles, who was afterwards the emperor Charles V. confirmed that nomination. The cardinal immediately made a reform of the officers of the supreme council and of the court, and put a stop to the oppression of the grandees. He vindicated the rights of the people against the nobility; and as by the feudal constitution the military power was lodged in the hands of the nobles, and men of inferior condition were called into the field only as their vassals, a king with scanty revenues depended on them in all his operations. From this state Ximenes resolved to deliver the crown; and issued a proclamation, commanding every city in Castile to inrol a certain number of its burgesses, and teach them military discipline; he himself engaging to provide officers to command them at the public expence. This was vigorously opposed by the nobles; but by his intrepidity and superior address he carried his point. He then endeavoured to diminish the possessions of the nobility, by reclaiming all the crown-lands, and putting a stop to the pensions granted by the late king Ferdinand. This addition made to the revenues enabled him to discharge all the debts of Ferdinand, and to establish magazines of warlike stores. The nobles, alarmed at these repeated attacks, uttered loud complaints; but before they proceeded to extremities, appointed some grandees of the first rank to examine the powers in consequence of which he exercised acts of such high authority. Ximenes received them with cold civility; produced the testament of Ferdinand, by which he was appointed regent, together with the ratification of that deed by Charles. To both these they objected; and he endeavoured to establish their validity. As the conversation grew warm, he led them insensibly to a balcony, from which they had a view of a large body of troops under arms, and of a formidable train of artillery. "Behold

Ximenes.

Ximenes, Xiphias.

"Behold (fays he, pointing to thefe, and raifing his voice) the powers which I have received from his Catholic majefty! With thefe I govern Caftile; and with thefe I will govern it, till the king, your mafter and mine, takes poffeffion of his kingdom!" A declaration fo bold and haughty filenced them, and aftonifhed their affociates. They faw that he was prepared for his defence, and laid afide all thoughts of a general confederacy againft his adminiftration. At length, from the repeated intreaties of Ximenes, and the impatient murmurs of the Spanifh miniftry, Charles V. embarked, and landed in Spain, accompanied by his favourites. Ximenes was advancing to the coaft to meet him, but at Bos Equillos was feized with a violent diforder, which his followers confidered as the effects of poifon. This accident obliging Ximenes to ftop, he wrote to the king, and with his ufual boldnefs advifed him to difmifs all the ftrangers in his train, whofe number and credit already gave offence to the Spaniards, and earneftly defired to have an interview with him, that he might inform him of the ftate of the nation, and the temper of his fubjects. To prevent this, not only the Flemings, but the Spanifh grandees, employed all their addrefs to keep Charles at a diftance from Aranda, the place to which the cardinal had removed. His advice was now flighted and defpifed. Ximenes, confcious of his own integrity and merit, expected a more grateful return from a prince to whom he delivered a kingdom more flourifhing than it had been in any former age, and a more extenfive authority than the moft illuftrious of his anceftors had ever poffeffed; and lamented the fate of his country, about to be ruined by the rapacioufnefs and infolence of foreign favourites. While his mind was agitated by thefe paffions, he received a letter from the king; in which, after a few cold and formal expreffions of regard, he was allowed to retire to his diocefe; and he expired a few hours after reading it in 1517, in the 81ft year of his age.

This famous cardinal ought not to be confounded with *Roderic Ximenes*, archbifhop of Toledo, in the 13th century, who wrote a Hiftory of Spain in nine books; nor with feveral other Spanifh writers of the name of *Ximenes*.

XIPHIAS, in zoology, the Sword-fish; a genus of fifhes belonging to the order of *apodes*. The upper jaw terminates in a long fword-fhaped roftrum, from which it is called the *fword-fifh*: there are no teeth in the mouth; the gill-membrane has eight rays; and the body is fomewhat cylindrical. There is but one fpecies, *viz.* the *gladius*, found in the European ocean. This fifh fometimes frequents our coafts, but is much more common in the Mediterranean Sea, efpecially in the part that feparates Italy from Sicily, which has been long celebrated for it: the promontory Pelorus, now Capo di Faro, was a place noted for the refort of the xiphias, and poffibly the ftation of the fpeculatores, or the perfons who watched and gave notice of the approach of the fifh.

The ancient method of taking them is particularly defcribed by Strabo, and agrees exactly with that practifed by the moderns. A man afcends one of the cliffs that overhangs the fea: as foon as he fpies the fifh, he gives notice, either by his voice or by figns, of the courfe it takes. Another, that is ftationed in a boat, climbs up the maft, and on feeing the fword-fifh, directs the rowers towards it. As foon as he thinks they are got within reach, he defcends, and taking a fpear in his hand, ftrikes it into the fifh; which, after wearying itfelf with its agitation, is feized and drawn into the boat. It is much efteemed by the Sicilians, who buy it up eagerly, and at its firft coming into feafon give about fixpence Englifh *per* pound. The feafon lafts from May till Auguft. The ancients ufed to cut this fifh into pieces and falt it; whence it was called *Tomus Thurianus*, from Thurii, a town in the bay of Tarentum, where it was taken and cured.

The fword-fifh is faid to be very voracious, and that it is a great enemy to the tunny, who (according to Belon) are as much terrified at it as fheep are at the fight of a wolf. It is a great enemy to the whales, and frequently deftroys them. See Balæna.

XYLO-ALOES, or Aloe-wood, in the materia medica, is the product of a tree growing in China and fome of the Indian iflands. See Excæcaria.

This drug is diftinguifhed into three forts: the calambac or tambac, the common lignum aloes, and calambour.

The calambac, or fineft aloes-wood, called by authors *lignum aloes præftantiffimum*, and by the Chinefe *fukhiang*, is the moft refinous of all the woods we are acquainted with: it is of a light fpongy texture, very porous, and its pores fo filled up with a foft and fragrant refin, that the whole may be preffed and dented by the fingers like wax, or moulded about by chewing in the mouth, in the manner of maftich. This kind, laid on the fire, melts in great parts like refin, and burns away in a few moments with a bright flame and perfumed fmell. Its fcent, while in the mafs, is very fragrant and agreeable; and its tafte acrid and bitterifh, but very aromatic and agreeable. It is fo variable in its colour, that fome have divided it into three kinds; the one variegated with black and purple; the fecond, with the fame black, but with yellowifh inftead of purple; and the third, yellow alone like the yolk of an egg: this laft is the leaft fcented of the three. The variation, however, is owing to the trunk of the tree being itfelf of three different colours; and the heart of it is the valuable fort firft defcribed. The two following are fuppofed to be the other parts of the trunk; though this feems doubtful, efpecially in regard to the laft fort, from the circumftance mentioned of its being found in large logs entire, and fometimes only the *heart*, which, as above noticed, conftitutes the calambac.

The lignum aloes vulgare is the fecond in value. This is of a more denfe and compact texture, and confequently lefs refinous than the other; there is fome of it, however, that is fpongy, and has the holes filled up with the right refinous matter; and all of it, when good, has veins of the fame refin in it. We meet with it in fmall fragments, which have been cut and fplit from larger: thefe are of a tolerably denfe texture in the more folid pieces, and of a dufky brown colour, variegated with refinous black veins. It is in this ftate very heavy, and lefs fragrant than in thofe pieces which fhow a multitude of little holes, filled up with the fame blackifh matter that forms the veins in others. The woody part of thefe laft pieces is fomewhat darker than the other, and is not unfrequently purplifh, or even blackifh. The fmell of the common aloe-wood is very agreeable, but not fo ftrongly perfumed as the former. Its tafte is fomewhat bitter and acrid, but very aromatic.

The calambour, called alfo *agallochum fylveftre*, and *lignum aloes mexicanum*, is light and friable, of a dufky and often mottled colour, between a dufky green black and a deep brown. Its fmell is fragrant and agreeable, but much lefs fweet than that of either of the others; and its tafte bitterifh, but not fo much acrid or aromatic as either of the two former. This is faid to be met with very frequently, and in large logs; and thefe fometimes entire, fometimes only the heart of the tree. This is the aloe-wood ufed by the cabinet-makers and inlayers.

This drug is efteemed a cordial taken inwardly; and is fometimes given in diforders of the ftomach and bowels, and to deftroy the worms. A very fragrant oil may be procured from it by diftillation; which is recommended in paralytic cafes from five to fifteen drops. It is at prefent, however,

however, but little ufed ; and would fcarce be met with any-where in the fhops, but that it is an ingredient in fome of the old compofitions.

XYNOECIA, in Grecian antiquity, an anniverfary feaft obferved by the Athenians in honour of Minerva, upon the fixteenth of Hecatombæon, to commemorate their leaving, by the perfuafion of Thefus, their country-feats, in which they lay difperfed here and there in Attica, and uniting together in one body.

XYSTARCHA, in antiquity, the mafter or director of the xyftus. In the Greek gymnafium, the xyftarcha was the fecond officer, and the gymnafiarcha the firft ; the former was his lieutenant, and prefided over the two xyfti, and all exercifes of the athletæ therein.

Xyftus.

XYSTUS, among the Greeks, was a long portico, open or covered at the top, where the athletæ practifed wreftling and running ; the gladiators, who practifed therein, were called *xyftici*. Among the Romans, the xyftus was only an alley, or double row of trees, meeting like an arbour, and forming a fhade to walk under.

Y.

Y or y, the 23d letter of our alphabet : its found is formed by expreffing the breath with a fudden expanfion of the lips from that configuration by which we exprefs the vowel *u*. It is one of the ambigenial letters, being a confonant in the beginning of words, and placed before all vowels, as in *yard*, *yield*, *young*, &c. but before no confonant. At the end of words it is a vowel, and is fubftituted for the found of *i*, as in *try*, *defcry*, &c. In the middle of words it is not ufed fo frequently as *i* is, unlefs in words derived from the Greek, as in *chyle*, *empyreal*, &c. though it is admitted into the middle of fome pure Englifh words, as in *dying*, *flying*, &c. The Romans had no capital of this letter, but ufed the fmall one in the middle and laft fyllables of words, as in *coryambus*, *onyx*, *martyr*. Y is alfo a numeral, fignifying 150, or, according to Baronius 159 ; and with a dafh a-top, as $\bar{Y}$, it fignified 150,000.

YACHT, or YATCH, a veffel of ftate, ufually employed to convey princes, ambaffadors, or other great perfonages, from one kingdom to another.

As the principal defign of a yacht is to accommodate the paffengers, it is ufually fitted with a variety of convenient apartments, with fuitable furniture, according to the quality or number of the perfons contained therein.

The royal yachts are commonly rigged as ketches, except the principal one referved for the fovereign, which is equipped with three mafts like a fhip. They are in general elegantly furnifhed, and richly ornamented with fculpture ; and always commanded by captains in his majefty's navy.

Befides thefe, there are many other yachts of a fmaller kind, employed by the commiffioners of the excife, navy, and cuftoms ; or ufed as pleafure-boats by private gentlemen.

YAMS. See DIOSCOREA.

YAMBOO. See EUGENIA.

YARD *of a* SHIP, a long piece of timber fufpended upon the mafts of a fhip, to extend the fails to the wind. See MAST and SAIL.

All yards are either fquare or lateen ; the former of which are fufpended acrofs the mafts at right angles, and the latter obliquely. See Plate CCCCXLIV. fig. 1.

The fquare yards are nearly of a cylindrical furface. They taper from the middle, which is called the *flings*, towards the extremities, which are termed the *yard-arms* ; and the diftance between the flings and the yard-arms on each fide is by the artificers divided into quarters, which are diftinguifhed into the firft, fecond, third quarters, and yard-arms. The middle quarters are formed into eight fquares, and each of the end parts is figured like the fruftum of a cone. All the yards of a fhip are fquare except that of the mizen.

Yard.

The proportions for the length of yards, according to the different claffes of fhips in the Britifh navy, are as follows :

			Guns.
1000 : gun-deck : :	560 :	main-yard fig. 1. Pl. CCCLXIV — Note, the figure reprefents the yard and fails of a fhip of 74 guns.	100
	559 :		90 80
	570 :		70
	576 :		60
	575 :		50
	561 :		44
1000 : main-yard : :	880 :	fore-yard.	100 90 80
	874 :		all the reft.

To apply this rule to practice, fuppofe the gun-deck 144 feet. The proportion for this length is as 1000 is to 575, fo is 144 to 83 ; which will be the length of the main-yard in feet, and fo of all the reft.

			Guns.
1000 main-yard : :	820 :	mizen-yard	100 90 80 60 44
	847 :		70
	84[illegible] :		24
1000 : main-yard : :	7[illegible]6 :	main topfail-yard	24
	7[illegible] :		all the reft.
1000 : fore-yard : :	719 :	fore topfail-yard	70
	726 :		24
	715 :		all the reft
1000 : main topfail yard : : main top gall. yard all the rates.			
1000 fore topfail-yard : :	690 :	fore top gallant-yard.	[illegible]
	690 :		all the reft.
1000 : fore topfail yard : :	768 :	mizen topfail yard	70
	75[illegible] :		all the reft.

Crofs-jack and fprit-fail yards equal to the fore topfail-yard.

Sprit-topfail-yard equal to the fore top-gallant-yard.

The diameters of yards are in the following proportions to their length.

The main and fore yards five-fevenths of an inch to one yard. The topfail, crofs-jack, and fprit-fail yards, nine-fourteenths of an inch to one yard. The top gallant, mizen top-fail, and fprit-fail topfail yards, eight-thirteenths of an inch to one yard.

The mizen yard five-ninths of an inch to one yard.

All ftudding-fail booms and yards half an inch to one yard in length.

The lifts of the main-yard are exhibited in the above figure by *gg* ; the horfes and their ftirrups by *h*, *i* ; the reef-tackles and their pendents by *k*, *l* ; and the braces and brace-pendents by *m*, *n*.

The lateen-yards evidently derive their names from having

ving been peculiar to the ancient Romans. They are uſually compoſed of ſeveral pieces faſtened together by wooldings, which alſo ſerve as ſteps whereby the ſailors climb to the peek or upper extremity, in order to furl or caſt looſe the ſail.

The mizen-yard of a ſhip, and the main-yard of a bilander, are hung obliquely on the maſt, almoſt in the ſame manner as the lateen-yard of a xebec, ſettee, or polacre.

Yard, a meaſure of length uſed in Britain and Spain, conſiſting of three feet, chiefly to meaſure cloth, ſtuffs, &c.

Yard-Arm is that half of the yard that is on either ſide of the maſt, when it lies athwart the ſhip.

Yards alſo denotes places belonging to the navy, where the ſhips of war, &c. are laid up in harbour.—There are belonging to his majeſty's navy ſix great yards, *viz.* Chatham, Deptford, Woolwich, Portſmouth, Sheerneſs, and Plymouth; theſe yards are fitted with ſeveral docks, wharfs, lanches, and graving places, for the building, repairing, and cleaning of his majeſty's ſhips; and therein are lodged great quantities of timber, maſts, planks, anchors, and other materials: there are alſo convenient ſtore-houſes in each yard, in which are laid up vaſt quantities of cables, rigging, ſails, blocks, and all other ſorts of ſtores needful for the royal navy.

YARE, among ſailors, implies ready or quick: as, be yare at the helm; that is, be quick, ready, and expeditious at the helm. It is ſometimes alſo uſed for bright by ſeamen: as, to keep his arms yare; that is, to keep them clean and bright.

Yare, a river of Norfolk, which runs from weſt to eaſt through that county, paſſing by Norwich, and falling into the German ſea at Yarmouth.

YARMOUTH, a ſea-port town of Norfolk, with a market on Wedneſdays and Saturdays, and a fair on Friday and Saturday in Eaſter-week for petty chapmen. It is ſeated on the river Yare, where it falls into the ſea; and is a place of great ſtrength, both by art and nature, being almoſt ſurrounded with water; and there is a draw-bridge over the river. It is eſteemed the key of this coaſt, and is a clean handſome place, whoſe houſes are well built, it being a conſiderable town for trade. It has one large church, and a neat chapel, and the ſteeple of St Nicholas's is ſo high that it ſerves for a ſea-mark. It is governed by a mayor. The harbour is a very fine one, though it is very dangerous for ſtrangers in windy weather; and it has for its ſecurity a pretty ſtrong fort. It is 27 miles eaſt of Norwich, and 112 north-eaſt of London. E. Long. 1. 55. N. Lat. 52. 45.

Yarmouth, a town of the Iſle of Wight, in Hampſhire, with a market on Fridays, and one fair on July 25th for toys. It is ſeated on the weſtern part of the iſland, on the ſea-ſhore, and is encompaſſed with water; for, not many years ago a channel was cut through the peninſula, over which there is a draw-bridge, and it is defended by a ſtrong caſtle on the quay. It is a handſome place, whoſe houſes are chiefly built with ſtone, and covered with ſlate; and it ſends two members to parliament. The market is now diſuſed. W. Long. 1. 28. N. Lat. 50. 40.

YARN, wool or flax ſpun into thread, of which they weave cloth. See Cloth.

YARROW, in botany. See Achillæa.

YAWNING, an involuntary opening of the mouth, generally produced by wearineſs or an inclination to ſleep. Yawning, according to Boerhaave, is performed by expanding at one and the ſame time all the muſcles capable of ſpontaneous motion; by greatly extending the lungs; by drawing in gradually and ſlowly a large quantity of air; and gradually and ſlowly breathing it out, after it has been retained for ſome time and rarified; and then reſtoring the muſcles to their natural ſtate. Hence the effect of yawning is to move, accelerate, and equally diſtribute all the humours through all the veſſels of the body, and conſequently to qualify the muſcles and organs of ſenſation for their various functions.

Sanctorius obſerves, that a great deal is inſenſibly diſcharged, when nature endeavours to get rid of the retained perſpirable matter, by yawning and ſtretching of the limbs. To theſe a perſon is moſt inclined juſt after ſleep, becauſe a greater quantity going off by the pores of the ſkin than at other times, whenſoever a perſon wakes, the increaſing contraction that then happens cloſes a great deal of the perſpirable matter in the cutaneous paſſages, which will continually give ſuch irritations as excite yawning and ſtretching; and ſuch motions, by ſhaking the membranes of the whole body, and ſhifting the contacts of their fibres, and the incloſed matter, by degrees throw it off. Hence we ſee the reaſon why healthful ſtrong people are moſt inclined to ſuch motions, becauſe they perſpire moſt in time of ſleep, and therefore have more of the perſpirable matter to lodge in the pores, and greater irritations thereunto. The advantages of ſome little exerciſe juſt after waking in a morning are conſiderable, as it throws off all the perſpirable matter that is ready for its exit out of the body. When yawning is troubleſome, Hippocrates ſays that long deep reſpiration or drawing in the air at long intervals cures it.

YEAR, in aſtronomy and chronology. See Astronomy, n° 347. p. 520. and Kalendar.

The ancient Roman year was the lunar year, which, as firſt ſettled by Romulus, conſiſted only of ten months; *viz.* 1. March, containing 31 days. 2. April, 30. 3. May, 31. 4. June, 30. 5. Quintilis, 31. 6. Sextilis, 30. 7. September, 30. 8. October, 31. 9. November, 30. 10. December, 30.—in all 304 days; which came ſhort of the true lunar year by 50 days, and of the ſolar, by 61 days. Numa Pompilius corrected this irregular conſtitution of the year, and compoſed two new months, January and February, of the days that were uſed to be added to the former year.

The ancient Egyptian year, called alſo the *year of Nabonaſſar*, on account of the epocha of Nabonaſſar, is the ſolar year of 365 days, divided into 12 months, of 30 days each, beſides five intercalary days added at the end. The names, &c. of the months are as follows: 1. Thoth. 2 Paophi. 3. Athyr. 4. Chojac. 5. Tybi. 6. Mecheir. 7. Phamenoth. 8. Pharmuthi. 9. Pachon. 10. Pauni. 11. Epiphi. 12. Meſori; beſide the ἡμεραι επαγομεναι.

The ancient Greek year was lunar; conſiſting of 12 months, which at firſt had 30 days apiece, then alternately 30 and 29 days. computed from the firſt appearance of the new moon; with the addition of an emboliſmic month of 30 days every 3d, 5th, 8th, 11th, 14th, 16th, and 19th year of a cycle of 19 years; in order to keep the new and full moons to the ſame terms or ſeaſons of the year. Their year commenced with that new moon, the full moon of which comes next after the ſummer ſolſtice. The order, &c. of their months was thus: 1. Ἑκατομβαιων, containing 29 days. 2. Μεταγειτνιων, 30. 3. Βοηδρομιων, 29. 4. Μαιμακτηριων, 30. 5. Πυανεψιων, 29. 6 Ποσειδεων, 30. 7. Γαμηλιων, 29. 8. Ανθεστηριων, 30. 9. Ελαφηβολιων, 30. 10. Μουνυχιων, 30. 11. Θαργηλιων, 29. 12. Σκιροφοριων, 30.

The ancient Jewiſh year is a lunar year, conſiſting commonly of 11 months, which alternately contain 30 and 29 days. It was made to agree with the ſolar year, either by the adding of 11, and ſometimes 12 days, at the end of the year, or by an emboliſmic month. The names and quanti-

ties of the months stand thus: 1. Nisan, or Abib, 30 days. 2. Jiar, or Zius, 29. 3. Siban, or Siwan, 30. 4. Thammuz, or Tammuz, 29. 5. Ab, 30. 6. Elul, 29. 7. Tisri, or Ethanim, 30. 8. Marchesvam, or Bul, 29. 9. Cisleu, 30. 10. Tebeth, 29. 11. Sabat, or Schebeth, 30. 12. Adar, in the embolismic year, 30. Adar, in the common year, was but 29. Note, in the defective year, Cisleu was only 29 days; and in the redundant year, Marchesvam was 30.

The Persian year is a solar year of about 365 days; consisting of 12 months of 30 days each, with 5 intercalary days added at the end.

The Arabic, Mahometan, and Turkish years, called also the *year of the Hegira*, is a lunar year, equal to 354 days 8 hours and 48 minutes, and consists of 12 months, which contain alternately 30 and 29 days.

The Hindoo year differs from all these, and is indeed different in different provinces of India. The best account that we have of it is by Mr Cavendish, in the Phil. Trans. of the Royal Society of London for the year 1792. "Before I speak of the civil year of the Hindoos (says this eminent philosopher), it will be proper to say a few words of the astronomical year, by which it is regulated.

"The astronomical year begins at the instant when the sun comes to the first point of the Hindoo zodiac. In the year 1792, it began on April 9th, at 22h. 14' after midnight of their first meridian, which is about 41' of time west of Calcutta; but, according to Mr Gentil's account of the Indian astronomy, it began 3h. 24' earlier. As this year, however, is longer than ours, its commencement falls continually later, in respect of the Julian year, by 3° 26' in four years. This year is divided into 12 months, each of which corresponds to the time of the sun's stay in some sign; so that they are of different lengths, and seldom begin at the beginning of a day.

"The civil day in all parts of India begins at sunrise, and is divided into 60 parts called *dandas*, which are again divided into 60 palas. In those parts of India in which the Benares almanac, or as it is there called *patras*, is used, the civil year is lunisolar, consisting of 12 lunar months, with an intercalary month inserted between them occasionally. It begins at the day after the new moon next before the beginning of the solar year. The lunar month is divided into 30 parts called *teethees*; these are not strictly of the same length, but are equal to the time in which the moon's true motion from the sun is 12°. From the new moon till the moon arrives at 12° distance from the sun is called the first *teethee*; from thence till it comes to 24°, is called the second *teethee*; and so on till the full moon, after which the teethees return in the same order as before.

"The civil day is constantly called by the number of that teethee which expires during the course of the day; and as the teethee is sometimes longer than one day, a day sometimes occurs in which no teethee ends. When this is the case, the day is called by the same number as the following day; so that two successive days go by the same name. It oftener happens, however, that two tethees end on the same day; in which case the number of the first of them gives name to the day, and there is no day called by the number of the last, so that a gap is made in the order of the days. In the latter part of the month the days are counted from the full moon, in the same manner as in the former part they are counted from the new moon; only the last day, or that on which the new moon happens, is called the 30th, instead of the 15th. It appears, therefore, that each half of the month constantly begins on the day after that on which the new or full moon falls; only sometimes the half month begins with the second day, the first being wanting.

"This manner of counting the days is sufficiently intricate; but that of counting the months is still more so.

"The civil year, as was before said, begins at the day after the new moon; and, moreover, in the years which have an intercalary month, this month begins at the day after the new moon; but notwithstanding this, the ordinary civil month begins at the day after the full moon. To make their method more intelligible, we will call the time from new moon to new moon the natural month. The civil month Visākha, the first in the Hindoo kalender, which extends from the 9th of our April to the 10th of May, begins at the day after that full moon which is nearest to the instant at which the sun enters Mesha, the first in order of the Indian signs, whether before or after; however, it is not always accurately the nearest.

"A consequence of this way of counting the months is, that the first half of Chitra, the last month in the Indian kalender, extending from March the 10th to April the 9th, falls in one year, and the latter half in the following year; and whenever the sun enters no sign during a natural month, this month is intercalary. The number of days in the month varies from 29 to 32. Indeed the Hindoo months, both solar and lunar, consist neither of a determinate number of days, nor are regulated by any cycle, but depend solely on the motions of the sun and moon, so that a Hindoo has no way of knowing what day of the month it is but by consulting his almanac; and what is more, the month ought sometimes to begin on different days, in different places, on account of the difference in latitude aud longitude, not to mention the difference which may arise from errors in computation. This mode of computing time must be attended with many inconveniences; but in the transactions of civil life the Hindoos do not much regard it. A disagreement, however, in the computation of the teethee, which sometimes also happens, occasions no small perplexity; because by the teethees or lunar days are regulated most of their religious festivals. Every Brahmin in charge of a temple, or whose duty it is to announce the times for the observance of religious ceremonies, is therefore furnished with one of their almanacs; and if he be an astronomer, he makes such corrections in it as the difference of latitude and longitude render necessary."

New Year's Gift. See Gift.

YEAST, or Yest, a head or scum rising upon beer or ale while working or fermenting in the vat. See Brewing.

It is used for a leaven or ferment in the baking of bread, as serving to swell or puff it up very considerably in a little time, and to make it much lighter, softer, and more delicate. See Baking, Barm, and Bread.

Mr Henry has published a method of preparing artificial yeast, by which good bread may be made without the assistance of any other ferment. The method is this: Boil flour and water together to the consistence of treacle, and when the mixture is cold saturate it with fixed air. Pour the mixture thus saturated into one or more large bottles or narrow-mouthed jars; cover it over loosely with paper, and upon that lay a slate or board with a weight to keep it steady. Place the vessel in a situation where the thermometer will stand from 70° to 80°, and stir up the mixture two or three times in 24 hours. In about two days such a degree of fermentation will have taken place, as to give the mixture the appearance of yeast. With the yeast in this state, and before it has acquired a thoroughly vinous smell, mix the quantity of flour intended for bread, in the proportion of six pounds of flour to a quart of the yeast, and a sufficient portion of warm water. Knead them well together in

in a proper veſſel, and covering it with a cloth, let the dough ſtand for 12 hours, or till it appears to be ſufficiently fermented in the fore mentioned degree of warmth. It is then to be formed into loaves and baked. Mr Henry adds, that perhaps the yeaſt would be more perfect, it a decoction of malt were uſed inſtead of ſimple water.

It has lately been diſcovered, that a decoction of malt alone, without any addition, will produce a yeaſt proper enough for the purpoſe of brewing. This diſcovery was made by Joſeph Senyor, ſervant of the reverand Mr Maſon of Allon near Rotheram; and he received for it a reward of L. 20 from the Society for promoting Arts, Manufactures, and Commerce. The proceſs is as follows: Procure three earthen or wooden veſſels of different ſizes and apertures, one capable of holding two quarts, the other three or four, and the third five or ſix: boil a quarter of a peck of malt for about eight or ten minutes in three pints of water; and when a quart is poured off from the grains, let it ſtand in the firſt or ſmaller veſſel in a cool place till not quite cold, but retaining that degree of heat which the brewers uſually find to be proper when they begin to work their liquor. Then remove the veſſel into ſome warm ſituation near a fire, where the thermometer ſtands between 70 and 80 degrees Fahrenheit, and there let it remain till the fermentation begins, which will be plainly perceived within 30 hours: add then two quarts more of a like decoction of malt, when cool, as the firſt was; and mix the whole in the ſecond or larger veſſel, and ſtir it well in, which muſt be repeated in the uſual way, as it riſes in a common vat: then add a ſtill greater quantity of the ſame decoction, to be worked in the largeſt veſſel, which will produce yeaſt enough for a brewing of 40 gallons.

Common ale yeaſt may be kept freſh and fit for uſe ſeveral months by the following method: Put a quantity of it into a cloſe canvas bag, and gently ſqueeze out the moiſture in a ſcrew-preſs till the remaining matter be as firm and ſtiff as clay. In this ſtate it may be cloſe packed up in a tight caſk for ſecuring it from the air; and will keep freſh, ſound, and fit for uſe, for a long time. This is a ſecret that might be of great uſe to the brewers and diſtillers, who, though they employ very large quantities of yeaſt, ſeem to know no method of preſerving it, or raiſing nurſeries of it; for want of which they ſuſtain a very conſiderable loſs; whereas the brewers in Flanders make a very great advantage of ſupplying the malt diſtillers of Holland with yeaſt, which is rendered laſting and fit for carriage by this eaſy expedient.

YELL, one of the iſlands of Shetland, lying north-eaſt from the main land, and divided from it by an arm of the ſea, called *Yell-Sound*. By ſome it is thought to have been the *Thule* of the ancients. In the old deſcriptions it is ſaid to be 20 miles long and 8 broad. It is very mountainous and full of moſs; but there are pretty conſiderable paſtures in which they feed a great many ſheep; and it alſo affords plenty of peat. It has eight large harbours, which would not be thought deſpicable in other countries. Anciently it ſeems to have been pretty populous, ſince there are in it three churches, twenty chapels, and many brughs or Pictiſh forts.

YELLOW, one of the original colours of light.

Yellow-Colour for Houſe-painting. See Chemistry, nº 699.

Naples Yellow, a beautiful colour much uſed by painters, formerly thought to be prepared from arſenic, but now diſcovered to have lead for its baſis.

Yellow-Hammer, in ornithology. See Fringilla.

Yellow-Fever. See Medicine, nº 168.

YEMEN, a province of Arabia, ſtretching along the Red Sea and Indian Ocean, and forming a part of the country once known by the name of Arabia Felix.

YEOMAN, the firſt or higheſt degree among the plebeians of England, next in order to the gentry.

The yeomen are properly freeholders, who having land of their own, live on good huſbandry.

Yeomen is alſo a title of office in the king's houſehold, of a middle place or rank between an uſher and a groom.

Yeoman of the Guard were anciently 250 men of the beſt rank under gentry, and of larger ſtature than ordinary, each being required to be ſix feet high. At preſent there are but 100 yeomen in conſtant duty, and 70 more not in duty; and as any of the 100 dies, his place is ſupplied out of the 70. They go dreſſed after the manner of King Hen. VIII.'s time. They formerly had diet as well as wages when in waiting; but this was taken off in the reign of Queen Anne.

YEST, or Yeast. See Yeast.

YEW, in botany. See Taxus.

YNCA, an appellation anciently given to the kings of Peru, and the princes of their blood; the word literally ſignifying, lord, king, emperor, and royal blood.

YORK, or Yoke, in agriculture, a frame of wood fitted over the necks of oxen, whereby they are coupled together, and harneſſed to the plough.

York of Land, in our ancient cuſtoms, was the ſpace which a yoke of oxen, that is, two oxen, may plow in one day.

YOLK, the yellow part in the middle of an egg (ſee Egg). It contains a lymphatic ſubſtance mixed with a certain quantity of mild oil, which, on account of this mixture, is ſoluble in water. When expoſed to heat, it aſſumes a conſiſtence not ſo hard as the white of the egg; and when bruiſed gives out the oil which it contains. This oil has been uſed externally as a liniment.

YONNE, a river in France, which riſing in Burgundy, and running north through Nivernois and Champaign, falls into the Seyne at Monterau ſur Yonne.

YORK, in Latin *Eboracum*, the capital of Yorkſhire in England. This city is ſo ancient that the origin of it is uncertain. In the time of the Romans a legion was ſtationed here, it being then the capital of the Brigantes; and here died the emperor Severus, and Flavius Valerius Conſtantius Chlorus, father of Conſtantine the Great. There was then alſo a temple of Bellona here, and no leſs than three military ways went from hence. In the time of the Saxons it was erected into an archbiſhopric by Pope Honorius, to which are now ſubject the biſhoprics of Cheſter, Durham, Carliſle, and the Iſle of Man; though anciently 12 biſhoprics in England, and all Scotland, were. A horn is ſtill kept in the miniſter, by which Ulphius, one of the Saxon princes, beſtowed all his lands and revenues upon the church.

This city ſuffered very much during the ravages of the Danes; but, after the conqueſt, it began to flouriſh again. The cathedral, which coſt a long time and a great deal of money in building, is a moſt ſtately Gothic pile. Its chapter-houſe is particularly admired for its painted glaſs, its fine marble ſtalls, its pillars of alabaſter, and curious contrivance. In it is the following line in gold letters:

Ut Roſa, flos florum, ſic eſt Domus iſta Domorum.

The choir is remarkable for its fine carvings, particularly the ſtatues of all the Engliſh monarchs; and the windows are exquiſitely painted with the hiſtory of the Bible. The lanthorn ſteeple is 70 feet ſquare, and 188 high, and the windows are 45. At the ſouth end is a circular light, called

ed the *marigold window* from the colour of its glafs; and at the north end is a very large one, whofe painting reprefents embroidery.

This city is generally reckoned the fecond city in England; but though it ftands upon more ground, it is inferior in trade, wealth, and number of people, to Briftol. The inhabitants are reckoned at 12,784. It is fituate in a fine plain, in the middle of the fhire, on both fides the Oufe, walled and divided into four wards, containing 28 parifhes. It enjoys large privileges and immunities, conferred upon it by a fucceffion of kings from Henry II. and its chief magiftrate has the title of *lord mayor*, which is an honour peculiar to it and London. Richard II. made it a county of itfelf. The confervancy of moft of the rivers of the county, within certain limits, belongs to the lord mayor and aldermen. The middle arch of the bridge here over the Oufe is thought to equal the Rialto at Venice in architecture, height, and breadth, the diameter being 81 feet, and the height 51. Though this city is 60 miles diftant from the fea, yet fhips of 70 tons burden come up the river to it. The town-houfe or Guild-hall ftands upon the bridge, and is fuperior in all refpects to that of London. In the Popifh times there were nine abbeys here, and a vaft number of churches; but of the latter there are only 17 now. The fteeple of that of Allhallows is reckoned the fineft in England. The archbifhop has a fine palace; and the affembly-room, defigned by the earl of Burlington, is very noble. Here are plays, affemblies, concerts, and the like entertainments, at fome houfe or other, almoft every night in the week. In the old caftle, built originally by William the Conqueror, and repaired in 1701, the affizes are kept. It ferves alfo for the county-gaol, which is the neateft and pleafanteft in England, with an area larger than that of the King's-bench, and it has a handfome chapel in it, with a good allowance for a preacher. This city has long given the title of *duke* to fome branch of the royal family.

The plenty and cheapnefs of provifions induces many perfons of fmall fortune, or that would live frugally, to take up their abode here; and the venerable remains of Roman antiquities, and thofe of a later date, as abbeys, churches, and caftles, procure this city a vifit from every curious traveller. Many Roman altars, urns, coins, infcriptions, &c. have been found; and Saxon coins are ftill extant that have been ftruck here. The members for this city have precedence of all others, except thofe of London, in the houfe of commons. An infirmary, after the manner of thofe of Bath, Briftol, &c. hath been erected in it; and a cotton manufacture eftablifhed and brought to great perfection. Befides four weekly markets, it has a great many fairs; one, in particular, every other Thurfday for cattle and fheep. W. Long. 1. 1. N. Lat. 53. 59.

YORKSHIRE, the largeft county of England, bounded on the fouth by Derbyfhire, Nottinghamfhire, and Lincolnfhire; on the north by Durham and Weftmoreland; on the eaft by the German Ocean; and on the weft by Lancafhire and a part of Chefhire.—It is upwards of 80 miles in length from eaft to weft, nearly as much in breadth, and about 360 in circumference, containing, in the whole, 26 hundreds or wapentakes, 49 market-towns, 563 parifhes, 242 vicarages, with many chapels of eafe, and 2330 villages. Its area is computed by fome at 4684 fquare miles, by others at 3,770,000 acres, and its inhabitants at upwards of 530,000. It is divided into three parts or ridings, viz. the Weft, Eaft, and North; fo denominated from their fituation, in refpect of the city of York. Each of thefe is as large, if not larger, than any ordinary county. There are other divifions, as Richmondfhire, Allertonfhire, Howdenfhire, Hallanfhire, Craven, Cleveland, Marfhland, Holdernefs, &c. New-York.

As the foil and face of the country vary greatly, fo does the air. In the hilly parts the air is good, but the foil very indifferent: of the lower fome are marfhy, others drier, and the foil of both rich; but the air of the former is more foggy and unhealthy than that of the latter. The manufactures of this country are cutlery and hard-wares; particularly knives, bits, and fpurs; but the principal are ftockings and woollen cloth, with which it fupplies in a great meafure Germany and the North. As to the produce, it abounds in corn, cattle, horfes, lead and iron, coal, wood, lime, liquorice, alum, jet, &c. It lies wholly in the northern circuit, and much the greater part of it in the diocefe of York; that only which is called *Richmondfhire* belonging to the diocefe of Chefter. The members it fends to parliament are 30; of which two are for the fhire and 28 for the towns.

New-York, one of the United States of America, is bounded towards the fouth-eaft by the Atlantic Ocean; eaft by Connecticut, Maffachufets, and Vermont; north by the 45th degree of latitude, which divides it from Canada; northweftwardly by the river Iroquois or St Lawrence, and the lakes Ontario and Erie; fouthweft and fouth by Pennfylvania and New Jerfey. The whole ftate contains about 44,000 fquare miles, equal to 28,160,000 acres.

The fettlements already made in this ftate are chiefly upon two narrow oblongs, extending from the city of New York eaft and north. The one eaft is Long Ifland, which is 140 miles long, and narrow, and furrounded by the fea. The one extending north is about 40 miles in breadth, and bifected by Hudfon's river. And fuch is the interfection of the whole ftate by the branches of the Hudfon, the Delaware, the Sufquehannah, and other large rivers, that there are few places throughout its whole extent which are more than 15 or 20 miles from fome navigable ftream. There are few fifh in the rivers, but in the brooks are plenty of trout; and on the lakes yellow perch, fun-fifh, falmon-trout, catfifh, and a variety of others.

The State, to fpeak generally, abounds with lakes, fome of falt and others of frefh water. It is interfected by ridges of mountains running in a north-eaft and fouth weft direction. Beyond the Allegany mountains, however, the country is a dead level, of a fine rich foil, covered, in its natural ftate, with maple, beach, birch, cherry, black-walnut, locuft, hickory, and fome mulberry trees. On the banks of lake Erie are a few chefnut and oak ridges. Hemlock fwamps are interfperfed thinly through the country. All the creeks that empty into lake Erie have falls, which afford many excellent mill feats. Eaft of the Allegany mountains, the country is broken into hills with rich intervening valleys. The hills are clothed thick with timber, and when cleared afford fine pafture; the valleys, when cultivated, produce wheat, hemp, flax, peafe, grafs, oats, Indian corn. Of the commodities produced from culture, wheat is the ftaple; of which immenfe quantities are raifed and exported. Indian corn and peafe are likewife raifed for exportation; and rye, oats, barley, &c. for home confumption. In fome parts of the State excellent dairies are kept, which furnifh for the market butter and cheefe.

The fituation of New York, with refpect to foreign markets, has decidedly the preference to any other in the United States. It has at all feafons of the year a fhort and eafy accefs to the ocean. Its exports to the Weft Indies are, bifcuit, peafe, Indian corn, apples, onions, boards, ftaves, horfes, fheep, butter, cheefe, pickled oyfters, beef, and pork. But wheat is the ftaple commodity of the State, of which

two

Newyork. no less than 677,700 bushels were exported in the year 1775, besides 2555 tons of bread and 2828 tons of flour. Inspectors of flour are appointed to prevent impositions, and to see that none is exported but that which is deemed by them merchantable. Besides the above-mentioned articles, are exported flax-seed, cotton wool, sarsaparilla, coffee, indigo, rice, pig-iron, bar-iron, pot-ash, pearl-ash, furs, deer-skins, logwood, fustick, mahogany, bees wax, oil, Madeira wine, rum, tar, pitch, turpentine, whale fins, fish, sugars, molasses, salt, tobacco, lard, &c. but most of these articles are imported for re-exportation. In the year 1774, there were employed, in the trade of this State, 1075 vessels, whose tonnage amounted to 40,812.

Since the revolution the literature of the State has engaged the attention of the legislature. In one of their earliest sessions an act passed, constituting 21 gentlemen (of whom the governor and lieutenant-governor for the time being are members *ex officiis*) a body corporate and politic, by the name and style of "The regents of the university of the State of New York." They are intrusted with the care of literature in general in the State, and have power to grant charters of incorporation for erecting colleges and academies throughout the state—are to visit these institutions as often as they shall think proper, and report their state to the legislature once a-year. All degrees above that of master of arts are to be conferred by the regents. A universal toleration is granted in religion.

The supreme legislative powers of the State are vested in two branches, a senate and assembly. The members of the senate are elected by the freeholders of the State, who possess freehold estates to the value of L. 100 clear of debts. For the purpose of electing senators, the State is divided into four great districts, each of which chooses a certain number.

The assembly of the State is composed of representatives from the several counties, chosen annually in May. Every male inhabitant of full age, who has resided in the State six months preceding the day of election, and possessing a freehold to the value of L. 20, in the county where he is to give his vote; or has rented a tenement therein of the yearly value of forty shillings, and has been rated and actually paid taxes—is intitled to vote for representatives in assembly. The number of representatives is limited to 300.

The supreme executive power of the State is vested in a governor chosen once in three years by the freemen of the State. The lieutenant governor is, by his office, president of the senate; and, upon an equal division of voices, has a casting vote; but has no voice on other occasions. The governor has not a seat in the legislature; but as a member of the council of revision and council of appointment, he has a vast influence in the State. The council of revision is composed of the chancellor, the judges of the supreme court, or any of them, and the governor. In the year 1790 the number of inhabitants in this State was 340,120, of whom 21,324 were negroes.

New-York, a city of North America, capital of the State of the same name. It is situated at the south-west point of an island, at the confluence of Hudson and East rivers, and is about four miles in circumference. The situation is both healthy and pleasant. Surrounded on all sides by water, it is refreshed by cool breezes in summer, and the air in winter is more temperate than in other places under the same parallel. York Island is 15 miles in length, and hardly one in breadth. It is joined to the main by a bridge called King's Bridge. The channels between Long and Staten Islands, and between Long and York Islands, are so narrow as to occasion an unusual rapidity of the tides, which is increased by the confluence of the waters of Hudson and East rivers. This rapidity, in general, prevents the obstruction of the channel by ice. There is no bason or bay for the reception of ships, but the road where they lie in East river is defended from the violence of the sea by the islands which interlock with each other; so that, except that of Rhode Island, the harbour of New York, which admits ships of any burden, is the best of the United States. The number of inhabitants in 1786 was 23,614. New York is 97 miles north-east of Philadelphia. W. Long. 74. 5. W. Lat. 40. 43.

Young. YOUNG (Dr Edward), was the son of a clergyman of the same name, and was born about the year 1679. When sufficiently qualified, he was matriculated into All-Souls college, Oxford; and designing to follow the civil law, he took a degree in that profession. In this situation he wrote his poems called *The Last Day*, published in 1704; which coming from a layman gave universal satisfaction: this was soon after followed by another, intitled *The Force of Religion*, or *Vanquished Love*. These productions gained him a respectable acquaintance; he was intimate with Addison, and thus became one of the writers of the Spectator: but the turn of his mind leading him to the church, he took orders, was made one of the king's chaplains, and obtained the living of Welwyn in Hartfordshire, worth about L. 500 *per annum*, but he never rose to higher preferment. For some years before the death of the late prince of Wales, Dr Young attended his court pretty constantly; but upon his decease all his hopes of church preferment vanished; however, upon the death of Dr Hales, he was taken into the service of the princess-dowager of Wales, and succeeded him as her privy chaplain. When pretty far advanced in life, he married the lady Elizabeth Lee, daughter of the late earl of Litchfield. This lady was a widow, and had an amiable son and daughter, who both died young. What he felt for their loss, as well as for that of his wife, is finely expressed in his Night Thoughts, in which the young lady is characterised under the name of Narcissa; her brother by that of Philander; and his wife, though nameless, is frequently mentioned; and he thus, in an apostrophe to death, deplores the loss of all the three.

> Insatiate archer, could not once suffice!
> Thy shaft flew thrice, and thrice my peace was slain,
> And thrice ere thrice yon moon renew'd her horn.

He wrote three tragedies, *The Revenge*, *Busiris*, and *The Brothers*. His satires, called *Love of Fame the universal Passion*, are by many esteemed his principal performance; though Swift said the poet should have been either more angry or more merry: they have been characterised as a string of epigrams written on one subject, that tire the reader before he gets through them. His *Complaint*, or *Night Thoughts*, exhibit him as a moral and melancholy poet, and are esteemed his masterpiece. They form a species of poetry peculiarly his own, and in which he has been unrivalled by all those who attempted to write in this manner. They were written under the recent pressure of his sorrow for the loss of his wife, daughter, and son-in-law; they are addressed to Lorenzo, a man of pleasure and the world, and who, as it is insinuated by some, is his own son, but then labouring under his father's displeasure. As a prose-writer, he arraigned the prevailing manners of his time, in a work called *The Centaur not Fabulous*; and when he was above 80 years of age, published *Conjectures on Original Composition*. He published some other pieces; and the whole of his works are collected in 4 and 5 vols 12mo. Dr Young's turn of mind was naturally solemn; and he usually,

when at home in the country, ſpent many hours of the day walking in his own church yard among the tombs. His converſation, his writings, had all a reference to the life after this; and this turn of diſpoſition mixed itſelf even with his improvements in gardening. He had, for inſtance, an alcove with a bench, ſo painted near his houſe, that at a diſtance it looked as a real one which the ſpectator was then approaching. Upon coming up near it, however, the deception was perceived, and this motto appeared, *Inviſibilia non decipiunt*, "The things unſeen do not deceive us." Yet, notwithſtanding this gloomineſs of temper, he was fond of innocent ſports and amuſement; he inſtituted an aſſembly and a bowling-green in the pariſh of which he was rector, and often promoted the gaiety of the company in perſon. His wit was generally poignant, and ever levelled at thoſe who teſtified any contempt for decency and religion. His epigram, ſpoken extempore upon Voltaire, is well known; who happening in his company to ridicule Milton, and the allegorical perſonages of Death and Sin, Young thus addreſſed him:

> Thou art ſo witty, profligate, and thin,
> You ſeem a Milton with his Death and Sin.

One Sunday preaching in office at St James's, he found, that though he ſtrove to make his audience attentive he could not prevail. Upon which his pity for their folly got the better of all decorums, and he ſat back in the pulpit and burſt into a flood of tears. Towards the latter part of life he knew his own infirmities, and ſuffered himſelf to be in pupilage to his houſe-keeper; for he conſidered that, at a certain time of life, the ſecond childhood of age demanded its wonted protection. His ſon, whoſe boyiſh follies were long obnoxious to paternal ſeverity, was at laſt forgiven in his will; and our poet died regretted by all, having performed all that man could do to fill his poſt with dignity. His death happened in 1765.

Youth ‖ Yunx

YOUTH, that ſtate of man in which he approaches towards his greateſt perfection of body.

YPRES, a handſome, large, and populous town of the Auſtrian Netherlands, with a biſhop's ſee. It has a conſiderable manufactory in cloth and ſerges, and every year in Lent there is a conſiderable fair. It is one of the barrier towns, but was beſieged and taken by the French in 1744. It is ſeated on a fertile plain on the river Ypre, in E. Long. 2. 48. N. Lat 50. 51.

YUCCA, Adam's Needle, in botany; a genus of plants of the claſs *hexandria* and order *monogynia*. The corolla is campanulate and patent, there is no ſtyle, the capſule is trilocular. There are four ſpecies, none of which are natives of Britain. All of them are exceedingly curious in their growth, and are therefore much cultivated in gardens. The Indians make a kind of bread from the roots of this plant.

YULE, Yool, or *Iul*. See Iul.

YUNX, in zoology, a genus of birds of the order *picæ*. The bill is ſhort, roundiſh, and pointed; the noſtrils concave and naked; the tongue very long and cylindrical; there are two fore and two hind claws. There is only one ſpecies, the *torquilla*, wry-neck, which is a native of Europe, Aſia, and Africa, and is often ſeen in Britain. It is aſh-coloured above, with light black and brown ſtrokes. Beneath light brown, with black ſpots. Tail aſh-colour, with four black bars. Weight 1¼ oz. Irides hazel. Length 7 inches. Migrates.

Z.

Z, Zaara.

Z, or z, the 24th and laſt letter, and the 19th conſonant of our alphabet; the ſound of which is formed by a motion of the tongue from the palate downwards and upwards to it again, with a ſhutting and opening of the teeth at the ſame time. This letter has been reputed a double conſonant, having the ſound *ds*; but ſome think with very little reaſon: and, as if we thought otherwiſe, we often double it, as in *puzzle*, *muzzle*, &c. Among the ancients, Z was a numeral letter, ſignifying 2000; and with a daſh added a-top, Z̄ ſignified 2000 times 2000, or 4,000,000.

In abbreviations this letter formerly ſtood as a mark for ſeveral ſorts of weights; ſometimes it ſignified an ounce and a half; and very frequently it ſtood for half an ounce; ſometimes for the eighth part of an ounce, or a dram Troy weight; and it has in earlier times been uſed to expreſs the third part of an ounce or eight ſcruples. ZZ were uſed by ſome of the ancient phyſicians to expreſs myrrh, and at preſent they are often uſed to ſignify zinziber or ginger.

ZAARA, zahara, sahara, or *the Deſert*, a vaſt country of Africa, bounded on the north by Barbary, on the eaſt by Fezzan and Caſhna, on the ſouth by Tombuctoo, and on the weſt by the Atlantic Ocean. Zaara contains a variety of wandering nations, all proceeding from Arabs, Moors, and fugitive Portugueſe, who took refuge there when the family of the Sherifs made themſelves maſters of the three kingdoms of Barbary. All theſe people bear indiſcriminately the names of *Nars*, *Moors*, or *Arabs*. They are ſubdivided into various nations, of which the moſt conſiderable are the Mongearts, Traſars, and Bracnars. The Mongearts lead a wandering life, and live chiefly on the milk of their flocks, with a little barley-meal, and ſome dates. The poorer ſort go naked, except the females, who commonly wrap a clout about their middle, and wear a kind of bonnet on their head; but the wealthier ſort have a kind of looſe gown, made of blue callicoe, with large ſleeves, that is brought them from Negro-land. When they move from one place to another for freſh paſture, water, or prey, moſt of them ride on camels, which have generally a ſort of ſaddle between the bunch and the neck, with a ſtring or ſtrap run through their noſtrils, which ſerves for a bridle; and inſtead of ſpurs they uſe a ſharp bodkin. Their tents or huts are covered with a coarſe ſtuff, made of camel's hair, and a kind of wool or moſs that grows on the palm trees. Theſe Arabs live here under the government of their ſheiks or cheyks; as in Arabia, Egypt, and other places. The other two tribes are rather more civilized. They are all Mahometans.

Zaara, Zabulon.

ZABULON (anc. geog.), one of the twelve tribes; bounded on the north by the tribes of Aſher and Naphthali; on the eaſt by the ſea of Galilee; on the ſouth by the tribe of Iſſachar or the brook Ciſon, which ran between both; on the weſt by the Mediterranean; ſo that it touched two ſeas, or was bimarous.

Zabulon (anc. geog.), a very ſtrong town in the tribe

of that name, on the Mediterranean, firnamed *of men*, near Ptolemais: its vicinity to which makes it probable that it was alfo Chabulon, unlefs either name is a faulty reading in Jofephus; diftant about 60 ftadia from Ptolemais.

ZACYNTHUS (anc. geog.), an ifland to the fouth of Cephalenia 60 ftadia, but nearer to Peloponnefus, in the Ionian Sea, formerly fubject to Ulyffes, in compafs above 160 ftadia, woody and fruitful, with a confiderable cognominal town and a port. The ifland lies over againft Elis, having a colony of Achæans from Peloponnefus, over-againft the Corinthian Gulf. Both ifland and town are now called *Zante*.

ZAFFRE, is the oxyd of cobalt, employed for painting pottery ware and porcelain of a blue colour. The method of preparing it is as follows: The cobalt taken out of the mine is broken with hammers into pieces about the fize of an hen's egg; and the ftony involucrum, with fuch other heterogeneous matters as are diftinguifhable by the eye, are feparated as much as poffible. The chofen mineral is then pounded in ftamping mills, and fifted through brafs wire fieves. The lighter parts are wafhed off by water, and it is afterwards put into a large flat-bottomed arched furnace, refembling a baking oven, where the flame of the wood reverberates upon the ore; which is occafionally ftirred and turned with long handled iron hooks or rakes; and the procefs is continued till it ceafes to emit any fumes. The oven or furnace is terminated by a long horizontal gallery, which ferves for a chimney; in which the arfenic, naturally mixed with the ore, fublimes. If the ore contains a little bifmuth, as this femimetal is very fufible, it is collected at the bottom of the furnace. The cobalt remains in the ftate of a dark grey oxyd, and is called *zaffre*. One hundred pounds of the cobalt ore lofe 20 and even 30 *per cent*. during this operation, which is continued 4 or even 9 hours, according to the quality of the ore. The roafted ore being taken out from the furnace, fuch parts as are concreted into lumps are pounded and fifted afrefh. Zaffre, in commerce, is never pure, being mixed with two or rather three parts of powdered flints. A proper quantity of the beft fort of thefe, after being ignited in a furnace, are thrown into water to render them friable, and more eafily reduced to powder; which, being fifted, is mixed with the zaffre, according to the before-mentioned dofe; and the mixture is put into cafks, after being moiftened with water. This oxyd, fufed with three parts of fand and one of pot-afh, forms a blue glafs; which, when pounded, fifted, and afterwards ground in mills, included in large cafks, forms *fmalt*.

Magellan's Cronftedt's Mineralogy.

The blue of zaffre is the moft folid and fixed of all the colours that can be employed in vitrification. It fuffers no change from the moft violent fire. It is fuccefsfully employed to give fhades of blue to enamels, and to the cryftal-glaffes made in imitation of fome opaque and tranfparent precious ftones, as the lapis lazuli, the turquois, the fapphire, and others of this kind.

ZALEUCUS, a famous legiflator of the Locrians, and the difciple of Pythagoras, flourifhed 500 years B. C. He made a law, by which he punifhed adulterers with the lofs of both their eyes; and his fon offending, was not abfolved from this punifhment: yet, to fhow the father as well as the juft lawgiver, he put out his own right, and his fon's left eye. This example of juftice and feverity made fo ftrong an impreffion on the minds of his fubjects, that no inftance was found of the commiffion of that vice during the reign of that legiflator. It is added, that Zaleucus forbad any wine being given to the fick on pain of death, unlefs it was prefcribed by the phyficians; and that he was fo jealous of his laws, that he ordered, that whoever was defirous of changing them, fhould be obliged, when he made the propofal, to have a cord about his neck, in order that he might be immediately ftrangled, if thofe alterations were efteemed no better than the laws already eftablifhed. Diodorus Siculus attributes the fame thing to Charondas legiflator of the Sybarites.

ZAMA (anc. geog.), a town of Chamane, a diftrict of Cappadocia, of unknown fituation.—Another Zama, of Mefopotamia, on the Saocoras, to the fouth of Nifibis.—A third, of Numidia, diftant five days journey to the weft of Carthage: it was the other royal refidence of the kings of Numidia, hence called *Zama Regia*. It ftood in a plain; was ftronger by art than nature; richly fupplied with every neceffary; and abounding in men, and every weapon both of defence and annoyance.

The laft of thefe is remarkable for the decifive battle fought between the two greateft commanders in the world, Hannibal the Carthaginian and Scipio Africanus. Of this engagement, the moft important perhaps that ever was fought, Mr Hooke gives us the following account.

"Scipio drew up his army after the Roman manner, except that he placed the cohorts of the Principes directly behind thofe of the Haftati, fo as to leave fufficient fpace for the enemy's elephants to pafs through from front to rear. C. Lælius was pofted on the left wing with the Italian horfe, and Mafiniffa with his Numidians on the right. The intervals of the firft line Scipio filled up with his Velites, or light-armed troops, ordering them, upon a fignal given, to begin the battle; and in cafe they were repulfed, or broke by the elephants, to run back through the lanes before mentioned, and continue on their flight till they were got behind the Triarii. Thofe that were wounded, or in danger of being overtaken, were to turn off to the right and left through the fpaces between the lines, and that way efcape to the rear.

"The army thus drawn up, Scipio went from rank to rank, urging his foldiers to confider the confequences of a defeat and the rewards of victory: on the one hand, certain death or flavery (for they had no town in Africa ftrong enough to protect them); on the other, not only a lafting fuperiority over Carthage, but the empire of the reft of the world.

"Hannibal ranged all his elephants, to the number of above 80, in one front. Behind thefe he placed his mercenaries, confifting of 12,000 men, Ligurians, Gauls, Baleares, and Mauritanians.

"The new levies of Carthaginians and other Africans, together with 4000 Macedonians, under a general named *Sopater*, compofed the fecond line. And in the rear of all, at the diftance of about a furlong, he pofted his Italian troops, in whom he chiefly confided. The Carthaginian horfe formed his right wing, the Numidians his left.

"He ordered their feveral leaders to exhort their troops not to be difcouraged by their own weaknefs, but to place the hope of victory in him and his Italian army; and particularly directed the captains of the Carthaginians to reprefent to them what would be the fate of their wives and children if the event of this battle fhould not prove fuccefsful. The general himfelf, walking through the ranks of his Italian troops, called upon them to be mindful of the 17 campaigns in which they had been fellow-foldiers with him; and of that conftant feries of victories by which they had extinguifhed in the Romans all hope of ever being conquerors. He urged them to remember, above all, the battles of Trebia, Thrafymenus, and Cannæ; with any of which the approaching battle was in no wife to be compared, either with refpect to the bravery or the number of the enemy. 'The Romans were yet unfoiled, and in the height of their ftrength, when you firft met them in the field; neverthelefs you

you vanquished them. The soldiers now before us are either the children of the vanquished, or the remains of those whom you have often put to flight in Italy. Maintain therefore your general's glory and your own, and establish to yourselves the name of invincible, by which you are become famous throughout the world.'

"When the Numidians of the two armies had skirmished a while, Hannibal ordered the managers of the elephants to drive them upon the enemy. Some of the beasts, frightened at the noise of the trumpets and other instruments of war which sounded on all sides, immediately ran back amongst the Numidians of the Carthaginian left wing, and put them into confusion; which Masinissa taking advantage of, entirely routed them. Great destruction was made of the Velites by the rest of the elephants, till these also being terrified, some of them ran through the void spaces of the Roman army which Scipio had left for that purpose; others falling in among the cavalry of the enemy's right wing, gave Lælius the same opportunity against the Carthaginian horse as had been given to Masinissa against the Numidian, and of which the Roman did not fail to make the same use. After this the infantry of the foremost lines joined battle. Hannibal's mercenaries had the advantage in the beginning of the conflict; but the Roman Hastati, followed and encouraged by the Principes, who exhorted them to fight manfully, and showed themselves ready to assist them, bravely sustained the attack, and at length gained ground upon the enemy. The mercenaries not being seasonably supported by their second line, and therefore thinking themselves betrayed, they in their retreat fell furiously upon the Africans; so that these, the Hastati coming up, were obliged to fight for some time both against their own mercenaries and the enemy. When the two Carthaginian lines had ceased their mutual rage, they joined their strength; and though now but a mere throng of men, broke the Hastati: but then the Principes advancing to the assistance of the latter, restored the battle; and most of the Africans and mercenaries were here cut off. Hannibal did not advance to their relief, the Roman Triarii not having yet engaged, and the Principes being still in good order; and lest the routed Africans and mercenaries should break the ranks of his Italian soldiers, he commanded these to present their spears at those who fled to them for protection, which obliged the runaways to move off to the right and left.

"The ground over which the Romans must march before they could attack Hannibal being strewed with heaps of dead bodies and weapons, and being slippery with blood, Scipio feared that the order of his battalions would be broke, should he pass it hastily. To avoid this mischief, he commanded the Hastati to give over the pursuit, and halt where they were, opposite to the enemy's centre: after which, having sent all his wounded to the rear, he advanced leisurely with the Principes and Triarii, and placed them on the wings of the Hastati. Then followed a sharp engagement, in which victory was long and eagerly disputed. It would seem that the Romans, though superior in number, were once upon the point of losing the day; for Polybius tells us, that Masinissa and Lælius came very seasonably, and as if sent from heaven, to their assistance. These generals being returned from the pursuit of the cavalry, fell suddenly upon the rear of Hannibal's men, most of whom were cut off in their ranks; and of those that fled, very few escaped the horse, the country all around being a plain.

"There died of the Carthaginians in the fight above 20,000, and almost the like number were taken prisoners. The loss on the side of the Romans amounted to about 2000 men. Hannibal escaped with a few horse to Adrumetum, having performed every thing in the engagement which could be expected from a great general. His army (says Polybius) could not have been more skilfully drawn up. For as the order of the Roman battalions makes it extremely difficult to break them, the Carthaginian wisely placed his elephants in the front, that they might put the enemy in confusion before the armies should engage. In his first line he placed the mercenaries; men bold and active, but not well disciplined, that by their impetuosity he might give a check to the ardour of the Romans. The Africans and Carthaginians, whose courage he doubted, he posted in the middle between the mercenaries and his Italian soldiers, that they might be forced to fight, or at least that the Romans, by slaughtering them, might fatigue themselves and blunt their weapons. Last of all, he drew up the troops he had disciplined himself, and in whom he chiefly confided, at a good distance from the second line, that the might not be broken by the route of the Africans and mercenaries, and kept them in reserve for a vigorous attack upon a tired and weakened enemy."

Zanguebar
Zante.

ZANGUEBAR, a country in Africa, lying on the eastern coast, between three degrees of north latitude, and 18 south. It includes several petty kingdoms, in which the Portuguese have various settlements. The inhabitants, except those converted by the Portuguese, are all Mahometans or idolaters; and the latter much the more numerous. The names of the principal territories are *Mombaza*, *Lamon*, *Melinda*, *Quiola*, and *Mosambique*. The Portuguese have built several forts in Mombaza and Mosambique, and have settled several colonies there. They trade with the negroes for slaves, ivory, gold, ostrich-feathers, wax, and drugs. The productions are much the same as in other parts of Africa between the tropics.

ZANONIA, in botany; the name of a genus of plants of the order *diœcia*, class *pentandria*. The characters are these: it produces separate male and female flowers; in the male flower the cup is a perianthium, composed of three leaves of an oval figure, expanding every way, and shorter than the flower; the flower is monopetalous, but divided into five segments, and has an open mouth; the segments are jagged, and are equal in size, and bend backwards; the stamina are five filaments of the length of the cup, standing open at their ends, and terminated by simple apices; the female flowers grow on separate plants, and have the cup and flower the same as in the male, only that the cup stands upon the germen of the pistil; this germen is oblong, and from it are propagated three reflex conic styles; the stigmata are bifid and curled; the fruit is a long and very large berry, truncated at the end, and very small at the base; it contains three cells, and has a curled suture near the apex; the seeds are two; they are of an oblong figure, and flat. There is one species, the *indi a*.

ZANTE, an island of the Mediterranean, near the coast of the Morea, 19 miles south-east of the island of Cephalonia, belonging to the Venetians. It is about 24 miles in length and 12 in breadth, and very pleasant and fertile; but its principal riches consist in currants, with which it greatly abounds. They are cultivated in a very large plain, under the shelter of mountains on the shore of this island; for which reason the sun has greater power to bring them to perfect maturity. The town called *Zante* may contain near 20,000 inhabitants; the whole island contains about 40,000. The houses are low, on account of the frequent earthquakes, for scarce a year passes without one; however, they do no great damage. The natives speak both Greek and Italian. There are very few Roman Catholics among them; but they have a bishop as well as the Greeks. This place has no fortifications, but there is a fortress upon an eminence

planted with cannon. In one part of this iſland is a place which ſhakes when trod upon like a quagmire; and a ſpring which throws out a great deal of bitumen, eſpecially at the time of an earthquake. It ſerves inſtead of pitch to pay the bottoms of the ſhips, and about 100 barrels in a year are uſed for this purpoſe. There are about 50 villages in the iſland; but no other large town beſide Zante. It is ſeated on the eaſtern ſide of the iſland, and has a good harbour. The Engliſh and Dutch have each a factory and conſul here. E. Long. 21. 3. N. Lat. 37. 53.

ZANTHOXYLUM, the TOOTHACH-TREE, in botany; a genus of plants of the claſs of *diœcia*, and order of *pentandria*; and in the natural ſyſtem arranged under the 46th order, *Hederaceæ*. The calyx is quinquepartite; there is no corolla; the female flower has five piſtils and as many monoſpermous capſules. There are two ſpecies, the clava *herculis*, and the *trifoliatum*; neither of which are natives of Britain.

ZAPATA, a kind of feaſt or ceremony held in Italy, in the courts of certain princes, on St Nicholas's day; wherein people hide preſents in the ſhoes or ſlippers of thoſe they would do honour to, in ſuch a manner as may ſurpriſe them on the morrow when they come to dreſs; being done in imitation of the practice of St Nicholas, who uſed in the night-time to throw purſes of money in at the windows to marry poor maids withal.

ZEA, INDIAN CORN, in botany; a genus of plants of the claſs *monœcia*, order *triandria*. The male-flowers are placed on diſtinct ſpikes; the calyx is a biflorous, beardleſs glume; the corolla a beardleſs glume; the female calyx is a bivalve glume, as is the corolla. There is one filiform, pendulous ſtyle; the ſeeds are ſolitary and buried in an oblong receptacle. There is only one ſpecies, the *Mays*, maize. The Indians in New England, and many other parts of America, had no other vegetable but maize or Indian corn for making their bread. They call it *weachin*; and in the United States of America there is much of the bread of the country made of this grain, not of the European corn. In Italy and Germany alſo there is a ſpecies of maize which is the food of the poor inhabitants.

The ear of the maize yields a much greater quantity of grain than any of our corn ears. There are commonly about eight rows of grain in the ear, often more, if the ground be good. Each of theſe rows contains at leaſt 30 grains, and each of theſe gives much more flour than a grain of any of our corn. The grains are uſually either white or yellowiſh; but ſometimes they are red, bluiſh, greeniſh, or olive-coloured, and ſometimes ſtriped and variegated. This ſort of grain, though ſo eſſentially neceſſary to the natives of the place, is yet liable to many accidents. It does not ripen till the end of September; ſo that the rains often fall heavy upon it while on the ſtalk, and the birds in general peck it when it is ſoft and unripe. Nature has, to defend it from theſe accidents, covered it with a thick huſk, which keeps off ſlight rains very well; but the birds, if not frighted away, often eat through it, and devour great quantity of the grain.

There are three or four varieties of maize in different parts of America. That of Virginia is very tall and robuſt, growing to ſeven or eight feet high; that of New England is ſhorter and lower. And the Indians farther up in the country have a yet ſmaller kind in common uſe. The ſtalk of the maize is joined like the ſugar-cane; it is very ſoft and juicy, and the juice is ſo ſweet and ſaccharine, that a ſyrup, as ſweet as that of ſugar, has been often made of it; and things ſweetened with it have been found not diſtinguiſhable from thoſe done with ſugar. It has not been tried yet whether it will cryſtallize into ſugar; but in all probability it will.

The Americans plant this corn any time from the beginning of March to the beginning of June; but the beſt ſeaſon is the middle of April. The ſavage Indians, who knew nothing of our account of months, uſed to guide themſelves in the ſeed-time of this uſeful plant by the budding of ſome particular trees of that country, and by the coming up of a ſort of fiſh into their rivers which they call the *aloofe*. Theſe things were both ſo regular, that they were in no danger of miſtaking the time.

The manner of planting maize is in rows, at equal diſtances, every way about five or ſix feet. They open the earth with a hoe, taking away the ſurface to three or four inches deep, and of the breadth of the hoe; they then throw in a little of the finer earth, ſo as to leave the hoe four inches deep or thereabouts, and in each of theſe holes they place four or five grains at a little diſtance from one another. If two or three of theſe grow up, it is very well; ſome of them are uſually deſtroyed either by the birds or other animals.

When the young plants appear, they hoe up the weeds from time to time; and when the ſtalk gathers ſome ſtrength, they raiſe the earth a little about it, and continue this at every hoeing till it begins to put forth the ears; then they enlarge the hill of earth, round the root, to the ſize of a hop-hill, and after this they leave it till the time of harveſt, without any farther care. When they gather the ears, they either immediately ſtrip off the corn, or elſe hang up the ears, tied in traces at diſtances from one another; for if they are laid near together, they will heat and rot or elſe ſprout and grow; but kept cool and ſeparate, they will remain good all the winter. The beſt method is to threſh out the corn as ſoon as the harveſt is over, to dry it well on mats in the ſun, and then lay it up in holes of the ground, well lined with mats, graſs, or the like, and afterwards covered at top with more earth. The moſt careful among the Indians uſe this method, and this ſort of ſubterranean granary always proves good.

The uſes of this plant among the Indians are very many. The great article is the making their bread of it; but beſides this, the ſtalks, when cut up before they are too much dried, are an excellent winter food for cattle; but they uſually leave them on the ground for the cattle to feed on. The huſks about the ear are uſually ſeparated from the reſt, and make a particular ſort of fodder, not inferior to our hay. The Indian women have a way of ſlitting them into narrow parts, and they then weave them artificially into baſkets and many other toys. The original way of eating the grain among the Indians was this: they boiled it whole in water till it ſwelled and became tender, and then they fed on it either alone or eat it with their fiſh and veniſon inſtead of bread. After this, they found the way of boiling it into a ſort of pudding, after bruiſing it in a mortar; but the way of reducing it to flour is the beſt of all. They do this by parching it carefully in the fire, without burning, and then beating it in mortars and ſifting it. This flour they lay up in bags as their conſtant proviſion, and take it out with them when they go to war, eating it either dry or with water. The Engliſh have contrived, by mixing it into a ſtiff paſte, either by itſelf or with rye or wheat-meal, fermenting it with leaven or yeaſt, and baking it in a hot oven, to make good bread of it. They have likewiſe found out a method of making good beer, either of the bread or by malting the grain.

ZEAL, paſſionate ardour for any perſon or cauſe. It is moſt frequently uſed to denote a ſtrong and warm attachment

ment to the distinguishing doctrines or worship of some particular sect of Christians. Thus we say, a zealous *Calvinist*, *Arminian*, or *Papist*; though we may likewise with the greatest propriety say of an upright and benevolent man, that he is zealous of *good works*.

ZEALAND, the chief of the Danish islands, is situated at the entrance of the Baltic Sea, bounded by the Schaggerrac Sea on the north; by the Sound, which separates it from Schonen, on the east; by the Baltic Sea on the south; and by the strait called the *Great Belt*, which separates it from the island of Funen, on the west; being of a round figure, near 200 miles in circumference: the chief town is Copenhagen.

ZEALAND, is also a province of the United Netherlands, consisting of eight islands, which lie in the mouth of the river Scheld, bounded by the province of Holland, from which they are separated by a narrow channel on the north; by Brabant on the east; by Flanders, from which they are separated by one of the branches of the Scheld, on the south; and by the German Ocean on the west.

New ZEALAND, a country of Asia, in the South Pacific Ocean, first discovered by Tasman, the Dutch navigator, in the year 1642, who gave it the name of *Staten Land*, though it has been generally distinguished in our maps and charts by the name of *New Zealand*, and was supposed to be part of a southern continent: but it is now known, from the late discoveries of Captain Cook who sailed round it, to consist of two large islands, divided from each other by a strait four or five leagues broad. They are situated between the latitudes of 34 and 48 degrees south, and between the longitudes of 166 and 180 degrees east from Greenwich. One of these islands is for the most part mountainous, rather barren, and but thinly inhabited; but the other is much more fertile, and of a better appearance. In the opinion of Sir Joseph Banks and Dr Solander, every kind of European fruits, grain, and plants, would flourish here in the utmost luxuriance. From the vegetables found here, it is supposed that the winters are milder than those in England, and the summers not hotter, though more equally warm; so that it is imagined, that if this country were settled by people from Europe, they would, with moderate industry, be soon supplied, not only with the necessaries, but the luxuries of life, in great abundance. Here are forests of vast extent, filled with very large timber trees; and near 400 plants were found here that had not been described by the naturalists. The inhabitants of New Zealand are stout and robust, and equal in stature to the largest Europeans. Their colour in general is brown, but in few deeper than that of the Spaniard who has been exposed to the sun, and in many not so deep; and both sexes have good features. Their dress is very uncouth, and they mark their bodies in a manner similar to the inhabitants of Otaheite, and which is called *tattowing*. Their principal weapons are lances, darts, and a kind of battle-axes; and they have generally shown themselves very hostile to the Europeans who have visited them.

ZEALOTS, an ancient sect of the Jews, so called from their pretended zeal for God's law and the honour of religion.

ZEBRA, in zoology. See EQUUS.

ZEBU, in zoology; a name given by M. de Buffon to the bos indicus of Linnæus. See BOS, vi.

ZECHARIAH, a canonical book of the Old Testament. See SCRIPTURE, n° 80.

ZECHIN, or ZECCHINO. See SEQUIN.

ZEDOARY, in the materia medica. See KÆMPFERIA.

ZELL, a city of Germany in the circle of Lower Saxony, capital of the duchies of Zell and Lunenburg, situated at the confluence of the rivers Aller and Fuhse, 30 miles north of Hanover, and 40 south of Lunenburg. E. Long. 10. 12. N. Lat. 52. 49.

ZEMBLA NOVA, a very large island, lying in the Northern Ocean, to the north of Russia, from which it is separated by the strait of Waigate. It has no inhabitants except wild beasts, particularly white foxes and bears. In 1595 a Dutch vessel was cast away on the coast, and the ship's company were obliged to winter here; but they did not see the sun from the fourth of November to the beginning of February, and had great difficulty to keep themselves from being frozen to death.

ZEMINDAR. See HINDOSTAN, Vol. VIII. page 585.

ZEND, or ZENDAVESTA, a book ascribed to Zoroaster, and containing his pretended revelations; which the ancient Magicians and modern Persees, called also *Gaurs*, observe and reverence in the same manner as the Christians do the Bible, and the Mahometans the Koran, making it the sole rule both of their faith and manners. The word, it is said, originally signifies any instrument for kindling fire, and is applied to this book to denote its aptitude for kindling the flame of religion in the hearts of those who read it.

The Zend contains a reformed system of Magianism; teaching that there is a Supreme Being, eternal, self-existent, and independent, who created both light and darkness, out of which he made all other things; that these are in a state of conflict, which will continue till the end of the world; that then there shall be a general resurrection and judgment; and that just retribution shall be rendered unto men according to their works; that the angel of darkness with his followers shall be consigned to a place of everlasting darkness and punishment, and the angel of light with his disciples introduced into a state of everlasting light and happiness; after which light and darkness shall no more interfere with each other. The Zend also enjoins the constant maintenance of sacred fires and fire-temples for religious worship; the distinction of clean and unclean beasts; the payment of tithes to priests, which are to be of one family or tribe; a multitude of washings and purifications, resembling those of the Jewish law; and a variety of rules and exhortations for the exercise of benevolence and charity.

In this book there are many passages evidently taken out of the Scriptures of the Old Testament, particularly out of the Psalms of David: The author represents Adam and Eve as the first parents of all mankind, gives in substance the same account of the creation and deluge with Moses, differing indeed with regard to the former, by converting the six days of the Mosaic account into six times, comprehending in the whole 365 days; and speaks also of Abraham, Joseph, Moses, and Solomon. Moreover, Dr Baumgarten asserts, that this work contains doctrines, opinions, and facts, actually borrowed from the Jews, Christians, and Mahometans; whence, and from other circumstances, he concludes that both the history and writings of this prophet were probably invented in the later ages, when the fire-worshippers under the Mahometan government thought fit to vindicate their religion from the suspicion of idolatry.

At whatever period the Zend may have been written, we are assured by Dr Hyde that it is in the pure old Persian language, and in the character called *Pehlavi*. Some parts of it contain the original text, and others Zoroaster's second thoughts subjoined, for explaining more fully his doctrine. These were occasioned by the opposition of adversaries, and unforeseen circumstances which occurred during the fabrication of the imposture. About 300 years

ago

Zendish, Zeno. ago, when the old Persian language had become antiquated and little understood, one of the destours or high-priests among the Persees composed the *Saddu*, which is a compendium in the vulgar or modern Persic tongue, of those parts of the Zend that relate to religion, or a kind of code of canons and precepts, drawn from the theological writings of Zoroaster, serving as an authoritative rule of faith and practice for his followers. This Sadda is written in a low kind of Persic verse, and, as Dr Hyde informs us, it is *bonorum & malorum farrago*, having many good and pious things, and others very superstitious and trifling. See PERSEES and ZOROASTER.

ZENITH, in astronomy, the vertical point, or a point in the heavens directly over our heads.

ZENO ELEATES, an eminent Grecian philosopher, was born at Elea about 504 years before Christ. He was a zealous friend of civil liberty, and is celebrated for his courageous and successful opposition to tyrants; but the inconsistency of the stories related by different writers concerning him in a great measure destroys their credit. He chose to reside in his small native city of Elea rather than at Athens, because it afforded freer scope to his independent and generous spirit, which could not easily submit to the restraints of authority. It is related, that he vindicated the warmth with which he resented reproach, by saying, "If I were indifferent to censure, I should also be indifferent to praise." The invention of the dialectic art has been improperly ascribed to Zeno; but there can be no doubt that this philosopher, and other metaphysical disputants in the Eleatic sect, employed much ingenuity and subtlety in exhibiting examples of most of the logical arts, which were afterwards reduced to rule by Aristotle and others.

Enfield's History of Philosophy.

According to Aristotle, he taught, that nothing can be produced either from that which is similar or dissimilar; that there is only one being, God; who is eternal, homogeneous, and spherical, neither finite nor infinite, neither quiescent nor moveable; that there are many worlds; that there is in nature no vacuum; that all bodies are composed of four elements, heat and moisture, cold and dryness; and that the body of man is from the earth, and his soul an equal mixture of these four elements. He argued with great subtlety against the possibility of motion. If Seneca's account of this philosopher deserves credit, he reached the highest point of scepticism, and denied the real existence of external objects. The truth is, that after all that has been advanced by different writers, it is impossible to determine whether Zeno understood the term *One*, metaphysically, logically, or physically; or whether he admitted or denied a nature properly divine.

ZENO, the founder of the sect of the Stoics, was born about 300 years before Christ, at Citium in the island of Cyprus. This place having been originally peopled by a colony of Phœnicians, Zeno is sometimes called a Phœnician. His father was by profession a merchant, but discovering in the youth a strong propensity towards learning, he early devoted him to philosophy. In his mercantile capacity he had frequent occasion to visit Athens, where he purchased for his son several of the writings of the most eminent Socratic philosophers. These he read with great avidity; and when he was about 30 years of age, he determined to take a voyage to a city which was so celebrated both as a mart of trade and of science. If it be true, as some writers relate, that he brought with him a valuable cargo of Phœnician purple, which was lost by shipwreck upon the coast of Piræus, this circumstance will account for the facility with which he at first attached himself to a sect whose leading principle was the contempt of riches. Upon his first arrival in Athens, going accidentally into the shop of a bookseller, he took up a volume of the Commentaries of Xenophon; and after reading a few passages, was so much delighted with the work, and formed so high an idea of the author, that he asked the bookseller where he might meet with such men. Crates the Cynic philosopher happening at that instant to be passing by, the bookseller pointed to him, and said, "Follow that man." Zeno attended upon the instructions of Crates, and was so well pleased with his doctrine that he became one of his disciples. But though he admired the general principles of the Cynic school, he could not easily reconcile himself to their peculiar manners. Besides, his inquisitive turn of mind would not allow him to adopt that indifference to every scientific enquiry which was one of the characteristic distinctions of the sect. He therefore attended upon other masters, who professed to instruct their disciples in the nature and causes of things. When Crates, displeased at his following other philosophers, attempted to drag him by force out of the school of Stilpo, Zeno said to him, "You may seize my body, but Stilpo has laid hold of my mind." After continuing to attend upon the lectures of Stilpo several years, he passed over to other schools, particularly to those of Xenocrates and Diodorus Cronus. By the latter he was instructed in dialectics. He was so much delighted with this branch of study, that he presented to his master a large pecuniary gratuity, in return for his free communication of some of his ingenious subtleties. At last, after attending almost every other master, he offered himself as a disciple of Polemo. This philosopher appears to have been aware, that Zeno's intention in thus removing from one school to another, was to collect materials from various quarters for a new system of his own; for, when he came into Polemo's school, he said to him, "I am no stranger, Zeno, to your Phœnician arts; I perceive that your design is to creep slyly into my garden, and steal away my fruit." Polemo was not mistaken in his opinion. Having made himself master of the tenets of others, Zeno determined to become the founder of a new sect. The place which he made choice of for his school was a public portico, adorned with the pictures of Polygnotus, and other eminent painters. It was the most famous portico in Athens, and called, by way of eminence, Στοα, "the Porch." It was from this circumstance that the followers of Zeno were called *Stoics*.

In his person Zeno was tall and slender; his aspect was severe, and his brow contracted. His constitution was feeble, but he preserved his health by great abstemiousness. The supplies of his table consisted of figs, bread, and honey; notwithstanding which, he was frequently honoured with the company of great men. In public company, to avoid every appearance of an assuming temper, he commonly took the lowest place. Indeed so great was his modesty, that he seldom chose to mingle with a crowd, or wished for the company of more than two or three friends at once. He paid more attention to neatness and decorum in external appearance than the Cynic philosophers. In his dress indeed he was plain, and in all his expences frugal; but this is not to be imputed to avarice, but a contempt of external magnificence. He showed as much respect to the poor as to the rich; and conversed freely with persons of the meanest occupations. He had only one servant, or, according to Seneca, none.

Zeno lived to the extreme age of 98; and at last, in consequence of an accident, voluntarily put an end to his life. As he was walking out of his school he fell down, and in the fall broke one of his fingers; upon which he was so affected with a consciousness of infirmity, that, striking the earth, he said, "Why am I thus importuned? I obey thy summons;" and immediately went home and strangled himself.

ſelf. He died in the firſt year of the 129th Olympiad. The Athenians, at the requeſt of Antigonus, erected a monument to his memory in the Ceramicum.

We ought not to confound the two Zenos already mentioned with

ZENO, a celebrated Epicurean philoſopher, born at Sidon, who had Cicero and Pomponius Atticus for his diſciples, and who wrote a book againſt the mathematics, which, as well as that of Poſſidonius's refutation of it, is loſt; nor with ſeveral other *Zenos* mentioned in hiſtory.

ZENOBIA, queen of Palmyra. See PALMYRA.

ZEOLITE. See CLAY, Vol. V. page 49. and MINERALOGY, Vol. XII. page 88.

ZEPHANIAH, a canonical book of the Old Teſtament. See SCRIPTURE, n° 79.

ZEPHYR, the *Weſt-Wind*, or that which blows from the cardinal point of the horizon oppoſite to the eaſt.

ZEPHYRUS, one of the Pagan deities, was repreſented as the ſon of Aurora, and the lover of the nymph Chloris, according to the Greeks, or of Flora according to the Romans; and as preſiding over the growth of fruits and flowers. He is deſcribed as giving a refreſhing coolneſs to the air by his ſoft and agreeable breath, and as moderating the heat of ſummer by fanning the air with his ſilken wings. He is depictured under the form of a youth, with a very tender air, with wings reſembling thoſe of the butterfly, and with his head crowned with a variety of flowers. As the poets of Greece and Rome lived in a warm climate, they are laviſh in their praiſe of this beneficent deity, and under his name deſcribe the pleaſure and advantage they received from the weſtern breezes.

ZERDA. See CANIS, Sp. xiv.

ZERTA, the ZERTE, a fiſh caught in the rivers of Italy and ſome other places, of the figure of the chub, and called by authors *capito anadromus*, and the *blike*. It ſeldom grows to more than two pounds weight, and at times lives in rivers, at times in the ſea; and is eſteemed a very well taſted fiſh, eſpecially a little before the ſeaſon of its ſpawning. The zerte is that ſpecies of cyprinus deſcribed by Geſner and others under the name of *capito anodromus*.

ZEST, the woody thick ſkin quartering the kernel of a walnut; preſcribed by ſome phyſicians, when dried and taken with white-wine, as a remedy againſt the gravel.

Zeſt is alſo uſed for a chip of orange or lemon peel; ſuch as is uſually ſqueezed into ale, wine, &c. to give it a flavour; or the fine oil which ſpurts out of that peel on ſqueezing it.

ZEUGMA, a figure in grammar, whereby an adjective or verb which agrees with a nearer word, is alſo, by way of ſupplement, referred to another more remote.

ZEUS, in ichthyology, a genus of fiſhes of the order of *thoracici*. The head is compreſſed, and declines, the upper lip being vaulted over by a tranſverſe membrane; the tongue is ſubulated; there are ſeven rays in the gill membrane; and the body is compreſſed.—The ſpecies are eight; of which the moſt remarkable is the *faber* or *doree*. It is of a hideous form, its body is oval, and greatly compreſſed on the ſides; the head large; the ſnout vaſtly projecting; the mouth very wide; the teeth very ſmall; the eyes great, the irides yellow; the lateral line oddly diſtorted, ſinking at each end, and riſing near the back in the middle; beneath it on each ſide is a round black ſpot. The tail is round at the end, and conſiſts of 15 yellow rays. The colour of the ſides is olive, varied with light blue and white, and while living is very reſplendent, and as if gilt; for which reaſon it is called the *doree*. The largeſt fiſh we have heard of weighed 12 pounds.

Superſtition hath made the doree rival to the haddock, for the honour of having been the fiſh out of whoſe mouth St Peter took the tribute-money, leaving on its ſides thoſe inconteſtible proofs of the identity of the fiſh, the marks of his finger and thumb. It is rather difficult at this time to determine on which part to decide the diſpute; for the doree likewiſe aſſerts an origin of its ſpots of a ſimilar nature, but of a later date than the former. St Chriſtopher, in wading through an arm of the ſea, having caught a fiſh of this kind *en paſſant*, as an eternal memorial of the fact, left the impreſſions on its ſides to be tranſmitted to all poſterity. In our own country it was very long before this fiſh attracted our notice, at leaſt as an edible one. We are indebted to the late Mr Quin for adding a moſt delicious fiſh to our table, who, overcoming all the vulgar prejudices on account of its deformity, has effectually eſtabliſhed its reputation. This fiſh was ſuppoſed to be found only in the ſouthern ſeas of this kingdom, but it has been diſcovered likewiſe on the coaſt of Angleſey. Thoſe of the greateſt ſize are taken in the Bay of Biſcay, off the French coaſts; they are alſo very common in the Mediterranean: Ovid muſt therefore have ſtyled it *rarus faber*, on account of its excellency, not its ſcarcity.

ZEUXIS, a celebrated painter of antiquity, flouriſhed about 400 years before Chriſt. He was born at Heraclea; but as there have been many cities of that name, it cannot be certainly determined which of them had the honour of his birth. Some learned men, however, conjecture, that it was the Heraclea near Crotona in Italy. He carried painting to a much higher degree of perfection than Apollodorus had left it; diſcovered the art of properly diſpoſing of lights and ſhades, and particularly excelled in colouring. He amaſſed immenſe riches; and then reſolved to ſell no more of his pictures, but gave them away; ſaying very frankly, "That he could not ſet a price on them equal to their value." Before this time he made people pay for ſeeing them; and nobody was admitted to ſee his Helena without ready money, which occaſioned the wags calling his picture *Helen the Courtezan*. It is not known whether this Helen of Zeuxis was the ſame with that which was at Rome in Pliny's time, or that which he painted for the inhabitants of Crotona to be hung up in the temple of Juno: this laſt he painted from five beautiful girls of that city, copying from each her greateſt excellencies. Pliny obſerves, that this admirable painter, diſputing for the prize of painting with Parrhaſius, painted ſome grapes ſo naturally, that the birds flew down to peck them. Parrhaſius, on the other hand, painted a curtain ſo very artfully, that Zeuxis miſtaking it for a real one that hid his rival's work, ordered the curtain to be drawn aſide, to ſhow what Parrhaſius had done; but having found his miſtake, he ingenuouſly confeſſed himſelf vanquiſhed, ſince he had only impoſed upon birds, while Parrhaſius had deceived even a maſter of the art. Another time he painted a boy loaded with grapes; when the birds alſo flew to this picture, at which he was vexed; and confeſſed, that this work was not ſufficiently finiſhed, ſince had he painted the boy as perfectly as the grapes, the birds would have been afraid of him. Archelaus, king of Macedon, made uſe of Zeuxis's pencil for the embelliſhment of his palace. One of this painter's fineſt pieces was a Hercules ſtrangling ſome ſerpents in his cradle, in the preſence of his affrighted mother: but he himſelf chiefly eſteemed his Athleta, or Champion, under which he placed a Greek verſe that afterwards became very famous, and in which he ſays, "That it was eaſier to criticiſe than to imitate the picture." He made a preſent of his Alcmena to the Agrigentines. Zeuxis did not value himſelf on ſpeedily finiſhing his pictures; but knowing that Agatharchus gloried in his being able to paint with eaſe and in a

little

little time, he said, "That for his part he, on the contrary, gloried in his slowness; and if he was long in painting, it was because he painted for eternity." Verrius Flaccus says, that Zeuxis having painted an old woman, he laughed so very heartily at the sight of this picture, that he died: but as no other of the ancients have mentioned this particular, there is the greatest reason to believe it fabulous. Carlo Dati has composed in Italian the Life of Zeuxis, with those of Parrhasius, Apelles, and Protogenes. This work was printed at Florence in 1667.

ZICLAG, or ZIKLAG (anc. geog.), a town of the tribe of Simeon, on the borders of the Philistines (Joshua xv. and xix.), but in the hands of the Philistines till David's time (1 Sam. xxvii. and xxx.)

ZIMB, in natural history. See ETHIOPIA, n° 11.

ZIMENT-WATER, COPPER-WATER, in natural history, the name by which some have called water found in places where there are copper-mines, and lightly impregnated with particles of that metal.

The most famous spring of this kind is about a mile distant from Newsol in Hungary, in the great copper-mine called by the Germans *herrn grundt*. The water in this mine is found at different depths, and is received into basons, for the purpose of separating the copper from it: in some of these it is much more sated with this metal than in others, and will make the supposed change of iron into that metal much sooner. The most common pieces of iron used in the experiments are horse-shoes, nails, and the like; and they are found very little altered in shape, after the operation, except that their surfaces are more raised. The water appears greenish in the bason, where it stands; but if a glass of it be taken up, it looks clear as crystal: it has no smell, but a strong vitriolic astringent taste, insomuch that the lips and tongue are blistered and scorched upon tasting it.

ZIN (anc. geog.), a wilderness encompassing Idumea, at least on the south and west, as far as Palestine or Canaan; but according to Wells, on the east of Edom, to the north of Ezion-gaber.

ZINC, a semimetal. For a description of the ores of this metal, the method of extracting it from these ores, and for its properties, see CALAMINE; CHEMISTY-*index*; MINERALOGY, Vol. XII. page 128; METALLURGY, Part II. sect. xii.

Zinc, besides its medical qualities (for which see PHARMACY-*index*), is of great use in the arts: united with copper in different proportions, it forms brass and pinchbeck; and united with tin, it forms a kind of pewter.

Brass is formed by mixing two parts of copper with one of zinc; pinchbeck by mixing three or four parts of copper to one of zinc: when the metals are mixed in equal quantities they form a very exact imitation of gold. Its inflammable property renders zinc a useful ingredient in fire-works.

It has been proposed to substitute this semimetal instead of tin in the lining of copper vessels; the latter being thought insufficient to prevent the dangerous effects of the copper. Mr Malouin, who has made many experiments on the lining of vessels in this manner, asserts that it spreads more evenly on the copper than tin itself; that it is much harder and less fusible, and consequently more durable than tin. Mr Macquer owns these advantages; but thinks it dangerous to be used in culinary vessels, as it is soluble in vegetable acids, and the combination of it with the vitriolic acid is known to be a strong emetic. Gaubius also mentions a celebrated remedy for convulsive disorders, named *luna fixta ludemaunic* which Macquer affirms to be strongly emetic in very small doses. "But, may it not be presumed (says Foucroy), that properties which are applicable only to the vitriol and flower zinc, cannot be applied to the semimetal itself, nor even, without farther experiments, to the salts formed by its combination with the vegetable acids." Mr de la Plandie, doctor in medicine of the faculty of Paris, has changed this presumption into certainty by experiments made with great care on himself. He took the salts of zinc, formed by its combination with vegetable acids, in a much stronger dose than the aliments prepared in copper covered with zinc can possibly contain them, and found no dangerous effects to follow. However, since objects which relate to the health and lives of mankind cannot be treated with too much circumspection, it appears to be prudent, and even necessary, not to decide on the subject till after a great number of experiments, and that the action of zinc combined with the vegetable acids used in cookery have been fully ascertained. The flowers of zinc have been used as an antispasmodic, and are an article of our present materia medica; but it does not clearly appear what success may be expected from them.

ZINNIA, in botany; a genus of plants of the class *syngenesia*, order *polygamia superflua*; and in the natural system arranged under the 49th order, *Compositæ*. The receptacle is paleaceous, the pappus consists of two erect awns, the calyx is ovato-cylindrical and imbricated; the rays consist of five persisting entire florets. There are two species, the *pauciflora* and *multiflora*, neither of which is a native of Britain.

ZINZENDORFF (Nicholas Lewis), count, was the noted founder of the German religious sect called *Moravians*, or *Herrnhuters*, or, as they pretend, the restorer of that society. From his own narrative it appears, that when he came of age in 1721, his thoughts were wholly bent on gathering together a little society of believers, among whom he might live, and who should entirely employ themselves in exercises of devotion under him. He accordingly purchased an estate at Bertholsdorff in Upper Lusatia, where being joined by some followers, he gave the curacy of the village to a man of his own complexion; and Bertholsdorff soon became talked of for a new mode of piety. One Christian David, a carpenter, brought a few proselytes from Moravia: they began a new town about half a league from the village, where count Zinzendorff fixed his residence among them, and where great numbers of Moravians flocked and established themselves under his protection: so that in 1732 their number amounted to 600. An adjacent hill, called the *Huthberg*, gave occasion to these colonists to call their new settlement *Huth des Herrn*, and afterward *Herrnhuth;* which may be interpreted "The guard or protection of the Lord:" and from this the whole sect have taken their name. The count spared neither pains nor art to propagate his opinions; he went himself all over Europe, and at least twice to America; and sent his missionaries throughout the world. Count Zinzendorff died in 1760. Those who wish to know more of the Moravian tenets may consult Rimius's account of them, translated in 1753. See UNITED BRETHREN.

ZISCA (John), a famous general of the forces of the Hussites, in the 15th century, was a gentleman educated at the court of Bohemia, in the reign of Wenceslaus. He entered very young into the army, and after distinguishing himself on several occasions, lost an eye in a battle, whence he was called *Zisca* or *One-eyed*. At length the Reformation, begun by John Huss, spreading through almost all Bohemia, Zisca placed himself at the head of the Hussites, and had soon under his command a body of 40,000 men. With this army he gained several victories over those of the Romish religion, who carried on a kind of crusade against them, and built a town in an advantageous situation, to which he gave the name of *Tabor;* whence the Hussites

ter were afterwards called *Taborites.* Zisca lost his other eye by an arrow at the siege of the city of Rubi; but this did not prevent his continuing the war, his fighting battles, and gaining several great victories, among which was that of Ausig on the Elbe, in which 9000 of the enemy were left dead on the field. The emperor Sigismund, alarmed at his progress, caused very advantageous proposals to be offered to him; which he readily accepted, and set out to meet Sigismund, but died on the road. He ordered that his body should be left a prey to the birds and wild beasts; and that a drum should be made of his skin, being persuaded that the enemy would fly as soon as they heard the sound. It is added, that the Hussites executed his will; and that the news of this order made such an impression on the disturbed imaginations of the German Papists, that in many battles they actually fled at the beat of the drum with the utmost precipitation, leaving their baggage and artillery behind them.

ZINZIBER, or ZINGIBER, in botany. See AMOMUM and GINGER.

ZION, or SION (anc. geog.), a very famous mountain, standing on the north side of the city of Jerusalem, (Psal. xlvii. 2.); containing the upper city, built by King David; and where stood the royal palace, (Josephus). A part of Zion, situated at its extremity, was called *Millo*, of, or in the city of David, (2 Chron. xxxii. 5.) Modern travellers, who have been upon the spot, say, that Zion is the whole of the mountain, on which Jerusalem stands at this day, though not to the extent in which it anciently stood on the same mountain, as appears Psal. ix. 12. 15. lxv. 1. lxxxvii. 2, 3. Is. lxii. 1. It is swelled into several eminences or tops; as Moriah, Acra Bezetha, and Zion a particular eminence of mount and Zion Proper, &c. encompassed on three sides, east, west, and south, with one continued very deep and steep valley; by means of which it was impregnable on these three sides, and always attacked and taken, according to Josephus, by the enemy on the north side, where mount Zion becomes level, and the vales of Gihon and Jehosophat gradually lose themselves. This deep and steep valley incontestibly constitutes the compass of the old Jerusalem on those three sides, as plainly appears to any person who has been upon the spot. On that particular top of the mount called *Zion* stood the fortress of the Jebusites; which being afterwards taken by David, came to be called the *City of David*, where he had his royal residence and kept his court. That part of the valley which lay to the east was called *Jehosophat's*, having mount Olivet lying beyond it; that to the south, *Gehinnon*; and that to the west, *Gihon*, from cognominal mountains lying beyond them. At the west end of Gihon, without the city, stood Golgotha or Calvary. The pretended Golgotha, shown at this day within the walls, is the spurious brat of interested and fraudulent monks, (Korte). There is another *Zion*, the same with HERMON.

ZION, or *Sion College*. See LONDON, n° 76.

ZIPH, or SIPH (anc. geog.), the name of a wilderness or desert in the tribe of Judah, where David was a fugitive; lying to the south-east of Hebron; so called from Ziph or Siph, a twofold town in this tribe; the one more to the south towards Idumea, on the confines of Eleutheropolis, (Jerome); the other eight miles to the east of Hebron, towards the Dead Sea, inclining southwards, because near mount Carmel. Here was a mountain, mentioned 1 Sam. xxiii. 14. in which David abode, said by Jerome to be rugged, dismal, and always overcast. *Ziphim*, *Ziphæi*, or *Ziphæses*, the inhabitants of Ziph, ver. 19.

ZIRCHNITZER-SEE, otherwise called the *Lake of Czirknitz*, in Carniola, is about one German or four English miles in length, and half as much in breadth, contains three beautiful islands, and is encompassed at some distance with mountains and forests. But what is most remarkable is, that it disappears generally once a year, about St John's or St James's day, running off through holes or pits in the bottom; sometimes it will disappear twice or thrice a year, and sometimes even in winter if the weather be dry. On the other hand, it has been known to continue two or three years without running off. Of the holes, or pits, there are five much larger than the rest, each of which successively, when the water runs off, stands empty five days; so that the whole lake becomes dry in 25. As soon as the beginning of the ebb is observed, the fishing in the pits begins, which belongs to five seigniories. The fish, which are carp, tench, pike, eels, and two other sorts called [illegible] and *rutan*, are caught by laying nets over the holes. Mr Keysler tells us, that upon the ringing of a bell at Zirknitz, when the waters begin to fall, the peasants, both men and women, run to the pools quite naked, notwithstanding both the clergy and magistrates have used their utmost endeavours to suppress so indecent a custom. When the water runs off early in the year, in about three weeks after it is gone there is good grass on the bottom, which is mowed down, and the bottom afterwards ploughed and sowed with millet. If the water runs not off early, nothing can be sown; and if it returns soon, the seed is lost. With respect to its return, the water at first bursts out of some pits on the south side with great violence, a little rain always falling at the same time; but afterwards (when the rain falls heavier, and it thunders at the same time so loud as to shake the earth) it breaks out through all the apertures with great force, insomuch that the lake is filled in 18 or 24 hours, at which time it is in a manner covered with wild fowl; such as geese, ducks, &c. After the millet-harvest, all manner of game is hunted, caught, or killed in it. On the south side are two caverns, out of which, when it thunders, water issues with astonishing violence; and if it happens in harvest, a great many naked, black, and blind, but fat ducklings, are brought up with the water, which in 14 days receive their sight, and are covered with feathers.

ZIZANIA, in botany; a genus of plants of the class *monœcia*, order *hexandria*; and in the natural system arranged under the 4th order, *Gramina*. There is no male calyx; the corolla is a bivalved, beardless glume, intermixed with the female flowers; there is no female calyx, the corolla is an univalved, cucullated, and aristated glume; the style is bipartite, and there is one seed covered with the plaited corolla. There are three species; the aquatica, the palustris, and terrestris, none of which are natives of Britain.

ZODIAC, in astronomy, a broad circle, whose middle is the ecliptic, and its extremes two circles parallel thereto, at such a distance from it as to bound or comprehend the excursions of the sun and planets, (see ASTRONOMY). It is a curious enough fact, that the solar division of the Indian zodiac is the same in substance with that of the Greeks, and yet that it has not been borrowed either from the Greeks or the Arabians. The identity, or at least striking similarity, of the division, is universally known; and M. Montucla has endeavoured to prove, that the Bramins received it from the Arabs. His opinion, we believe, has been very generally admitted; but in the second volume of the Asiatic Researches, the accomplished president Sir William Jones has proved unanswerably, that neither of those nations borrowed that division from the other; that it has been known among the Hindoos from time immemorial; and that it was probably invented by the first progenitors of that race, whom he considers as the most ancient of mankind, before their dispersion. The question is not of importance sufficiently general, straitened as we are by the limits prescribed us, for our entering into the dispute; but we think it

our

Zogea, Zone.

our duty to mention it, that our aſtronomical readers, if they think it worth their while, may have recourſe to the original writers for further imformation.

ZOEGEA, in botany; a genus of plants of the claſs *ſyngeneſia*, and order *polygamia fruſtranea*. The receptacle is briſtly; the pappus ſetaceous; the corollulæ of the radius ligulated; the calyx imbricated. There are two ſpecies, the capenſis and the leptaurea, neither of which are natives of Britain.

ZONE, in geography and aſtronomy, a diviſion of the terraqueous globe with reſpect to the different degrees of heat found in the different parts thereof. The zones are denominated torrid, frigid, and temperate. The torrid zone is a band, ſurrounding the terraqueous globe, and terminated by the two tropics. Its breadth is 46°. 58′. The equator, running through the middle of it, divides it into two equal parts, each containing 23°. 29′. The ancients imagined the torrid zone uninhabitable. The temperate zones are contained between the tropics and the polar circles. The breadth of each is 43. 2. The frigid zones are ſegments of the ſurface of the earth, terminated, one by the antarctic, and the other by the artic circle. The breadth of each is 46. 58.

ZOOLOGY,

Mammalia.

IS that part of Natural Hiſtory which relates to *Animals*.

In order to abridge the ſtudy of zoology, many methods of reducing animals to claſſes, genera, and ſpecies, have been invented: But as that of Linnæus is undoubtedly the beſt, the moſt extenſive, and the moſt generally adopted, we ſhall give a brief account of it.

Linnæus divides the whole animal kingdom into ſix claſſes. The characters of theſe ſix claſſes are taken from the internal ſtructure of animals, in the following manner:

Class I. MAMMALIA, includes all animals that ſuckle their young. The characters of this claſs are theſe:—The *heart* has two ventricles and two auricles; the *blood* is red and warm; and the animals belonging to it are *viviparous*.

Class II. AVES, or Birds. The characters are the ſame with thoſe of Claſs I. excepting that the animals belonging to it are *oviparous*. See Bird, and Ornithology.

Class III. AMPHIBIA, or Amphibious Animals. The *heart* has but *one ventricle* and one *auricle*; the *blood* is red and cold; and the animals belonging to this claſs have the command of their *lungs*, ſo that the intervals between *inſpiration* and *expiration* are in ſome meaſure *voluntary*. See Amphibious.

Class IV. PISCES, or Fishes. The *heart* has the ſame ſtructure, and the *blood* the ſame qualities, with thoſe of the *Amphibia*; but the animals belonging to this claſs are eaſily diſtinguiſhed from the Amphibia, by having no ſuch voluntary command of their *lungs*, and by having external *branchiæ* or *gills*. See Fish, and Ichthyology.

Class V. INSECTA, or Insects. The *heart* has *one ventricle*, but no *auricle*; the *blood* is cold and white; and the animals are furniſhed with *antennæ* or *feelers*. See Insect.

Class VI. VERMES, or Worms. The characters are the ſame with thoſe of Claſs V. only the animals have no antennæ, and are furniſhed with *tentacula*.

The *Firſt Claſs*, MAMMALIA, is ſubdivided into ſeven Orders; the characters of which are taken from the number, ſtructure, and ſituation of the Teeth.

Order I. The Primates have four inciſores, or *fore-teeth*, in each jaw, and one *dog tooth* N. B. By *one* dog-tooth, Linnæus means one on each ſide of the fore-teeth in both jaws.—This order includes four genera, *viz.* Homo, Simia, Lemur, Veſpertilio.

Order II. The Bruta have no *fore-teeth* in either jaw. This order includes ſeven genera, *viz.* Rhinoceros, Elephas, Trichechus, Bradypus, Myrmecophaga, Manis, Daſypus.

Order III. The Feræ have, for the moſt part, ſix *conical fore-teeth* in each jaw. This order includes 10 genera, *viz.* Phoca, Canis, Felis, Viverra, Muſtela, Urſus, Didelphis, Talpa, Sorex, Erinaceus.

Order IV. The Glires have two fore-teeth in each jaw, and no *dog-teeth*.—This order includes 10 genera, *viz.* Hyſtrix, Lepus, Caſtor, Mus, Sciurus, Myoxus, Cavia, Arotomys, Dypus, Hyrox.

Order V. The Pecora, have no *fore-teeth* in the upper jaw, but 6 or 8 in the under jaw.—This order includes 8 genera, *viz.* Camelus, Moſchus, Giraffa, Cervus, Antilope, Capra, Ovis, Bos.

Order VI. The Belluæ, have *obtuſe fore-teeth* in each jaw.—This order includes 4 genera, *viz.* Equus Hippopotamus, Sus, Tapir.

Order VII. The Cete, or *whale kind*, have no uniform character in their teeth, being very different in the different genera; but are ſufficiently diſtinguiſhed from the other orders of Mammalia, by living in the ocean, having pectoral fins, and a fiſtula or ſpiraculum upon the head.—This order includes 4 genera, *viz.* Monodon, Balæna, Phyſeter, Delphinus. See Cetaceous.

The *generic* characters of the Mammalia are, like thoſe of the orders, almoſt entirely taken from the Teeth, excepting the Veſpertilio, which, beſides the character of the order derived from the teeth, has this farther mark, that there is a membrance attached to the feet and ſides, by means of which the creature is enabled to fly:—the Hyſtrix, whoſe body is covered with ſharp ſpines:—and the whole order of Pecora, whoſe genera, beſides the characters taken from the teeth, are diſtinguiſhed into thoſe which have *horns*, thoſe which have *no horns*, and by peculiarities in the horns themſelves.

The *ſpecific* characters are very various, being taken from any part of the body which poſſeſſes a peculiar uniform mark of diſtinction. As examples of theſe characters are to be found under the proper name of each genus, it is unneceſſary to ſay any thing further concerning them in this place.

The *Second Claſs*, AVES, is ſubdivided into ſix Orders; the characters of which are taken chiefly from the ſtructure of the bill.

Order I. The Accipitres, have a hooked bill, the ſuperior mandibule, near the baſe, being extended on each ſide beyond the inferior; and in ſome it is armed

armed with *teeth*.—This order includes four ſpecies, *viz.* Vultur, Falco, Strix, Lanius.

ORDER II. The PICÆ, have a convex, compreſſed BILL, reſembling a knife.—This order contains 23 genera, *viz.* Trochilus, Certhia, Upupa, Glaucopis, Buphaga, Sitta, Oriolus, Coracias, Gracula, Corvus, Paradiſea, Ramphaſtos, Trogon, Pſittacus, Crotophaga, Picus, Yunx, Cuculus, Bucco, Boceros, Alcedo, Merops, Todus.

ORDER III. The ANSERES, have a ſmooth BILL, broadeſt at the point, covered with a ſmooth ſkin, and furniſhed with teeth: The *tongue* is fleſhy; and the toes are palmated or webbed.—This order includes 13 genera, *viz.* Anas, Mergus, Phaeton, Plotus, Rhyncops, Diomedea, Aptenodyta, Alca, Procellaria, Pelecanus, Larus, Sterna, Colymbus.

ORDER IV. The GRALLÆ, have a ſomewhat cylindrical BILL: The tail is ſhort, and the thighs are naked. This order contains 20 genera, *viz.* Phœnicopterus, Platalea, Palamedea, Myćteria, Tantalus, Ardea, Corrira, Recurviroſtra, Scolopax, Tringa, Fulica, Parra, Rallus, Vaginalis, Pſophia, Cancroma, Scopus, Glareola, Hæmatopus, Charadrius.

ORDER V. The GALLINÆ, have a convex BILL; the ſuperior mandibule is vaulted over the inferior: The *noſtrils* are half covered with a convex cartilaginous membrane; and the *feet* are divided, but connected, at the inmoſt joint.—This order contains 10 genera, *viz.* Otis, Struthio, Didus, Pavo, Meleagris, Penelope, Crax, Phaſianus, Numida, Tetrao.

ORDER VI. The PASSERES, have a conical ſharp-pointed BILL; and the *noſtrils* are oval, wide, and naked.—This order contains 17 genera, *viz.* Loxia, Colius, Fringilla, Phytotoma, Emberiza, Caprimulgus, Hirundo, Pipra, Turdus, Ampelis, Tanagra, Mucicapa, Parus, Motacilla, Alauda, Sturnus, Columba.

The *generic* characters of this claſs are taken from peculiarities in the *bill*, the *noſtrils*, the *tongue*, the *feet*, the *feathers*, the *face*, the *figure* of the *body*, &c.

The characters which ſerve to diſtinguiſh the *ſpecies* are very various: For example, the *colour* of the particular *feathers* or parts of *feathers*; *creſts* of feathers on the head, diſpoſed in different manners; the colour of the *cere* or *wax*; the colour of the *feet*; the ſhape and length of the *tail*; the number, ſituation, &c. of the *toes*; the colour and figure of the *bill*, &c.

The *Third Claſs*, AMPHIBIA, is divided into two ORDERS.

ORDER I. The REPTILES, have four *feet*, and breath by the *mouth*.—This order contains four genera, *viz.* Teſtudo, Draco, Lacerta, Rana.

ORDER II. The SERPENTES, have no *legs*, and breath by the *mouth*.—This order contains ſix genera, *viz.* Crotalus, Boa, Coluber, Anguis, Amphiſbæna, Cœcilia.

The *generic* characters of this claſs are taken from the general figure of the *body*; from their having *tails* or *no tails*; being covered with a *ſhell*; having *teeth* or *no teeth*, in the *mouth*; being furniſhed with *lungs*; having *covered* or *naked* bodies; from the number, ſituation, and figure of the *ſcuta* and *ſcales*; from the number and ſituation of the *ſpiracula*; from the ſituation of the *mouth*, &c.

The *ſpecific* characters are ſo very various, that it would be ſuperfluous to enumerate them.

The *Fourth Claſs*, PISCES, is ſubdivided into ſix ORDERS, the characters of which are taken from the ſituation of the *belly-fins*.

Piſces, Inſecta.

ORDER I. The APODES, have no *belly-fins*.—This order contains eight genera, *viz.* Muræna, Gymnotus, Trichiurus, Anarchichas, Ammodytes, Ophidium, Stromateus, Xiphias, Sternoptyx, Leptocephalus.

ORDER II. The JUGULARES, have the *belly-fins* placed before the *pectoral fins*.—This order includes five genera, *viz.* Callionymus, Uranoſcopus, Trachinus, Gadus, Blennius, Kurtus.

ORDER III. The THORACICI, have the *belly-fins* placed *under* the *pectoral fins*.—This order comprehends 19 genera, *viz.* Cepola, Echeneis, Coryphæna, Gobius, Cottus, Scorphæna, Zeus, Pleuronectes, Chætodon, Sparus, Scarus, Labrus, Sciæna, Perca, Gaſteroſteus, Scomber, Centrogaſter, Mullus, Trigla.

ORDER IV. The ABDOMINALES, have the *belly-fins* placed *behind* the *pectoral fins*.—This order contains 16 genera, *viz.* Cobitis, Amia, Silurus, Teuthis, Loricaria, Salmo, Fiſtularia, Eſox, Elops, Argentina, Atherina, Mugil, Exocœtus, Polynemus, Clupea, Cyprinus.

ORDER V. The BRANCHIOSTEGI, have the *gills* deſtitute of bony rays.—This order contains 10 genera, *viz.* Mormyrus, Oſtracion, Tetrodon, Diodon, Syngnathus, Pegaſus, Centriſcus, Baliſtes, Cyclopterus, Lophius

ORDER VI. The CHONDROPTERYGII, have cartilaginous *gills*.—This order contains five genera, *viz.* Acipenſer, Chimæra, Squalus, Raia, Petromyzon.

The *generic* characters of this claſs are taken from peculiarities in the *head*, the *mouth*, the *teeth*, the *noſtrils*, the *rays* in the *membrane* of the *gills*, the *eyes*, the general *figure* of the *body*, the figure of the *tail*, the ſituation of the *ſpiracula*, &c.

The *ſpecific* characters are taken from peculiarities in all the parts above enumerated, and many others.

See further the articles FISH and ICHTHYOLOGY.

The *Fifth Claſs*, INSECTA, is ſubdivided into ſeven ORDERS, the characters of which are taken from the wings. See the article INSECT.

ORDER I. The COLEOPTERA, have *four wings*, the two ſuperior ones being cruſtaceous, and furniſhed with a *ſtraight ſuture*.—This order comprehends 47 genera, *viz.* Scarabæus, Lucanus, Dermeſtes, Melyris, Byrrhus, Silpha, Tritoma, Hydrophilus, Hiſter, Pauſus, Boſtrichus, Anthrenus, Nitidula, Coccinella, Curculio, Brentus, Attelabus, Erodius, Staphylinus, Scaurus, Zygia, Meloe, Tenebrio, Caſſida, Opatrum, Mordella, Chryſomela, Horia, Apalus, Manticora, Pimelia, Gyrinus, Cucujus, Cryptocephalus, Bruchus, Ptinus, Hiſpa, Bupreſtis, Necydalis, Lampyris, Cantharis, Notoxus, Elater, Calopus, Alurnus, Carabus, Lytta, Serropalpus, Cerambyx, Leptura, Rhinomacer, Zonitis, Cicindela, Dyticus, Forficula.

ORDER II. The HEMIPTERA, have *four wings*, the two ſuperior ones being *ſemicruſtaceous*, and *incumbent*, *i. e.* the *interior edges* lie above one another.—This order includes 14 genera, *viz.* Blatta, Pneumora, Mantis, Gryllus, Fulgora, Cicada, Notonecta, Nepa, Cimex, Macrocephalus, Aphis, Chermes, Coccus, Thrips.

Infecta, Vermes.

Order III. The Lepidoptera, have *four wings*, all of them imbricated with *fcales*.—This order contains three genera, *viz*, Papilio, Sphinx, Phalæna.

Order IV. The Neuroptera, have *four wings*, interwoven with veins, like a piece of *network*, and no *fting* in the *anus*.—This order includes feven genera, *viz*. Libella, Ephemera, Hemerobius, Myrmelion, Phryganea, Panorpa, Rophidia.

Order V. The Hymenoptera, have the fame characters with the former, only the *anus* is armed with a *fting*. But this mark is peculiar to the *females* and *neuters*; for the males have no *fting*.—This order comprehends 15 genera, *viz*. Cynips, Tentredo, Sirex, Ichneumon, Sphex, Scolia, Thynnus, Leucofpis, Tiphia, Chalcis, Chryfis, Vefpa, Apis, Formica, Mutilla.

Order VI. The Diptera, have *two wings*, and two *clavated halteres* or *balances* behind each wing.—This order contains 12 genera, *viz*. Diopsis, Tipula, Musca, Tabanus, Empis, Conops, Oestrus, Asilus, Stomoxys, Culex, Bombylius, Hippobosca.

Order VII. The Aptera, have *no wings*.—This order contains 15 fpecies, *viz*. Lepifma, Podura, Termes, Pediculus, Pulex, Acarus, Hydrachna, Aranea, Phalangium, Scorpio, Cancer, Monoculus, Oniscus, Scolopendra, Julus. See further the articles Entomology and Insect.

The *Sixth Clafs*, VERMES, is divided into five Orders.

Order I. The Intestina, are the moft *fimple animals*, being perfectly *naked*, and without *limbs* of any kind.—This order contains 21 genera, *viz*. Afcaris, Trichocephalus, Uncinaria, Filaria, Scolex, Ligula, Linguatula, Strongylus, Echinorhynchus, Hæruca, Cucullanus, Caryophyllæus, Fafciola, Tænia, Furia, Myxine, Gordius, Hirudo, Lumbricus, Sipunculus, Planaria.

Order II. The Mollusca, are likewife *fimple naked animals*, without any *fhell*; but they are *brachiated*, or furnifhed with a kind of *limbs*.—This order comprehends 31 genera, *viz* Actinia, Clava, Mammaria, Pedicellaria, Afcidia, Salpa, Dagyfa, Pterotrachea, Limax, Aplyfia, Doris, Tethis, Holothuria, Terebella, Triton, Sepia, Clio, Lobaria, Lernæa, Scyllæa, Glaucus, Aphrodita, Amphitrite, Spio, Nereis, Nais, Phyffophora, Medufa, Lucernaria, Afterias, Echinus.

Order III. The Testacea, have the fame characters with thofe of Order II. but are covered with a *fhell*.—This order includes 36 genera, *viz*. Chiton, Lepas, Pholas, Mya, Solen, Tellina, Cardium, Mactra, Donax, Venus, Spondylus, Chama, Arca, Oftrea, Anomia. Mytilus, Pinna, Argonauta, Nautilus, Conus, Cypræa, Bulla, Voluta, Buccinum, Strombus, Murex, Trochus, Turbo, Helix, Nerita, Haliotis, Patella, Dentalium, Serpula, Teredo, Sabella.

Order IV. The Zoophyta, are *compound animals*, furnifhed with a kind of *flowers*, and having a vegetating *root* and *ftem*.—This order contains 15 genera, *viz*. Tubipora, Madrepora, Millepora, Cellepora, Ifis, Antipathes, Gorgonia, Alcyonium, Spongia, Fluftra, Tubularia, Corralina, Sertularia, Pennatula, Hydra. See *Animal Flower*.

Order V. The Infusoria, confifts of very fmall *fimple animals*.—This order contains 15 genera, *viz*. Brachionus, Vorticella, Trichoda, Cercaria, Leucopera, Gonium, Colpoda, Paramecium, Cyclidium, Burfaria, Vibrio, Enchelis, Bacillaria, Volvox, Monas.

For more particular information concerning the feveral branches and fubjects of zoology, the reader may confult the various articles above referred to, and he will find moft of the genera defcribed in their order in the alphabet.

Zoophite || Zoroafter.

ZOOPHYTE, in natural hiftory, the 4th order of the clafs of *Vermes*. See Zoology.

ZOOTOMY, the art of diffecting animals or living creatures, being the fame with anatomy. See Anatomy, and *Comparative Anatomy*.

ZORILLE, in zoology, a fpecies of weefel, having the back and fides marked with fhort ftripes of black and white, the laft tinged with yellow; the tail long and bufhy, partly white and partly black; the legs and belly black. This animal inhabits Peru, and other parts of South America: its peftilential vapour overcomes even the panther of America, and ftupefies that formidable enemy.

ZOROASTER, or Zerdusht, a celebrated ancient philofopher, faid to have been the reformer or the founder of the religion of the magi. It is wholly uncertain to how many eminent men the name of Zoroafter belonged. Some have maintained that there was but one Zoroafter, and that he was a Perfian; others have faid that there were fix eminent founders of philofophy of this name. Ham the fon of Noah, Mofes, Ofiris, Mithras, and others, both gods and men, have by different writers been afferted to have been the fame with Zoroafter. Many different opinions have alfo been advanced concerning the time in which he flourifhed. Ariftotle and Pliny fix his date at fo remote a period as 6000 years before the death of Plato. According to Laertius, he flourifhed 600 years before the Trojan war; according to Suidas, 500. If, in the midft of fo much uncertainty, any thing can be advanced with the appearance of probability, it feems to be this; that there was a Zoroafter, a Perfo-Median, who flourifhed about the time of Darius Hyftafpes; and that befides him there was another Zoroafter, who lived in a much more remote period among the Babylonians, and taught them aftronomy. The Greek and Arabian writers are agreed concerning the exiftence of the Perfian Zoroafter; and the ancients unanimoufly afcribe to a philofopher, whom they call *Zoroafter*, the origin of the Chaldean aftronomy, which is certainly of much earlier date than the time of Hyftafpes: it feems, therefore, neceffary to fuppofe a Chaldean Zoroafter diftinct from the Perfian. Concerning this Zoroafter, however, nothing more is known, than that he flourifhed towards the beginning of the Babylonifh empire, and was the father of the Chaldean aftrology and magic. All the writings that have been afcribed to Zoroafter are unqueftionably fpurious.

Zoro Zoft

ZOSTERA, in botany; a genus of plants of the clafs *gynandria*, order *polyandria*; and in the natural fyftem arranged under the fecond order, *Piperitæ*. The fpadix is linear, and fertile only on one fide; there is no calyx nor corolla; the ftamina are alternate; the feeds folitary and alternate. There are two fpecies, the marina and oceanica; neither of which is a native of Britain.

ZOSIMUS, an ancient historian who lived at the end of the fourth and beginning of the fifth centuries. There are six books of his history extant; in the first of which he runs over the Roman affairs in a very succinct manner from Augustus to Dioclesian; the other five are written more diffusely. Zosimus was a zealous Pagan; whence we find him frequently inveighing with great bitterness against the Christian princes, particularly against Constantine the Great, and the elder Theodosius. His history has been published with the Latin version of Leunclavius at Frankfort, 1590, with the other minor historians of Rome, in folio; and at Oxford in 8vo, 1679.

ZUG, a canton of Switzerland, bounded on the east and north by that of Zurich, on the south by Schweiz and Lucern, and on the west by the canton of Lucern and the Freye-Amt or Free Provinces. It is not above 12 miles either way; but very populous and fruitful, yielding wine, wheat, chesnuts, and other fruits, in its vales, and excellent pasture on its mountains. The inhabitants of this canton are staunch Roman Catholics. It lies in the diocese of Constance, and its government is democratical. There are two lakes in it abounding in fish, particularly large carps, pikes, and a species of trouts called *rotels*; as well as several woods full of game. Zug, which gives name to it, and is its capital, stands on the east side of a lake of the same name, about seven miles long, and is a strong neat town, containing a priory and two convents.

ZUINGLIUS (Ulricus), an able and zealous reformer, who laid the foundation of a separation from Rome in Switzerland, at the same time that Luther did the like in Saxony, was born at Wildehausen in 1487. While he officiated as preacher at Zurich, a Franciscan sent by Leo X. came to publish indulgences there; against which Zuinglius, after the example of Luther, declaimed powerfully. In the course of this opposition he started a new doctrine, which he called *Evangelical Truth*; and from the beginning of 1519 to 1523, he preached not only against indulgences, but against other articles of the Romish church. But though Zuinglius made no less progress than Luther, he yet conducted himself with more moderation and prudence; and wishing to have the concurrence of the civil powers, procured two assemblies to be called at Zurich: by the first, he was authorised to proceed as he had begun; and by the second, the outward worship and ceremonies of the church of Rome were abolished. During these transactions, Zuinglius published several books in defence of his doctrines; but treating of the eucharist, and prescribing a form of celebrating the Lord's Supper different from Luther, he was involved in violent disputes with the rest of his reforming brethren. Interpreting the words *hoc est corpus meum*, by *hoc significat corpus meum*, he maintained, that the body and blood of Christ are not *really* present in the eucharist; and that the bread and wine are nothing more than external *signs* or *symbols*, designed to excite in the minds of Christians the remembrance of the sufferings of the Divine Saviour, and of the benefits which arise from them. This opinion, which was afterwards so plausibly supported by the celebrated Hoadley (see *Supper of the Lord*), gave offence to Calvin as well as to Luther; but the doctrines of Zuinglius, which were most obnoxious to that eminent reformer, were those which deny *election* and *reprobation*, and make the church as a society wholly dependent on the state. Respecting the divine decrees, the opinion of Zuinglius and his followers differed very little from that of the PELAGIANS: for he maintained that heaven is open to all who live according to the dictates of right reason; and he seems to have denied the doctrine of original sin. Instead of declaring with Calvin, that the church is a separate independent body, vested with the right of legislation for itself, Zuinglius ascribed to the civil magistrate an absolute and unbounded power in religious matters, allowing at the same time a certain subordination among the ministers of the church. This was accordingly adopted by the magistrates of Zurich; but the rest of the cantons [illegible] of their proceedings, other assemblies were called, and [illegible] tending to tumult, both sides had recourse to arms; when Zuinglius, who became a preacher, died [illegible] a soldier, in 1531. His works [illegible].

ZURICH, a canton of Switzerland, bounded on the north by Swabia and the canton of [illegible]; to the south by the town and territory of R[illegible] and the cantons of Switz and Zug; to the [illegible] the Thurgau, Toggenburg, and Utznach; [illegible] by the bailiage and county of Baden. [illegible] north to south, and 48 from east to west. [illegible] its face, air, and soil, it is said to be [illegible] of all Switzerland, as containing in it hills, valleys, plains, [illegible] lands, vineyards, lakes, and rivers. The [illegible] tartness at first, but the longer they are [illegible] the more agreeable they are. The other products are excellent fruits, corn, pasture, fine clay, chalk, several coloured earths, pit-coal, turf, and sulphur. There are also some mineral waters in the canton; and of the lakes, that of Zurich is the most considerable. The reformation was introduced here by Zuinglius in the year 1517. This canton is the first in rank, and inferior only to that of Bern in extent, power, and wealth: in consequence of which, its representatives preside in the general diets, when held in any place belonging in common to the cantons; and the affairs relating to the whole confederacy are transacted in its offices. Its quota, for the defence of the several members of the confederacy, is 1400 men. Of one of the two armies raised on these occasions, it nominates one of the commanders in chief, as Lucern does the other. Its revenue is said to be about 150,000 crowns a-year: of which, one year with another, two thirds are expended in the charges of government, and the rest laid up in the treasury. It can bring 50,000 fighting men into the field at a very short warning.

ZURICH, the capital of a canton of the same name in Switzerland, stands in a pleasant country, near where the river Aa issues from the lake that takes its name from the town, 23 miles from Schaffhausen, and 114 from Geneva. After having been ruined by Attila the Hun, it is said to have been restored by Thuricus, son of Theodoric king of the Goths, from whom it took the name of *Thuricum*, corrupted afterwards into that of *Zurich*. It is fortified in the modern way, and has wide ditches, faced with free stone. There are five arsenals in it, well stored with arms and artillery; an academy or college, having 15 professors; a museum, or chamber of rarities; a stately town-house, the pillars in the front of which are of black marble, streaked with white; and a town library. The sovereignty and administration of all affairs are lodged in the greater and lesser council, out of which are chosen the city-officers, as the councils are out of the 13 companies of burghers. There are several other councils or colleges, each of which has its particular department. Here are a great variety of silk, woollen, linen, cotton, and other manufactures; this being the place of the greatest trade in all Switzerland. The town is well supplied with provisions by and from the lake. The streets are neat, and houses well built, but not magnificent. In the town-library are several letters to Bullinger from lady Jane Gray daughter to the duke of Suffolk. In one of the arsenals is the figure of William Tell, drest and

armed

Zurich. armed in the ancient Swiss manner, with the cross-bow whence he shot the arrow that struck the apple off his child's head.

Both men and women are so fond of music, that there are few of them that cannot play on some instrument. If a burgher goes out of town, or a peasant enters it, without a sword, they are liable to be fined. No persons, whatever their rank or office may be, are exempted from the sumptuary laws. The burgomasters, who are the same as the advoyers at Bern, have the title of excellence. The hospitals here are very neat and well endowed; but they do not affect the ridiculous vanity of lodging the poor in palaces. Not only in this town and canton, and other parts of Switzerland, but also among the Grisons, the ministers all preach covered. The country about the town is very pleasant and fruitful; for both which it is not a little indebted to the lake, that extends 24 miles in length, and about two or three in breadth. The water is of a green colour, supposed to be owing to the melted snow that falls into it from the adjacent mountains. That part of it next Zurich is called the *Lower Lake*, and the other end the *Upper*. The cathedral, or great church here, is collegiate. The present city is said to owe its origin to a nunnery, founded by the emperor Lewis I. near where the ancient Tigurum stood. E. Long. 8. 30. N. Lat. 47. 20.

What may be reckoned one of the greatest curiosities of Zurich is the pump invented and erected here by H. Andreas Wirtz, a tinplate worker of this place. The invention shows him to be a person of very uncommon mechanical knowledge and sagacity. As it is a machine which operates on a principle widely different from all other hydraulic machines, and is really excellent in its kind, we presume that our readers will not be displeased with some account of it, although it be rather out of place here, and should have appeared in the article *Water-Works*.

Pl DXLII. Fig. 16. is a sketch of the section of the machine, as it was first erected by Wirtz at a dye house in Limmat, in the suburbs or vicinity of Zurich. It consists of a hollow cylinder, like a very large grindstone, turning on a horizontal axis, and partly plunged in a cistern of water. The axis is hollow at one end, and communicates with a perpendicular pipe CBZ′, part of which is hid by the cylinder. This cylinder or drum is formed into a spiral canal by a plate coiled up within it like the main spring of a watch in its box; only the spires are at a distance from each other, so as to form a conduit for the water of uniform width. This spiral partition is well joined to the two ends of the cylinder, and no water escapes between them. The outermost turn of the spiral begins to widen about ¼ths of a circumference from the end, and this gradual enlargement continues from Q to S nearly a semicircle: this part may be called the Horn. It then widens suddenly, forming a Scoop or shovel SS′. The cylinder is supported so as to dip several inches into the water, whose surface is represented by VV′.

When this cylinder is turned round its axis in the direction ABEO, as expressed by the two darts, the scoop SS′ dips at V′, and takes up a certain quantity of water before it emerges again at V. This quantity is sufficient to fill the taper part SQ, which we have called the Horn; and this is nearly equal in capacity to the outermost uniform spiral round.

After the scoop has emerged, the water passes along the spiral by the motion of it round the axis, and drives the air before it into the rising-pipe, where it escapes.—In the mean time, air comes in at the mouth of the scoop; and when the scoop again dips into the water, it again takes in some. Thus there is now a part filled with water and a part filled with air. Continuing this motion, we shall receive a second round of water and another of air. The water in any turn of the spiral will have its two ends on a level; and the air between the successive columns of water will be in its natural state; for since the passage into the rising pipe or Main is open, there is nothing to force the water and air into any other position. But since the spires gradually diminish in their length, it is plain that the column of water will gradually occupy more and more of the circumference of each. At last it will occupy a complete turn of some spiral that is near the centre; and when sent farther in, by the continuance of the motion, some of it will run back over the top of the succeeding spiral. Thus it will run over at K 4 into the right hand side of the third spiral. Therefore it will push the water of this spire backwards, and raise its other end, so that it also will run over backwards *before* the next turn be completed. And this change of disposition will at last reach the first or outermost spiral, and some water will run over into the horn and scoop, and finally into the cistern.

But as soon as water gets into the rising pipe, and rises a little in it, it stops the escape of the air when the next scoop of water is taken in. Here are now two columns of water acting against each other by hydrostatic pressure and the intervening column of air. They must compress the air between them, and the water and air-columns will now be unequal. This will have a general tendency to keep the whole water back, and cause it to be higher on the left or rising side of each spire than on the right descending side. The excess of height will be just such as produces the compression of the air between that and the preceding column of water. This will go on increasing as the water mounts in the rising-pipe; for the air next to the rising-pipe is compressed at its inner end with the weight of the whole column in the main. It must be as much compressed at its outer end. This must be done by the water column without it; and this column exerts this pressure partly by reason that *its* outer end is higher than its inner end, and partly by the transmission of the pressure on its outer end by air, which is similarly compressed from without. And thus it will happen that each column of water, being higher at its outer than at its inner end, compresses the air on the water-column beyond or within it, which transmits this pressure to the air beyond it, adding to it the pressure arising from its own want of level at the ends. Therefore the greatest compression, viz. that of the air next the main, is produced by *the sum of all the transmitted pressures*; and these are the sum of all the differences between the elevations of the inner ends of the water columns above their outer ends: and the height to which the water will rise in the main will be just equal to this sum.

Draw the horizontal lines K′K 1, K′K 2, K′K 3, &c. and *m n*, *m n*, *m n*, &c. Suppose the left hand spaces to be filled with water, and the right hand spaces to be filled with air. There is a certain gradation of compression which will keep things in this position. The spaces evidently decrease in arithmetical progression; so do the hydrostatic heights and pressures of the water columns. If therefore the air be dense in the same progression, all will be in hydrostatical equilibrium. Now this is evidently producible by the mere motion of the machine; for since the density and compression in each air column is supposed inversely as the bulk of the column, the absolute quantity of air is the same in all; therefore the column first taken in will pass gradually inwards, and the increasing compression will cause it to occupy precisely the whole right hand side of every spire. The gradual diminution of the water columns will be produced during the motion by the water running over backwards at the

the top, from spire to spire, and at last coming out by the scoop.

It is evident that this disposition of the air and water will raise the water to the greatest height, because the hydrostatic height of each water column is the greatest possible, *viz.* the diameter of the spire. This disposition may be obtained in the following manner: Take CL to CB as the density of the external air to its density in the last column next the rising-pipe or main; that is, make CL to CB as 33 feet (the height of the column of water which balances the atmosphere), to the sum of 33 feet and the height of the rising-pipe. Then divide BL into such a number of turns, that the sum of their diameters shall be equal to the height of the main; then bring a pipe straight from L to the centre C. The reason of all this is very evident.

But when the main is very high, this construction will require a very great diameter of the drum or many turns of a very narrow pipe. In such cases it will be much better to make the spiral in the form of a cork-screw, as in fig. 17. instead of this flat form like a watch spring. The pipe which forms the spiral may be lapped round the frustum of a cone, whose greatest diameter is to the least (which is next to the rising pipe) in the same proportion that we assigned to CB and CL. By this construction the water will stand in every round so as to have its upper and lower surfaces tangents to the top and bottom of the spiral, and the water columns will occupy the whole ascending side of the machine, while the air occupies the descending side.

This form is vastly preferable to the flat: it will allow us to employ many turns of a large pipe, and therefore produce a great elevation of a large quantity of water.

The same thing will be still better done by lapping the pipe on a cylinder, and making it taper to the end, in such a proportion that the contents of each round may be the same as when it is lapped round the cone. It will raise the water to a greater height (but with an increase of the impelling power) by the same number of turns, because the vertical or pressing height of each column is greater.

Nay, the same thing may be done in a more simple manner, by lapping a pipe of uniform bore round a cylinder. But this will require more turns, because the water columns will have less differences between the heights of their two ends. It requires a very minute investigation to show the progress of the columns of air and water in this construction, and the various changes of their arrangement, before one is attained which will continue during the working of the machine.

We have chosen for the description of the machine that construction which made its principle and manner of working most evident, namely, which contained the same material quantity of air in each turn of the spiral, more and more compressed as it approaches to the rising-pipe. We should otherwise have been obliged to investigate in great detail the gradual progress of the water, and the frequent changes of its arrangement, before we could see that one arrangement would be produced which would remain constant during the working of the machine. But this is not the best construction. We see that, in order to raise water to the height of a column of 34 feet, which balances the atmosphere, the air in the last spire is compressed into half its bulk; and the quantity of water delivered into the main at each turn is but half of what was received into the first spire, the rest flowing back from spire to spire, and being discharged at the spout.

But it may be constructed so as that the quantity of water in each spire may be the same that was received into the first; by which means a greater quantity (double in the instance now given) will be delivered into the main, and raised to the same height by very nearly the same force.— This may be done by another proportion of the capacity of the spires, whether by a change of their caliber or of their diameters. Suppose the bore to be the same, the diameter must be made such that the constant column of water, and the column of air compressed to the proper degree, shall occupy the whole circumference. Let A be the column of water which balances the atmosphere, and h the height to which the water is to be raised. Let A be to A + h as 1 to m. Zurich.

It is plain that m will represent the density of the air in the last spire, if its natural density be 1, because it is pressed by the column A + h, while the common air is pressed only by A. Let 1 represent the constant water column, which is therefore nearly equal to the air column in the first spire. The whole circumference of the last spire must be $1 + \frac{1}{m}$, in order to hold the water 1, and the air compressed into the space $\frac{1}{m}$ or $\frac{A}{A+h}$.

The circumference of the first spire is 1 + 1 or 2. Let D and d be the diameters of the first and last spires; we have $2 : 1 + \frac{1}{m} = D : d$, or $2m : m + 1 = D : d$. Therefore if a pipe of uniform bore be lapped round a cone, of which D and d are the end diameters, the spirals will be very nearly such as will answer the purpose. It will not be quite exact, for the intermediate rounds will be somewhat too large. The conoidal frustum should be formed by the revolution of a curve of the logarithmic kind. But the error is very trifling.

With such a spiral, the full quantity of water which was confined in the first spiral will find room in the last, and will be sent into the main at every turn. This is a very great advantage, especially when the water is to be much raised. The saving of power by this change of construction is always in proportion of the greatest compression of the air.

The great difficulty in the construction of any of these forms is in determining the form and position of the horn and the scoop; and on this greatly depends the performance of the machine. The following instructions will make it pretty easy.

Let ABEO (fig. 18.) represent the first or outermost round of the spiral, of which the axis is C. Suppose it immerged up to the axis in the water VV, we have seen that the machine is most effective when the surfaces E*b* and O*n* of the water columns are distant the whole diameter EO of the spiral. Therefore let the pipe be first supposed of equal caliber to the very mouth E*e*, which we suppose to be just about to dip into the water. The surface O*n* is kept there, in opposition to the pressure of the water column BAO, by the compressed air contained in the quadrant OE, and in the quadrant which lies behind EB. And this compression is supported by the columns behind, between this spire and the rising pipe. But the air in the outermost quadrant EB is in its natural state, communicating as yet with the external air. When, however, the mouth E*e* has come round to A, it will not have the water standing in it in the same manner, leaving the half space BEO filled with compressed air; for it took in and confined only what filled the quadrant BE. It is plain, therefore, that the quadrant BE must be so shaped as to take in and confine a much greater quantity of air; so that when it has come to A, the space BEO may contain air sufficiently dense to support the column AO. But this is not enough: For when the wide mouth, now at A*a*, rises up to the top, the surface of the water in it rises also, because the part AO*oa* is more capacious

cious than the cylindric part OE *e o* which fucceeds it, and which cannot contain all the water that it does. Since, then, the water in the fpire rifes above A, it will prefs the water back from O *n* to fome other pofition *m' r'*, and the preffing height of the water column will be diminifhed by this rifing on the other fide of O. In fhort, the horn muft begin to widen, not from B, but from A, and muft occupy the whole femicircle ABE; and its capacity muft be to the capacity of the oppofite cylindrical fide as the fum of BO, and the height of a column of water which balances the atmofphere to the height of that column. For then the air which filled it, when of the common denfity, will fill the uniform fide BEO, when compreffed fo as to balance the vertical column BO. But even this is not enough; for it has not taken in enough of water. When it dipped into the ciftern at E, it carried air down with it, and the preffure of the water in the ciftern caufed the water to rife into it a little way; and fome water muft have come over at B from the other fide, which was drawing narrower. Therefore when the horn is in the pofition EOA, it is not full of water. Therefore when it comes into the fituation OAB, it cannot be full nor balance the air on the oppofite fide. Some will therefore come out at O, and rife up thro' the water. The horn muft therefore, 1*ft*, Extend at leaft from O to B, or occupy half the circumference; and, 2*dly*, It muft contain at leaft twice as much water as would fill the fide BEO. It will do little harm though it be much larger; becaufe the furplus of air which it takes in at E will be difcharged, as the end E *e* of the horn rifes from O to B, and it will leave the precife quantity that is wanted. The overplus water will be difcharged as the horn comes round to dip again into the ciftern. It is poffible, but requires a difcuffion too intricate for this place, to make it of fuch a fize and fhape, that while the mouth moves from E to B, paffing through O and A, the furface of the water in it fhall advance from E to O *n*, and be exactly at O when the beginning or narrow end of the horn arrives there.

We muft alfo fecure the proper quantity of water. When the machine is fo much immerfed as to be up to the axis in water, the capacity which thus fecures the proper quantity of air will alfo take in the proper quantity of water. But it may be erected fo as that the fpirals fhall not even reach the water. In this cafe it will anfwer our purpofe if we join to the end of the horn a fcoop or fhovel QRSB (fig. 19.), which is fo formed as to take in at leaft as much water as will fill the horn. This is all that is wanted in the beginning of the motion along the fpiral, and more than is neceffary when the water has advanced to the fucceeding fpire; but the overplus is difcharged in the way we have mentioned. At the fame time, it is needlefs to load the machine with more water than is neceffary, merely to throw it out again. We think that if the horn occupies fully more than one-half of the circumference, and contains as much as will fill the whole round, and if the fcoop lifts as much as will certainly fill the horn, it will do very well.

N. B. The fcoop muft be very open on the fide next the axis, that it may not confine the air as foon as it enters the water. This would hinder it from receiving water enough.

The following dimenfions of a machine erected at Florence, and whofe performance correfponded extremely well with the theory, may ferve as an example.

The fpiral is formed on a cylinder of 10 feet diameter, and the diameter of the pipe is 6 inches. The fmaller end of the horn is of the fame diameter; and it occupies $\frac{3}{4}$ths of the circumference, and it is $7\frac{8}{10}$ths inches wide at the outer end. Here it joins the fcoop, which lifts as much water as fills the horn, which contains 4340 Swedifh cubic inches, each = 1,577 Englifh. The machine makes 6 turns in a minute, and raifes 1354 pounds of water, or 22 cubic feet, 10 feet high in a minute.

The above account will, we hope, fufficiently explain the manner on which this fingular hydraulic machine produces its effect. When every thing is executed by the maxims which we have deduced from its principles, we are confident that its performance will correfpond to the theory; and we have the Florentine machine as a proof of this. It raifes more than $\frac{9}{10}$ths of what the theory promifes, and it is not perfect. The fpiral is of equal caliber, and is formed on a cylinder. The friction is fo inconfiderable in this machine, that it need not be mended: but the great excellency is, that whatever imperfection there may be in the arrangement of the air and water columns, this only affects the elegance of the execution, caufing the water to make a few more turns in the fpiral before it can mount to the height required; but waftes no power, becaufe the power employed is always in proportion to the fum of the vertical columns of water in the rifing fide of the machine; and the height to which the water is raifed by it is in the very fame proportion. It fhould be made to move very flow, that the water be not always dragged up by the pipes, which would caufe more to run over from each column, and diminifh the preffure of the remainder.

If the rifing-pipe be made wide, and thus room be made for the air to efcape freely up through the water, it will rife to the height affigned; but if it be narrow, fo that the air cannot get up, it rifes almoft as flow as the water, and by this circumftance the water is raifed to a much greater height mixed with air, and this with hardly any more power. It is in this way that we can account for the great performance of the Florentine machine, which is almoft triple of what a man can do with the fineft pump that ever was made: indeed the performance is fo great, that one is apt to fufpect fome inaccuracy in the accounts. The entry into the rifing-pipe fhould be no wider than the laft part of the fpiral; and it would be advifable to divide it into four channels by a thin partition, and then to make the rifing-pipe very wide, and to put into it a number of flender rods, which would divide it into flender channels that would completely entangle the air among the water. This will greatly increafe the height of the heterogeneous column. It is furprifing that a machine that is fo very promifing fhould have attracted fo little notice. We do not know of any being erected out of Switzerland except at Florence in 1778. The account of its performance was in confequence of a very public trial in 1779, and honourable declaration of its merit, by Sig. Lorenzo Ginori, who erected another, which fully equalled it. It is fhortly mentioned by Profeffor Sulzer of Berlin, in the *Sammlungen Vermifchten Schriften* for 1754. A defcription of it is publifhed by the Philofophical Society at Zurich in 1766, and in the defcriptions publifhed by the Society in London for the encouragement of Arts in 1776. The celebrated Daniel Bernouilli has publifhed a very accurate theory of it in the Peterfburgh Commentaries for 1772, and the machines at Florence were erected according to his inftructions. Baron Alftromer in Sweden caufed a glafs model of it to be made, to exhibit the internal motions for the inftruction of artifts, and alfo ordered an operative engine to be erected; but we have not feen any account of its performance. It is a very intricate machine in its principles; and an ignorant engineer, nay the moft intelligent, may erect one which fhall hardly do any thing; and yet, by a very trifling change, may become very powerful. We prefume that failures of this kind have turned the attention of engineers from it; but we are perfuaded that it may be made very effective, and we are certain that it muft be very durable. Fig. 20. is a fection of the manner in which the author

author has formed the communication between the spiral and the rising-pipe. P is the end of the hollow axis which is united with the solid iron axis. Adjoining to P, on the under side, is the entry from the last turn of the spiral. At Q is the collar which rests on the supports, and turns round in a hole of bell-metal. *ff* is a broad flanch cast in one piece with the hollow part. Beyond this the pipe is turned somewhat smaller, very round and smooth, so as to fit into the mouth of the rising-pipe, like the key of a cock. This mouth has a plate *e e* attached to it. There is another plate *d d*, which is broader than *e e*, and is not fixed to the cylindrical part, but moves easily round it. In this plate are four screws, such as *g*, *g*, which go into holes in the plate *ff*, and thus draw the two plates *ff* and *d d* together, with the plate *e e* between them. Pieces of thin leather are put on each side of *e e*; and thus all escape of water is effectually prevented, with a very moderate compression and friction.

ZUTPHEN, a strong and considerable town of the United Provinces in Guelderland, and capital of a county of the same name. It has a magnificent church, and is surrounded with walls. It was taken by the French in 1672, who in 1674 delivered it up to the States-General. It is seated at the confluence of the rivers Berkel and Yessel, nine miles south-east of Deventer, and 55 east by south of Amsterdam. E. Long. 6. 0. N. Lat. 52. 10.

ZUYDER-ZEE, a great gulph or bay of the German Ocean, which extends from south to north in the United Provinces, between Friesland, Over-Yessel, Guelderland, and Holland. It is so called from its situation towards the south. It is said that the Zuyder-zee was formerly a lake, and that the land is swallowed up which united North-Holland with Friesland.

Zygoma | Zymosimeter.

ZYGOMA, in anatomy, a bone of the head, or rather an union or assemblage of two processes or eminences of bones; the one from the os temporis, the other from the os malæ: these processes are hence termed the *zygomatic processes*, and the suture that joins them together is denominated the *zygomatic suture*.

ZYGOMATICUS, in anatomy, a muscle of the head, arising from the *Os Zygoma*, whence its name, and terminating at the angle of the lips.

ZYGOPHYLLUM, BEAN-CAPER, in botany; a genus of plants of the class of decandria and order monogynia, and in the natural system arranged under the 14th order, *Gruinales*. There are 11 species, partly shrubby and partly herbaceous plants, all natives of warm climates, though some of them are hardy enough to endure the open air in this country.

ZYMOSIMETER (formed from ζυμωσις *fermentation*, and μετρον *measure*), an instrument proposed by Swammerdam in his book *De Respiratione*, wherewith to measure the degree of fermentation occasioned by the mixture of different matters, and the degree of heat which those matters acquire in fermenting, as also the heat or temperament of the blood of animals.

F I N I S

ERRATA not pointed out at the end of any preceding Volume.

N. B. *b* added to the number of the line ſignifies " from the bottom of the page."

Vol.	page.	col.	line.	
I.	273	2	3	For " fig. 15." read " fig. 4."
	368	2	marg.	After " Index," add " at *Spirit of wine.*"
II.	48	2	8 *b.*	For " 10. 8," read " 10. 82."
	216	2	31 *b.*	For " ARCHIMIDES," read " ARCHIMEDES."
	250	2	22	For " ſloping," read " ſtopping."
	770	2	7 *b.*	For " n° 79." read " 578."
III.	258	1	20	For " 50th," read " 57th."
	283	1	marg.	For " See *Index*, &c." read " See MEDICINE, n° 359, &c."
	342	2	25	Dele " MEDICINE and."
	672	1	28	For " Miniſtry," read " Minority."
IV.	86	2	11 *b.*	For " MEDICINE," read " SURGERY."
	374	2	12 *b.*	For " tar," read " water."
	390	2	30 *b.*	For " 23°," read " 32°."
	392	1	23 *b.*	For " vapour," read " heat."
	392	1	1 *b.*	For " 807 degrees," read " 811."
	403	1	4 *b.*	For " quantity," read " quality."
V.	137	1	31	For " MEDICINE-*Index*," read " *Catarrh*, MEDICINE-*Index*."
	606	1	23	For " the only oſtenſible," read " only the oſtenſible."
VI.	181	1	19 *b.*	For " Elvet," read " Wear."
	462 463	2 2	4 *b.* 65	For " fig. 74." read " fig. 73."
VII.	581	1	17 *b.*	For " naturalizes," read " neutralizes."
VIII.	71	1	24	For " particle," read " participle."
	120	2	4 *b.*	For " See *Index*," read " See MEDICINE, n° 396, 397, 400."
	124	1	39	For " *Ornithology*," read " *Ichthyology*."
	191	2	18	For " *Ichthyology*," read " *Ornithology*."
	293	1	11	For " queen's palace at Weſtminſter," read " Windſor caſtle."
	311	1	11	For " *venery*," read " *venary*."
	390	2	16 *b.*	For " *Polydectes*," read " *Philoctetes*."
	497	2	27 *b.*	For " Cumberland," read " Northumberland."
	521	2	19 *b.*	For " 155," read " 355."
	696	1	25	For " Procklesby," read " Brocklesby."
	743	2	16	For " dibblers," read " droppers."
	783	1	6	For " ſpeprority," read " proſperity."
IX.	5	1	20 *b.*	For " too," read " two."
	6	1	4	At " AMLB," read " Plate CCXL. fig. 1."
	467	2	21 *b.*	For " 1715," read " 1725."
	505	2	25 *b.*	For " directly," read " direct."
	583	2	29 *b.*	For " turned," read " tinned."
X.	114	2	3 *b.*	For " 1694," read " 1664."
	542	1	1 *b.*	Dele the ſentence beginning with " It is an earldom."
	729	2	16 *b.*	For " from E to B, and from B to C," read " from B to E, and from C to E." inſerting an E in the fig. where AD and CB croſs each other.
	730	1	31	For " CD," read " AC."
	767	1	20 *b.* 19 *b.*	For " corn," read " water;" and for " water," read " corn."
XI.	475	1	12 *b.*	For " n° 50." read " n° 54."
	482	2	19	For " loquacity," read " logomachy."
	631	2	5	For " μετφια," read " μετρια," or " μετρον."
				In the article METHODISTS, *paſſim*. For " Hanſon," read " Hampſon."
XII.	17	1	15	For " lives," read " live."
	73	1	23	For " are," read " air."
	278	Note		For " Low," read " LAW."
	409	2	25 *b.* 22 *b.*	For " BC," read " AC."
XIII.	204	2	18	For " 364th," read " 304th."
	577	2	5 *b.*	For " γινομιαι," read " γινομαι."

ER-

ERRATA not pointed out at the end of any preceding Volume.

Vol.	*page.*	*col.*	*line.*	
XIII.	709	2	25	For "9," read "g."
XIV.	141	1		Before the article "PERCHE" insert "PERCH, in ichthyology. See PERCA."
	178	2	33	For "PERSICANA," read "PERSICARIA."
	196	2	27	For "Teith," read "Tay."
	196	2	29	For "Blair of Drummond," read "Stob-hall."
	214	1	28 *b.*	For "bottom," read "top."
	669	2	18 *b.*	For "667," read "669."
	671	2	16	For "rine," read "pine."
XV.	373	1	6 *b.*	For "Wenderdon," read "Wenderborn."
XVI.	9	2	25	For "1697," read "1679."
	533	1	10	For "Emelia," read "Emelius."
	591	2	6 *b.*	For "facrifices," read "fcriptures."
	592	1	26	For "demand," read "demeanor."
XVII.	99	Note	5 *b.*	For "it is abfurd," read "is it abfurd."
	512	2	7	Add "See MURÆNA."
	610	2	22	For "an Englifh gallon," read "half an Englifh gallon."
	712	2	9 *b.*	For "112," read "212."
	782	2	22	For "Dorfetfhire," read Hampfhire."
XVIII.	129	1	27 *b.*	For "(fig. 28. *b*)," read "(fig. 26. *b*)."
	143	1	marg.	For "338," read "238.
	187	2	20	For "337," read "237."
	187	2	22, 23, 25,	For "338," read "238."
	297	2	32 *b.*	Read "For almoft every fpecies of quadrupeds has a fpecies of tænia peculiar to itfelf."
	419	Note	6 *b.*	For "layman," read "clergyman likewife, but."
	429	1	6	For "application," read "fupplication."
	431	2	38 *b.*	For "the," read "that."
	453	2	39	Read "ἡμασθαν."
	455	1	6 *b.*	For "this," read "his."
	455	Note	1 *b.*	Read "*Harmonia.*"
	469	1	20	For "defcent," read "diffent."
	475	2	13	For "fhalt," read "fhall."
	479	2	24	For "grow," read "grew."
	480	1	15	Dele ";"
	490	2	22	Dele "the" before the word "interceffion."
	497	1	2 *b.*	For "phyficians," read "philofophers."
	510	2	24	For "obliges," read "oblige."

Plate CCCXCVIII. fig. 1. For what appears to be "E c D," read E *f* D.

3. For "IM," read "CM."

CCCCLXXXVIII. The crooked pipe on the right of fig. 38. fhould be marked "38 *a*."

DIRECTIONS

DIRECTIONS FOR PLACING THE PLATES OF VOL. XVIII.

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